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Helen Smith, Charles Ameh, Pamela Godia, Judith Maua, Kigen Bartilol, Patrick Amoth, Matthews Mathai, Nynke van den Broek

Glob Health Sci Pract. 2017;5(3):345–354
https://doi.org/10.9745/GHSP-D-17-00130

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Use of simple wall charts by community and facility health workers to collect and visualize data helped inform data-based decision making for community health education activities, tracking stock-outs, staffing decisions, and other programming issues. Since intervention scale-up, however, use of the wall chart has dropped, demonstrating need for continued investment in supportive supervision.

Elizabeth Hazel, Emmanuel Chimbalanga, Tiyese Chimuna, Humphreys Nsona, Angella Mtimuni, Ernest Kaludzu, Kate Gilroy, Tanya Guenther

Glob Health Sci Pract. 2017;5(3):355–366
https://doi.org/10.9745/GHSP-D-17-00103

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Glob Health Sci Pract. 2017;5(3):367–381
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- **Ensuring sufficient supply of commodities and human resources to avoid stock-outs and implicit rationing**
- **Reducing nonfinancial barriers to access**

Thomas Fagan, Arin Dutta, James Rosen, Agathe Olivetti, Kate Klein

Glob Health Sci Pract. 2017;5(3):382–398
https://doi.org/10.9745/GHSP-D-17-00057

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Marasi Mwencha, James E Rosen, Cary Spisak, Noel Watson, Noela Kisoka, Happiness Mberesero

Glob Health Sci Pract. 2017;5(3):399–411
https://doi.org/10.9745/GHSP-D-16-00395

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When providers in 6 different countries were asked how they would care for the same patient, there was wide variation within and between countries. Nevertheless, 11% of the physicians scored over 80%, suggesting good quality of care is possible even with resource constraints. Use of validated clinical vignettes, which can be applied affordably at scale, could help improve quality of services in low- and middle-income countries.

John W Peabody, Lisa DeMaria, Owen Smith, Angela Hoth, Edmond Dragoti, Jeff Luckg

Glob Health Sci Pract. 2017;5(3):412–429
https://doi.org/10.9745/GHSP-D-17-00044

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Yi No Chen, Michelle MSchmitz, Florina Serbanescu, Michelle M Dynes, Godson Maro, Michael R Kramer

Glob Health Sci Pract. 2017;5(3):430–445
https://doi.org/10.9745/GHSP-D-17-00110

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Benjamin Bellows, Anna Mackay, Antonia Dingle, Richard Tuyiragize, William Nnyombi, Aisha Dasgupta

Glob Health Sci Pract. 2017;5(3):446–455
https://doi.org/10.9745/GHSP-D-17-00065

Overcoming Operational Challenges to Ebola Case Investigation in Sierra Leone

Deficiencies in transportation and communication, low frontline staff morale, and mistrust among communities, among other operational challenges, greatly limited Ebola case investigation in Sierra Leone. Recommendations for future outbreaks: (1) timely compensation for frontline staff, (2) context-appropriate transportation and communication resources, (3) systematic data collection, storage, and retrieval systems, (4) sound linkages between frontline staff and communities, (5) daily meetings between frontline staff and epidemiologists, (6) clear and appropriate operational chain of command, and (7) political and funding support to operational agencies.

Samuel T Boland, Erin Polich, Allison Connolly, Adam Hoar, Tom Sesay, Anh-Minh A Tran

Glob Health Sci Pract. 2017;5(3):456–467
https://doi.org/10.9745/GHSP-D-17-00126

From Albania to Zimbabwe: Surveying 10 Years of Summer Field Experiences at the Rollins School of Public Health

Since 1985, students from the Rollins School of Public Health have worked for more than 300 organizations in 84 countries. The students indicated key benefits of applying public health course work in real-world settings and gaining skills, including cultural competency, leadership, teamwork, communication, and program implementation. They also experienced challenges related to health, safety, and support.

Evelyn L Howatt Donahoe, Roger W Rochat, Deborah McFarland, Carlos del Rio

Glob Health Sci Pract. 2017;5(3):468–475
https://doi.org/10.9745/GHSP-D-16-00262

FIELD ACTION REPORTS

The Tobacco-Free Village Program: Helping Rural Areas Implement and Achieve Goals of Tobacco Control Policies in India

Tobacco control and prevention in rural areas are possible as demonstrated by a community-driven tobacco-free village program in India. Success factors included community ownership with supportive program guidance, motivated and committed local leaders, collaboration with grassroots organizations, rewards and sanctions to establish new social norms, and provision of other income-generating options for vendors who sell tobacco. While the program required time and dedicated effort and was not successful in all villages, it holds promise for helping to achieve the goals of tobacco control policies, especially in resource-scarce settings.

Nilesh Chatterjee, Deepak Patil, Rajashree Kadam, Genevie Fernandes

Glob Health Sci Pract. 2017;5(3):476–485
https://doi.org/10.9745/GHSP-D-17-00064

A Mobile-Based Community Health Management Information Systemfor Community HealthWorkers and Their Supervisors in 2 Districts of Zambia

Using simple-feature mobile phones, CHWs sent weekly reports on disease caseloads and commodities consumed, ordered drugs and supplies, and sent pre-referral notices to health centers. Supervisors provided feedback to CHWs on referred patient outcomes and received monthly SMS reminders to set up mentoring sessions with the CHWs. Scale-up limitations include: (1) staff shortages at health centers to supervise the CHWs, (2) need for ongoing technical support to troubleshoot challenges with mobile phones and software, and (3) recurring costs for data bundles.

Godfrey Biemba, Boniface Chiluba, Kojo Yeboah-Antwi, Vichaels Silavwe, Karsten Lunze, Rodgers K Mwale, Scott Russpatrick, Davidson H Hamer

Glob Health Sci Pract. 2017;5(3):486–494
https://doi.org/10.9745/GHSP-D-16-00275

Community-Based Noncommunicable Disease Care for Syrian Refugees in Lebanon

The high prevalence of noncommunicable diseases (NCDs) among Syrian refugees in Lebanon required a shift in the humanitarian response, from direct care provided through mobile medical clinics to community-based primary health care and health promotion provided through trained refugee outreach volunteers (ROVs). During the first 2 months after training, these ROVs conducted 753 blood pressure monitoring visits and 657 blood glucose checks; monitored medication adherence among 387 patients with NCDs; referred 293 refugees to the local primary health care facility for additional care; and provided 346 targeted health education messages.

Stephen Sethi, Rebecka Jonsson, Rony Skaff, Frank Tyler

Glob Health Sci Pract. 2017;5(3):495–506
https://doi.org/10.9745/GHSP-D-17-00043

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EDITORIAL

Maternal Death Surveillance and Response: A Tall Order for Effectiveness in Resource-Poor Settings

Marge Koblinsky[a]

Most countries with high maternal (and newborn) mortality have very limited resources, overstretched health workers, and relatively weak systems and governance. To make important progress in reducing mortality, therefore, they need to carefully prioritize where to invest effort and funds. Given the demanding requirements to effectively implement the maternal death surveillance and response (MDSR) approach, in many settings it makes more sense to focus effort on the known drivers of high mortality, e.g., reducing geographic, financial, and systems barriers to lifesaving maternal and newborn care.

See related article by Smith et al.

While extensive efforts to reduce maternal mortality through a maternal death surveillance and response (MDSR) investigation approach in Kenya were laudable, they fell far short in a number of ways toward having any tangible impact. In low- and middle-income countries (LMICs) with high maternal mortality, resources are better spent addressing obvious causes through interventions with proven effectiveness.

The MDSR strategy aims to improve quality of care and reduce maternal deaths by investigating individual maternal deaths and taking action to avoid remediable causes. As reported in this issue of GHSP, the MDSR (or an early variant thereof) was first introduced in Kenya in 2004.[1] At that time, the Kenyan maternal mortality ratio (MMR) was estimated at over 700 deaths per 100,000 live births. As of 2015, a decade later, the MMR was not significantly different, at an estimated 510 per 100,000 live births.[2] Yet there were further efforts to strengthen and implement the MDSR nationally. We explore the aims and implementation steps of the MDSR as launched by the World Health Organization (WHO) in 2013; the recent process of MDSR implementation in Kenya and its results; the long history of maternal death audits including response efforts; and the effectiveness of MDSR in other LMICs.

WHAT IS THE MDSR?

As WHO stated in its 2013 launch of the MDSR[3]:

> ***The primary goal*** *of MDSR* is to eliminate preventable maternal mortality *by obtaining and strategically using information to guide public health actions and monitoring their impact.*
>
> ***The overall objectives of MDSR*** *are to provide* information that effectively guides immediate as well as longer term actions *to reduce maternal mortality; and to count* every maternal death, *permitting an assessment of the true magnitude of maternal mortality and the impact of actions to reduce it.*

In a continuous action cycle, there are 4 primary steps to the MDSR:

1. **Identification and notification on an ongoing basis:** Identification of suspected maternal deaths in facilities and communities, followed by immediate notification to the appropriate authorities.
2. **Review of maternal deaths by local maternal death review committees:** Examination of medical and nonmedical contributing factors that led to the death, assessment of avoidability and development of recommendations for preventing future deaths, and immediate implementation of pertinent recommendations.
3. **Analysis and interpretation of aggregated findings from reviews:** Reviews conducted at the district level and reported to the national level; development of priority recommendations for national action based on the aggregated data.
4. **Response and monitoring of the response:** Implementation of recommendations made by the

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review committee and those based on aggregated data analyses; monitoring to ensure that recommended actions are being adequately implemented. Actions can address problems at the community, facility, or multi-sectoral level.

Glaring gaps were found between development of a national policy for MDSR and actual implementation in-country.

In WHO's review of progress in MDSR implementation as of 2015,[4] glaring gaps were found between development of a national policy for MDSR and actual implementation in-country, according to data from WHO's survey of 64 LMICs and from the WHO Maternal and Newborn, Child and Adolescent Health Policy Indicator database. According to this database, 86% of countries stated they had a national policy to notify all maternal deaths and 65% declared they had subnational maternal death review committees in place, but only 46% had a national maternal death review committee that met biannually. Although information on the Response component of MDSR was minimal in WHO's review (perhaps due to the short time since the formal launch of MDSR in 2013), challenges and barriers to MDSR implementation from 18 countries that contributed case studies were identified (Box). The WHO guideline suggests that it is best to start slowly, beginning with government facilities in urban areas. With growing know-how, strong leadership, and legal backing to ensure there is no blame leading to litigation, the MDSR may then be initiated in less advanced areas.

Ideal implementation of the MDSR requires a coordinated approach between national and district stakeholders in a "no name, no blame" environment.

BOX. Country Case Study Insights on Challenges to MDSR Implementation

- Lack of political buy-in and long-term vision
- Underreporting of suspected maternal deaths due to inefficient and incomplete systems of notification
- A blame culture in some places that inhibits health professionals and others from participating fully in the MDSR process
- Incomplete or inadequate legal frameworks
- Inadequate staff numbers, resources, and budget
- Cultural norms and practices that inhibit the operation of MDSR
- Problems of geography and infrastructure that inhibit the operation of MDSR

Source: WHO (2016).[4]

HOW DOES THE MDSR DIFFER FROM OTHER AUDITS?

The many types of maternal audits now in use (e.g., for maternal death, maternal near-miss morbidities, specific practices such as cesarean deliveries) typically aim to improve quality of care, but the MDSR places particular emphasis on the need to respond to each maternal death with actions to prevent such deaths in the future. With an emphasis on the Surveillance component, the approach also entails notification, systematic collection, and analysis of every maternal death at all levels of the health system.[3] Perinatal deaths, typically far more common than maternal deaths, have only recently received much-needed attention; WHO launched the perinatal death review guidelines in 2016[5] and coined the term MPDSR—adding perinatal death reviews into the process.

WHAT IS THE MDSR IMPLEMENTATION STATUS IN KENYA?

In this issue of GHSP, Smith and colleagues of the Liverpool School of Tropical Medicine describe recent experience implementing MDSR in Kenya.[1] Since 2007, the Liverpool School has provided financial and technical assistance to implement MDSR (and its earlier iterations) in Kenya, first at the facility level and more recently (2014) at the national level. As the authors state, ideal implementation of the MDSR requires a coordinated approach, whereby both national- and district-level stakeholders are enabled and supported to implement MDSR in a "no name, no blame" environment.

At the national level, newly created entities (a coordinating secretariat and the MPDSR Committee) now manage and oversee the MPDSR process (note that the "P" for Perinatal is aspirational at this point but is incorporated in the official Kenyan title). The recently formed national coordinating committee set up to oversee and guide the MPDSR process includes both public and private stakeholders involved in health care, plus representatives from professional associations, regulatory bodies, multi- and bilateral partners, and civil society groups. Although how or who initiated this national committee is not made clear in the article, the process of bringing all partners together in a committee was reported as "difficult," perhaps because running the committee remains a "gray area."

Staff of the MPDSR Secretariat, established in 2014 within the Ministry of Health, are to retrieve

facility case notes of maternal deaths and centrally collate and anonymize the notes, which are then sent to assessors for review. Assessors are professionals (including medical officers, obstetricians, pediatricians, and midwives) who investigate the deaths for causes. At the county level, it is intended that maternal death reporting and data capture efforts at the facility level be strengthened. Given the results reported in the article, however, it is evident that county-level efforts have not functioned as described in the WHO guide.[3]

The results fell well short of what is needed:

- Only 12% of the estimated maternal deaths in the nation were identified in 2014.
- Only half of these were reviewed.
- Only data from facilities were recovered (about half of all women deliver in facilities in Kenya).
- Assessments of cause were grouped rather generally, e.g., incorrect management for the diagnosis, infrequent monitoring, and prolonged observations with no action.
- Recommendations were also rather nonspecific, including improving the documentation of the deaths, providing regular updates for professionals in emergency obstetric care, including resuscitation at lower levels for improved transfer, and ensuring staffing by professionals 24/7 in all facilities.
- Responsible groups were assigned to follow up; however the article does not report on what, if any, implementation of these recommendations was found to have happened.

WHAT IS THE HISTORY OF AUDITS OF MATERNAL DEATH AND RESPONSE?

The WHO MDSR builds on long-established approaches to death notification and reviews/audits, initiated in high-income countries and later adopted for LMICs. In Sweden, the system of birth and death reporting, including maternal deaths, began in the mid-1700s. The country also reported how many of these maternal deaths could have been prevented (e.g., "avoidable maternal deaths").[6] In response to the findings, Sweden's Ministry of Health issued a new policy of training and strategically posting more midwives. This response has been credited with Sweden's early reduction in the MMR—dropping to the low 200s by 1900, before transfusions, antibiotics, and cesarean delivery became available.[7] Similar efforts based on knowledge of the magnitude of maternal mortality were carried out in other northern European countries—Denmark, the Netherlands, and Norway—with similar early decreases in maternal mortality.[7]

The United Kingdom and the United States were slower to initiate registration and response efforts. In the United Kingdom, registering maternal deaths began with the investigation of puerperal fever in Aberdeen, Scotland, in the late 1800s, with confidential enquiries into maternal deaths (CEMD) formalized beginning only in the 1950s and 60s.[8] In the United States, maternal death statistics became available from 1900 onwards, but inquiries into such deaths and any response came even later (early 1930s) when the public responded to obvious differences in maternal mortality levels with those reported from northern European countries.[7]

Around the early 2000s, many LMICs officially adopted CEMD or maternal death reviews, following on the UK method, and often with UK assistance. These efforts, as well as the system of integrated disease surveillance and response (IDSR) that has now been introduced in most African districts,[3] have become the stepping stones for the present-day MDSR.

WHAT IS NEEDED FOR MDSR TO BE EFFECTIVE?

Over the past 3 decades, we have made substantial gains in understanding the causes of maternal deaths[9] and implementing policy and programmatic responses.[10,11] So what is needed now for the MDSR to be effective in achieving its goals—improving the quality of maternal health care and reducing maternal deaths? Unfortunately, there are few examples of success in LMICs. The most oft-quoted are the national MDSR programs in Malaysia and South Africa: building on prior national efforts with CEMD, they both initiated the MDSR when their MMRs were increasing due to the rise in indirect causes of maternal deaths as well as quality of care issues. The MMRs subsequently declined through program efforts addressing the indirect causes and improved care management.[12,13] In South Africa specifically, maternal deaths are known to have reduced from non-obstetric infections, typically AIDS-related, due to adoption of a new drug regimen. Deaths from hemorrhage related to cesarean delivery decreased in 1 state due to a 3-pronged strategy, including improving inter-facility ambulance transport, intensive district training on postpartum hemorrhage, and realignment of district hospitals that perform cesarean delivery.[13]

There are few examples of success with MDSR in low- and middle-income countries.

In the few places where MDSR has been implemented successfully, MMR was estimated to be low, meaning the maternal health care program had already addressed obvious common problems with some degree of effectiveness.

Other countries with MDSR implemented at large scale or nationally include Sri Lanka and Thailand, and the Indian states of Kerala and Tamil Nadu. In these sites, as well as in Malaysia and South Africa, the MMR was estimated to be low, typically well below 200, when the MDSR was implemented. This is important as lower MMRs mean that a maternal health care program is functioning and has addressed obvious common problems with some degree of effectiveness: staff are trained to improve maternal health and manage obstetric complications and are available in adequate numbers; facilities are equipped and supplied; and the skilled staff are accessible and used by women for improved health care (e.g., barriers to access, such as transport between levels of facilities, are being addressed). Programmatic gaps that still remain are likely quality of care and equity issues.

In numerous other countries—Ethiopia, Ghana, Indonesia, Nigeria, Rwanda, Tanzania, Uganda, and Zimbabwe, to name a few—the MDSR is now being tested at the project level.[4] These are countries with much higher MMRs that reflect resource-poor health systems and continued barriers to access, including insufficiently available and accessible skilled providers to manage women with direct complications, let alone the increasing numbers of women with indirect complications, plus insufficient functioning facilities. To address these problems, and improve the existing availability and use of quality maternal health care for all, direct maternal health interventions (e.g., uterotonics immediately postdelivery) are urgently required, along with the means to make them more accessible. Preventive means to address unwanted or poorly timed pregnancies[14] and to improve women's and girls' nutrition and health status remain high priorities as well.

In places where maternal mortality is high and the major drives of death are well known, the required interventions do not need to be identified through MDSR; instead they can and should be directly implemented.

Certainly, promoting a broad culture of assessment of maternal deaths among the professional cadres serving pregnant women and strengthening "bottom-up" approaches are worthy goals. However, in such circumstances with high mortality and where the major drivers of maternal death are well known, the required interventions do not need to be identified through the Response component of the MDSR to "discover" them; rather they can and should be directly implemented.

CONCLUSION

The MDSR, as presently promoted by WHO, is a complex health systems strengthening process that takes time to complete the continuous action cycle. The Response component, now in the shadow of Surveillance, should be equally implemented and both Response and Surveillance monitored to ensure progress in achieving quality maternal health care and reduction of maternal deaths—the stated end goals of the MDSR. This requires strong leadership both nationally and at lower levels of governance; an appropriate legal framework to ensure no blame to professionals; the willingness and social norm of those involved in health care (eg., public and private; obstetricians, anesthetists, midwives, and other specialists to address indirect causes of maternal death) and health management (e.g., hospital administrators, district health officials) to participate; and a useful but minimal reporting/recording system to follow progress. When implemented well, the MDSR could increase communications among and between care providers, levels of care, and their management, as well as address systemic issues. But adequately meeting such conditions for effectiveness is a very tall order.

Competing Interests: None declared.

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GLOBAL HEALTH: SCIENCE AND PRACTICE
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EDITORIAL

Routine Health Facility and Community Information Systems: Creating an Information Use Culture

Theo Lippeveld[a]

Substantial progress has been made to strengthen health information systems, with most efforts focusing on digitization, improving data quality and analysis, and *identifying problems*. But the ultimate goal is *using* information to *solve problems*, which requires building an information use culture over time. How? Human-centered design, role modeling by senior managers in use of data, and incentive-based systems hold considerable promise.

See related articles by Biemba et al., Hazel et al., and O'Hagan et al.

Since the 1990s, knowledge and understanding of the role of health information on global health systems have markedly improved. Despite this, use of information for evidence-based decision making is still very weak in most low- and middle-income countries (LMICs), and particularly for data produced by health facility and community information systems, also called routine health information systems (RHISs). Ill-defined information needs, major data quality issues, and centralization and fragmentation of health information systems are some of the root causes, leading to poor quality and use of routine information at all levels.

The Paris Declaration and initiatives such as the Health Metrics Network, the Millennium Development Goals, and the Sustainable Development Goals have triggered governments of LMICs to make the development of well-performing RHISs a high priority. In June 2015, at the Measurement and Accountability for Health Summit, the U.S. Agency for International Development, the World Health Organization (WHO), and the World Bank called for action "to improve health facility and community information systems including disease and risk surveillance and financial and health workforce accounts, empowering decision makers at all levels with real-time access to information."[1]

Based on this Health Summit, the Health Data Collaborative was created, which has a special focus on improving RHIS performance. WHO and the MEASURE Evaluation project, in collaboration with many university partners, have developed an RHIS standard curriculum for health managers and care providers.[2] Many LMICs in Africa and Asia have made strengthening of RHISs one of their main health systems strengthening priorities.

In this issue of GHSP, 3 articles have been published about RHIS performance improvement in Malawi and Zambia:

- Richael O'Hagan et al.[3] "National assessment of data quality and associated systems-level factors in Malawi"
- Elizabeth Hazel et al.[4] "Using data to improve programs: assessment of a data quality and use intervention package for integrated community case management in Malawi"
- Godfrey Biemba et al.[5] "A mobile-based community health management information system for community health workers and their supervisors in 2 districts of Zambia"

DATA QUALITY ASSESSMENTS VS. DATA QUALITY ASSURANCE SYSTEMS

The O'Hagan article[3] focuses on data quality assessment of the facility-based health management information system (HMIS) in Malawi, using a customized set of data quality assessment (DQA) tools developed by WHO. The findings indicate weaknesses in data quality based on lack of data quality assurance systems and unreliable supervision. The authors advise LMICs to regularly undertake such types of assessments. The article

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puts a lot of emphasis on systemic issues of data quality, which is a very welcome viewpoint. Previous data quality assessment tools were very program-specific, but the Data Quality Review tool, recently developed by WHO and MEASURE Evaluation, has a health systems component. Also, a district version of the Data Quality Review tool is under development. Most of all, rather than assessing data quality, priority should be given to setting up institutionalized mechanisms of data quality assurance at all levels of the health system, thereby addressing in a preventive way the production of low-quality data.

COMMUNITY-BASED HEALTH INFORMATION SYSTEMS

The 2 other articles in this issue focus on community-based health information systems (CHIS or C-HMIS). In recent years, many LMICs have developed community-based health services, which are delivered by community health workers in close connection to primary care facilities. These community health systems address the existing dearth of skilled workforce by training community health workers and volunteers to deliver simple health care services as well as behavioral change interventions, and expanding as such the coverage of the health services. Key to such efforts is the development and strengthening of CHISs as an integral part of facility- and community-based health information systems to improve the availability, accessibility, quality, and use of community health data.

The Hazel article[4] discusses the development of a data quality and use package for integrated community case management (iCCM) data in Malawi. This training package is based on MEASURE Evaluation guidelines for data analysis and interpretation. While the data quality and use package allows for better data analysis using data visualization templates, it addresses only iCCM data, which is a small part of the routine data for community-based health services. Hopefully, this approach can be expanded to other community services.

The Biemba article[5] examines the development of a community version of the open-source District Health Information System 2 (DHIS 2) application in Zambia. Using mobile technology (simple-feature phones), community-based data can be reported into the facility-based DHIS 2 database, allowing for better integration of facility- and community-based data. However, there is a need for ongoing technical support to address the hardware and software challenges faced by the community health workers.

THE ULTIMATE GOAL: TRANSLATING DATA INTO ACTION

As illustrated in the 3 articles, substantial progress has been made in improving RHIS performance and developing relevant CHISs, but many challenges remain such as fragmentation and disjointed efforts to strengthen community- and facility-based health information systems. Greater collaboration, coordination, and joint action are needed at global and particularly country levels to address these challenges, accelerate progress, and achieve national health priorities.

Priority should be given to setting up institutionalized mechanisms of data quality assurance at all levels of the health system.

Yet most efforts to strengthen health facility and community health information systems are focused on digitization, improving data quality and data analysis, and identifying problems. But the ultimate goal of RHISs is that information is used *to solve problems* and to improve access to and delivery of quality health services. This last step of translating data into action is the most challenging, and many barriers have been identified leading to poor use of data for action, such as poor data quality, poor access to data, lack of capacity of health managers and providers in core competencies for data use, and poor identification of information needs.[6]

The ultimate goal of routine health information systems is that information is used to solve problems.

Behavioral Barriers to Creating an Information Use Culture

While most of these barriers to data use are technical issues that can be addressed by technical solutions, many barriers are linked to organizational and behavioral factors as explained in the PRISM framework.[7] The decision-making and problem-solving behavior of data users can heavily influence the ultimate use of data for service delivery improvements. Both data producers and users function in an organizational context that can support or hinder them to use information for action. An example of negative organizational behavior is the pressure exerted by senior health managers on district health managers and care providers to reach unrealistic service delivery targets, leading to false reporting and denial of existing service delivery problems. An excellent example of positive organizational behavior has been published in the *Quarterly Journal of Economics* by Bjorkman et al.[8] The authors, through a randomized field experiment in 9 districts in Uganda, document how community monitoring of health service delivery data, as well as active participation and accountability by the communities, led to large increases in utilization of services and improved health outcomes.

Many barriers to data use are linked to organizational and behavioral factors.

Substantial progress has been made in improving routine health information system performance and developing relevant community health information systems, but many challenges remain.

Strengthening routine health information systems involves building an information culture where information is valued at all health systems levels.

Human-centered design could be used to help build an information culture.

RHIS strengthening therefore involves *building an information culture* where information is valued at all levels of the health system. The challenge of creating a culture of data use is that this is a behavioral change intervention, both at the individual and organizational level. As with all behavior change interventions, the time span to create new perceptions, attitudes, and skills of users related to the value of information ranges from 10 years to a "generation" (25 years), so way beyond the classical 5-year period of most projects. Yet cultural change, once it has been established, will ultimately lead to sustained data use at all levels of the health system.

Potential Solutions to Creating an Information Use Culture

The question is how to build an information use culture. Recently, human-centered design (HCD) has been used increasingly in the private sector for product and technology development as an approach to better understand the user needs and involve them early on in the design of solutions. HCD is a collaborative problem-solving approach that provides broadly applicable methods of developing an in-depth understanding of human behavior.[9] It involves the process of understanding the "how" and the "why" of a problem. This approach can be adopted not only to create products and technologies but also to develop systems, programs, and services that are most needed by the users and that are most appropriate in the given context to maximize impact and outcomes. Therefore, the HCD approach and methods, as an organizational behavioral intervention, could be applied in establishing a culture of information, together with other promising interventions such as role modeling by senior managers to promote use of data at the district level and below (as in Ethiopia), as well as incentive-based systems to promote use of information including performance-based financing schemes (e.g., Benin, Liberia, Rwanda); allocation of resources based on HMIS indicator results (e.g., Brazil); and use of information as criteria for annual performance appraisals.

Many of these innovative approaches to promote information use at all levels will be tested in the coming years in "Data Use Partnerships" (DUP), which have been established by the governments of Ethiopia, Malawi, and Tanzania with funding by the Bill & Melinda Gates Foundation, and with technical support by various implementing partners. One of the main principles of DUP is the promotion of country ownership and accountability for the national HMIS, and less dependency on donor-driven projects, so as to ensure a long-term investment in building high-performing HMISs and in the establishment of a sustainable information culture.

It is hoped that many countries in Africa and Asia will set up comparable initiatives and establish an information culture with institutionalized mechanisms for use of RHIS information for improved service delivery at all levels of the health system.

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GLOBAL HEALTH: SCIENCE AND PRACTICE
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COMMENTARY

Seeking Synchrony Between Family Planning and Immunization: A Week-10 DMPA Start Option for Breastfeeding Mothers

John Stanback[a]

Many mothers initiate DMPA injectables at 6 weeks postpartum, at the time of their baby's first immunization visit. Offering an optional delayed DMPA start at the next (10-week) immunization visit has potential advantages including a reduced follow-up schedule with DMPA visits synchronized with other immunization visits, and, possibly, improved contraceptive and immunization outcomes.

The single most popular moment in Africa (and many other regions) to initiate family planning may well be the 6-week postpartum clinic visit, when mothers also bring infants to begin the crucial primary immunization series.[1] A 6-week start does indeed work well for mothers accepting long-acting, reversible contraceptives (LARCs) such as implants and intrauterine devices (IUDs), because these methods have no negative impacts on breastfeeding and, once inserted, remain effective for years. However, although there are no medical restrictions on starting injectables at 6 weeks, the 6-week postpartum visit may *not* be the optimal timing for initiating injectables, the most popular method in sub-Saharan Africa, comprising nearly half of modern method use in the region.[2]

What is the potential downside of initiating depot-medroxyprogesterone acetate (DMPA) injectables at 6 weeks? Beyond the redundant use of contraceptives during lactational infertility[3,4] is the problem of high discontinuation. In a review of Demographic and Health Survey (DHS) data from 19 countries, Ali et al.[5] noted that more than 40% of new injectable clients discontinued within the first year of use. When such early discontinuation occurs among postpartum women—during the time infants are weaned and fertility is reestablished—the stakes are even higher, because these mothers need effective contraception for optimal birth spacing.

Although high injectable discontinuation has proven a particularly challenging problem to solve,[6] several partial solutions present themselves for better protection during the first postpartum year. For example, more intensive counseling, particularly on the side effects that users can expect, has been shown to increase continuation rates among injectable users.[7,8] Also, for the many women who use DMPA because more effective methods are not available, programs must continue to improve access to LARCs, particularly in rural areas where the poorest and most vulnerable live. Finally, we should do a better job promoting exclusive breastfeeding during the first 6 months postpartum and ensuring that those using the Lactational Amenorrhea Method (LAM) can smoothly transition to another effective method when desired.

There is another option that merits investigation. Fully or nearly fully breastfeeding mothers desiring the most popular injectable, DMPA, at 6 weeks could be offered the option of delaying their injection for 1 month, until the second visit of the scheduled 6-, 10-, and 14-week primary immunization series. Week-10 DMPA initiation has much to recommend it. For example, given existing discontinuation patterns, the delayed start time will translate into a delayed discontinuation time, meaning that mothers will have an extra month of contraceptive protection, more likely to fall at a time without redundant protection from lactational infertility. Furthermore, well-counseled clients who want to limit births or who want a highly effective spacing method will have an extra month to consider their family planning options and to discuss these options with their providers and partners. Upon return, they may be more likely to accept a more effective method and/or one with less chance of early discontinuation. Finally, when DMPA initiation is delayed until the second well-baby visit at 10 weeks, mothers benefit from better synchronization of clinic visits during the first year postpartum.

SYNCHRONIZED SERVICES

This last advantage, better synchrony, may be the most important, but the benefits of synchronized visits have

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The 6-week postpartum visit may not be the optimal timing for initiating injectable contraceptives.

Fully or nearly fully breastfeeding mothers desiring DMPA at 6 weeks postpartum could be offered the option of delaying their injection until the second immunization visit at 10 weeks.

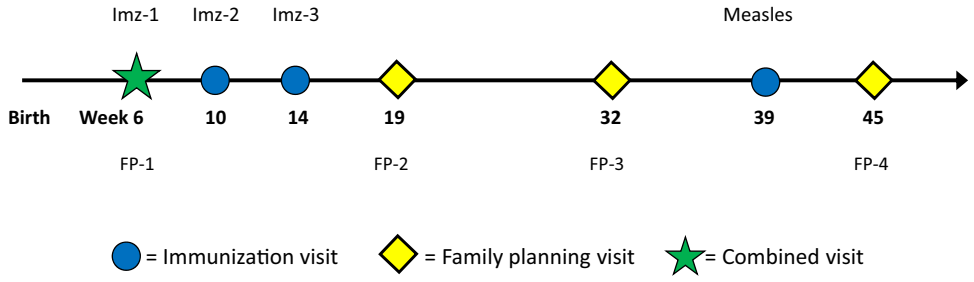
When DMPA initiation is delayed until the 10-week visit, mothers benefit from better synchronization of clinic visits during the first year postpartum.

never been promoted or evaluated, in spite of much recent attention focused on the benefits of integrating family planning with other health services such as immunization.[9] Intuitively, initiating contraception during the 6-week visit makes good sense. Throughout the developing world, maternal and child health programs have made enormous investments to ensure that mothers come to clinics at this time for their infants' immunizations and growth monitoring, so it is no surprise that family planning programs have tried to "piggyback" onto this all-important visit.

However, given the 3-month (13-week) cycle of DMPA, subsequent resupply visits after a week-6 initiation do not align well with scheduled immunization visits, resulting in a total of 6 scheduled family planning and immunization revisits in the following 10 months (Figure 1).

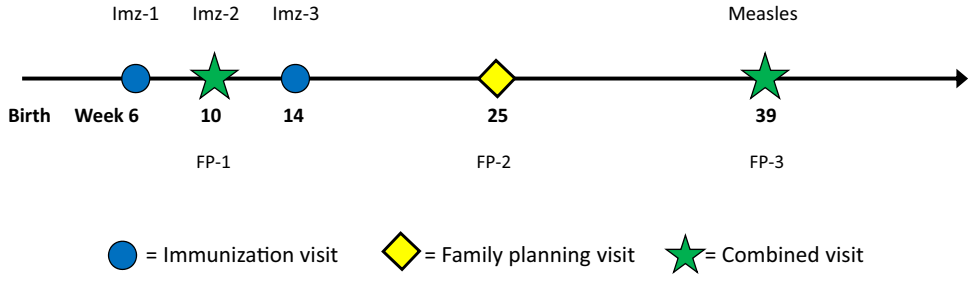
In contrast, if new mothers are counseled about family planning at week 6 and choose DMPA, they can be offered the option of a more "mother-friendly" schedule if they delay their first injection until their baby's second immunization visit at week 10. This voluntary alternative schedule (Figure 2), which takes modest advantage of the 1-month "grace period" for DMPA resupply, decreases the number of follow-up visits (after the initial 6-week visit) over the next 10 months by a full third—from 6 visits to 4 visits. (If the full 12 months postpartum period is considered, a final family planning visit would be due at week 52.) Furthermore, it is possible that women will better

FIGURE 1. Standard Week-6 DMPA Initiation Schedule With 7 Immunization and DMPA Visits Through 11 Months Postpartum



Abbreviations: DMPA, depot-medroxyprogesterone acetate; FP, family planning; Imz, immunization.

FIGURE 2. Optional Week-10 DMPA Initiation Schedule With 5 Immunization and DMPA Visits Through 11 Months Postpartum



Abbreviations: DMPA, depot-medroxyprogesterone acetate; FP, family planning; Imz, immunization.

adhere to a reduced schedule of dual-purpose visits than to more numerous single-purpose visits. This could improve contraceptive continuation if scheduled immunization visits help overcome any hesitation to seek DMPA reinjection. Similarly, a synchronized schedule could boost immunization timeliness and coverage if the family planning appointment provides an extra cue to action for the 10-week booster or the often-neglected measles vaccination at 39 weeks. Finally, a scheduled mid-year family planning visit at around 6 months (25 weeks) (Figure 2) coincides with the baby's recommended first dose of vitamin A, and also presents a good opportunity for growth monitoring and counseling on complementary feeding at the World Health Organization's recommended timing for weaning.

Of course, there are several potential arguments *against* the 10-week start for DMPA. The first, that mothers may become pregnant between 6 and 10 weeks postpartum, should be negligible if providers are careful to offer this option only to fully (or nearly fully) breastfeeding mothers who plan to continue breastfeeding for several months. A more serious argument is that a mother who presents at 6 weeks postpartum might never return. This is certainly possible, but drop-out between the first and third visits in the primary immunization series is already low—an average of 6% in Gavi-supported countries[10]—and having 2 reasons to return at 10 weeks, instead of only 1 reason, could further reduce that drop-out rate.

It is much more likely that some mothers will be *late* for the 10-week visit. Indeed, a 2009 *Lancet* review of the timing of children's vaccinations in 45 low- and middle-income countries, while not explicitly addressing the 10-week visit, found that tardiness was common.[11] However, such delays might actually be *reduced* by virtue of the dual-purpose nature of the visit—mothers not sufficiently motivated to be on time for their baby's vaccination boosters may be more motivated by their own contraceptive needs. Furthermore, even if mothers are late, fully or nearly fully breastfeeding should protect them from pregnancy for at least 6 months, if they experience no bleeding episodes.

A CALL FOR RESEARCH

Compelling practical and theoretical arguments exist for giving breastfeeding mothers the option of delaying DMPA initiation from 6 weeks to 10 weeks postpartum. Research should be undertaken to test hypotheses related to the potential benefits of "synchronizing" the DMPA schedule with that for infant immunizations. Will new mothers accept a 1-month delay in initiating DMPA use? Will providers offer women this option, given the modest extra effort required? And, most importantly, will the benefits of synchronized, dual-purpose visits translate into better contraceptive continuation, immunization coverage, and other outcomes, compared with possible risks, such as unintended pregnancies among mothers who stop breastfeeding or fail to return?

Synchronized scheduling for new mothers, with fewer, more integrated revisits, not only reflects the tenets of integrated services and patient-centered, mother-friendly care, but could also improve important outcomes in vulnerable populations.

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Research should be undertaken to test the potential benefits of synchronizing the DMPA schedule with that for infant immunizations.

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GLOBAL HEALTH: SCIENCE AND PRACTICE
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ORIGINAL ARTICLE

Implementing Maternal Death Surveillance and Response in Kenya: Incremental Progress and Lessons Learned

Helen Smith,[a] Charles Ameh,[a] Pamela Godia,[b,c] Judith Maua,[b] Kigen Bartilol,[d] Patrick Amoth,[e] Matthews Mathai,[a] Nynke van den Broek[a]

A national coordinating structure was established but encountered significant challenges including: (1) a low number of estimated maternal deaths identified that only included some occurring within facilities, (2) only half of those identified were reviewed, (3) reviewers had difficulties assessing the cause of death largely because of limited documentation in clinical records; and (4) resulting actions were limited. Successful implementation will require addressing many issues, including building support for the process lower down in the health system.

ABSTRACT

Maternal death surveillance and response (MDSR) constitutes a quality improvement approach to identify how many maternal deaths occur, what the underlying causes of death and associated factors are, and how to implement actions to reduce the number of preventable stillbirths and maternal and neonatal deaths. This requires a coordinated approach, ensuring both national- and district-level stakeholders are enabled and supported and can implement MDSR in a "no name, no blame" environment. This field action report from Kenya provides an example of how MDSR can be implemented in a "real-life" setting by summarizing the experiences and challenges faced thus far by maternal death assessors and Ministry of Health representatives in implementing MDSR. Strong national leadership via a coordinating secretariat has worked well in Kenya. However, several challenges were encountered including underreporting of data, difficulties with reviewing the data, and suboptimal aggregation of data on cause of death. To ensure progress toward a full national enquiry of all maternal deaths, we recommend improving the notification of maternal deaths, ensuring regular audits and feedback at referral hospitals lead to continuous quality improvement, and strengthening community linkages with health facilities to expedite maternal death reporting. Ultimately, both a top-down and bottom-up approach is needed to ensure success of an MDSR system. Perinatal death surveillance and response is planned as a next phase of MDSR implementation in Kenya. To ensure the process continues to evolve into a full national enquiry of all maternal deaths, we recommend securing longer-term budget allocation and financial commitment from the ministry, securing a national legal framework for MDSR, and improving processes at the subnational level.

BACKGROUND

In 2012, the World Health Organization (WHO) and partners introduced the Maternal Death Surveillance and Response (MDSR) approach as a new method to maternal death review.[1] While MDSR was built upon well-established review processes, its benefit was that it reemphasized the importance of the timely reporting (surveillance) of deaths and implementation of actions (response) to prevent further deaths. Maternal mortality is often described as the "litmus test" of the health system – a measure of a system's ability to respond to women's health needs, especially during and after pregnancy and birth.[2] In principle, MDSR builds on existing health system processes for reporting and surveillance, and offers a systematic way of ensuring information on avoidable factors is aggregated and used to guide action at all levels.[1] Implementing MDSR involves establishing an entire system to link surveillance and review of maternal deaths at facility and community levels in order to inform national scale in-depth confidential enquiry of maternal deaths. Depending on the burden

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Maternal mortality is often described as the "litmus" test of the health system.

Maternal death surveillance and response (MDSR) requires identification and reporting pathways for maternal deaths, review of deaths, aggregation of data, interpretation of findings, and formulation and implementation of recommendations for action.

of maternal mortality, some countries may prefer to also include surveillance and review of near-miss and perinatal deaths at national or subnational levels. Because existing approaches, systems, or platforms for capturing maternal health data are similarly named – Maternal Death Review (MDR), MDSR, and Maternal and Perinatal Death Surveillance and Response (MPDSR) – they are sometimes used interchangeably, which can lead to confusion.

The first WHO report on the global implementation of MDSR clearly set out the key policy indicators and principles to guide operation of the system (Box 1). The indicators were measured in the 2015 MDSR baseline survey, which found that of 67 countries surveyed 86% had a national policy to notify all maternal deaths, 85% had a national policy to review all maternal deaths, 76% had a national maternal death review committee in place, 65% had subnational maternal death review committees in place, and 60% had both national and subnational committees, but only 46% had national maternal death review committees that met at least biannually.[3] While this represents good progress over a relatively short period, these figures mask the wide variation across countries in the adoption of each of the key components of the MDSR. The challenge of agreeing upon national policy indicators for MDSR is that it does not ensure the adoption of processes and principles to guide operation at subnational level.

MDSR requires identification and reporting pathways for maternal deaths, review of deaths, aggregation of data, interpretation of findings, and formulation and implementation of recommendations for action and quality improvement at each level of the health system. To be effective, MDSR needs central and local government support, adequate human and financial resources, and stakeholder participation and buy-in, including a "no name, no blame" approach to maternal death review that emphasizes identifying and correcting health system problems rather than faults in individuals' practice and management. A legal framework is also essential to ensure that maternal death reporting is mandatory and, perhaps more importantly, that information generated as

BOX 1. Key Components of a National Maternal Death Surveillance and Response (MDSR) System

Key policy indicators:

- A national policy to notify all maternal deaths
- A national policy to review all maternal deaths
- A national maternal death review committee in place
- Subnational maternal death review committees in place
- Both national and subnational maternal death review committees in place
- A national maternal death review committee that meets at least biannually

Key principles to guide operation of the system:

- Notification and investigation of all suspected maternal deaths in women of reproductive age (15–45 years)
- Notification within 24 hours of maternal deaths in facilities (or within 48 hours when a woman dies in the community)
- Zero reporting when no suspected maternal deaths have occurred
- Timely review of all probable maternal deaths
- Immediate recommendations, where possible, to help facilities and communities prevent similar deaths, ensuring that key messages reach people who can make a difference
- Timely review and analysis at district and national levels to identify trends and patterns
- Timely publication of findings and recommendations at national level
- Continuous monitoring of the MDSR system and of how recommendations are implemented

Source: World Health Organization, 2016.[3]

part of the MDSR is not used for litigation purposes, for which separate processes exist. Depending on the country context, some or all of these factors may be missing or require strengthening. In practice, countries tend to start by introducing components of MDSR at different times, making full implementation incremental rather than rapid and linear. For these reasons, it has been recommended that countries start by implementing elements of the MDSR system in specific projects, and scaling up and introducing perinatal deaths only when systems and processes are in place and when success is demonstrated.[3]

In this field action report, we describe the implementation of MDSR in Kenya, which started with facility-based maternal death reviews and has progressed to a centrally coordinated system to support the development and establishment of a full confidential enquiry into maternal deaths process. We summarize the experiences and critical challenges faced thus far, and suggest improvements to overcome them. We also summarize program experiences and lessons learned though discussion with maternal death assessors and Ministry of Health (MOH) representatives during training workshops held in Kenya in June 2016. Assessors and MOH representatives were asked to reflect on the introduction of MDSR in Kenya and their experience of key steps in the process: establishing a national secretariat, retrieving case notes, and a confidential review of maternal deaths and assessors' personal experiences. For each step, stakeholders were asked to discuss in small groups the challenges faced, lessons learned, and suggestions for sustainability. We have drawn on these insights to highlight the challenges, lessons learned, and the way forward, which will be useful to other countries considering or setting up such a process.

MATERNAL DEATH REVIEWS IN KENYA: AN OVERVIEW OF PROGRESS

In response to the high maternal mortality ratio, estimated to be 759 per 100,000 live births in 2000,[4] the Government of Kenya made maternal death notification mandatory and introduced MDR in 2004. A review of all maternal deaths notified and reviewed between 2004 and 2006 revealed significant underreporting—only 46% of deaths reported via the Health Management Information System (HMIS) were notified via the MDR system.[5] As a result, in 2009, the Government relaunched facility-based MDR, emphasizing a "no name, no blame" approach in order to increase facility and practitioner engagement. At this time, new supporting documents were also developed, including a revised notification form and a more detailed review form.[6]

In 2009, Kenya relaunched facility-based maternal death reviews, emphasizing a "no name, no blame" approach.

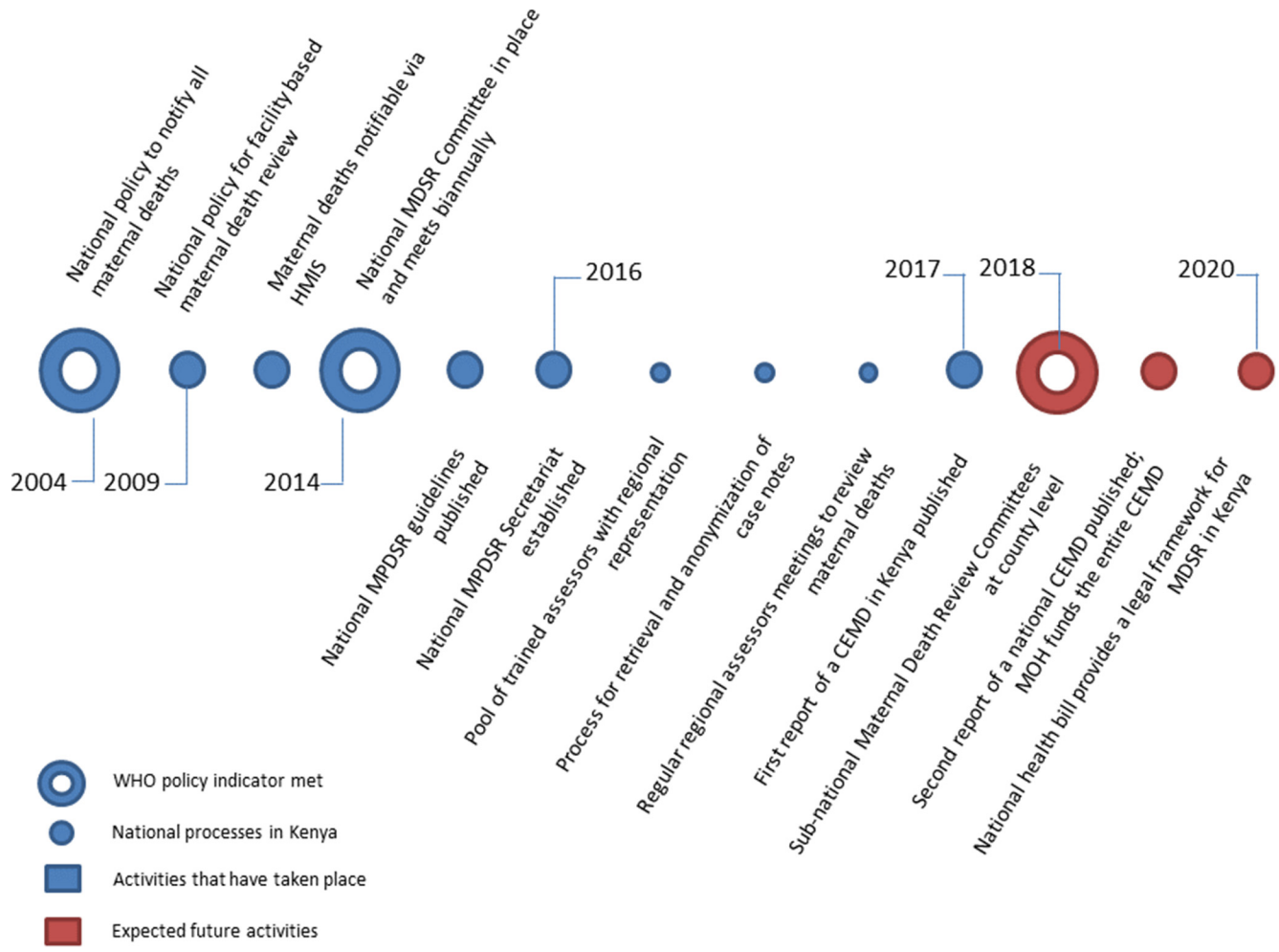
In 2011, a subsequent review of maternal deaths that occurred between 2008 and 2010 revealed a low review rate of just 20% of deaths recorded via the HMIS, poor completion of death review forms, lack of use of data to formulate recommendations, and no evidence of response to the findings of MDRs at facility or national levels. In response to this, and following the recommendations of the Commission on Information and Accountability in maternal and child health[7] and the 2013 WHO technical guidelines for MDSR, the MOH re-orientated health care workers at all levels via workshops on MDSR.[8] In 2014, a review of the MDR system showed mixed results; the system appeared to be working under partner-funded programs in a few counties, but notification and reporting of maternal deaths had not really improved overall.[9] For example, the estimated number of maternal deaths in Kenya was 8,000, based on a maternal mortality rate (MMR) of 510 per 100,000 live births,[10] compared with a total of 945 maternal deaths in facilities reported in the District Health Information System (DHIS) for the year 2014. Despite the MDSR tools—notification and review forms—being integrated into the DHIS database, the system has gaps, and the DHIS and Civil Registration and Vital Statistics system do not yet adequately capture all maternal deaths in Kenya.

National guidelines for Maternal and Perinatal Death Surveillance and Response (MPDSR) were launched in Kenya in 2016 (see Supplement 1).[11] The guidelines were formulated to include perinatal death surveillance and response—hence the inclusion of the 'P' in MPDSR. The guidelines provide a framework for establishing and maintaining a system for collecting, analyzing, and reviewing data on stillbirths, neonatal and maternal deaths, and maternal near-misses.

In 2014, Kenya established a national committee for maternal and perinatal death surveillance and response (MPDSR).

The timeline of key MDSR policies set out by WHO (Box 1) and implementation of processes in Kenya is illustrated in Figure 1. Two of the global policy indicators have been met—a national policy to notify all maternal deaths, in 2004, and a national committee for MPDSR, in 2014. The committee was inaugurated by the

FIGURE 1. Timeline of Maternal Death Surveillance and Response Policies and Processes in Kenya



Abbreviations: CEMD, Confidential Enquiry into Maternal Deaths; HMIS, Health Management Information System; MDSR, Maternal Death Surveillance and Response; MPDSR, Maternal and Perinatal Death Surveillance and Response; WHO, World Health Organization.

Cabinet Secretary for Health after 18 months of stakeholder consultations. The 10-year hiatus between the first national policy on notification and coordinated action on maternal death review is partly explained by a lack of funding, illustrating that sustained support is needed to introduce and establish a new surveillance system. A third MPDSR policy, subnational maternal death review committees at the county level, should be established by 2018.

IMPLEMENTING MPDSR IN KENYA: LESSONS LEARNED

National Leadership

Since 2007, the Centre for Maternal and Newborn Health at the Liverpool School of Tropical Medicine—working with the Reproductive Maternal Health Services Unit in the MOH and with funding from Department for International Development (DFID)/UKAid and the United

Nations Population Fund (UNFPA)—has supported the Kenya MOH to improve implementation of facility-based MDR and, since 2014, to strengthen central coordination of MDSR. While the funding and technical support has been important, the crucial impetus and commitment that drives the process has come from the Cabinet Secretary for Health; professional medical, nursing, and midwifery associations; and medical and nursing regulatory bodies. These key stakeholders participate actively in the process and are represented on the national MPDSR committee, along with representatives from UNFPA, WHO, the United Nations Children's Fund (UNICEF), the U.S. Agency for International Development (USAID), DFID, and civil society groups. As in other countries, such as India, South Africa, and the UK, –the support of professional associations has been key.[3,12–14]

The composition of a national MPDSR committee is an important consideration, to ensure representation of key organizations able to capitalize on the political commitment and to oversee the practical work of establishing the national process for MPDSR. The MOH representatives and assessors we consulted stated that getting all partners to agree on creating a national-level committee and identifying potential members from government and private stakeholders was difficult, particularly because there was no precedent or experience of running such a committee. Accordingly, finding people with the know-how of running the committee at the national level was a challenge.

The Role of the National MPDSR Secretariat

In 2014, a new national MPDSR secretariat was established within the MOH. The secretariat received short-term technical support from the UK and South Africa. A terms of reference for the secretariat was developed and agreed upon (Supplement 2) by the MOH and technical partners. Secretariat staff help to retrieve paper-based case notes from county- and subcounty-level facilities of women who died a maternal death. This is done by secretariat staff visiting participating health facilities and carefully recording the number of case notes retrieved against a list of the number of maternal deaths reported to have occurred at the facility. Photocopies of original case notes are made and sent to the secretariat office, with the original notes remaining on site.

The assessors and MOH representatives we consulted shared several critical challenges in retrieving case notes. Staff at the health facility are often reluctant to release the case files of women who have died and case notes may be missing and/or contain insufficient information. The stakeholders explained that these problems may arise because of a lack of awareness of the MPDSR process, lack of trust and suspicion about what the case notes will be used for, and, linked to this, the fear of blame and follow-up action against individuals because of the information contained within the reports. Others pointed out that there is no legal mandate in Kenya to retrieve case notes, so the process is entirely based on goodwill.

Facility staff are often reluctant to release case files of women who have died and case notes may be missing and/or incomplete.

Case notes are centrally collated and anonymized, and subsequently sent to assessors for review. Anonymization of retrieved case notes happens at the secretariat and is carried out, by hand, by staff specifically employed for the task. Our stakeholders described this as a time-consuming and meticulous process that requires trained and dedicated staff. The assessors described inefficiencies in the process, particularly in terms of the time taken to review case notes, as some are as long as 50 pages and many contain too much or too little anonymization.

Assessor Experiences

To facilitate the first national confidential enquiry into maternal deaths process, a total of 93 assessors from across Kenya were identified and trained to carry out in-depth confidential review of maternal deaths. The assessors are self-motivated health care professionals—medical officers, obstetricians, pediatricians, midwives, anesthetists, and public health specialists—serving on a voluntary basis. They represent various professional bodies, including the Kenya Medical and Dentists Practitioners Board, Kenya Obstetrics and Gynecological Society, Nursing Council of Kenya, Kenya Nurses and Midwives Association, and Kenya Clinical Officers Association, as well as national teaching and referral hospitals. The assessors conduct independent detailed assessments of maternal deaths, assign cause of death using the WHO International Statistical Classification of Diseases for Maternal Mortality (ICD-MM) cause classification system,[15] and are guided by technical experts from South Africa and the UK.[16,17]

The ICD-MM classification system is the standard tool to guide the collection, coding, tabulation, and reporting of maternal mortality. Maternal deaths are characterized and defined as due to direct or indirect causes; deaths during pregnancy,

childbirth, and puerperium; or late maternal deaths. Assessors were trained by the MPDSR secretariat and the team from the Liverpool School of Tropical Medicine on how to complete the assessor maternal death forms and how to group the deaths, based on the ICD-MM system. They described the confidential review process as having a steep learning curve, and mentioned the time taken to participate in review meetings and the workload involved as too much and too detailed. Assessors also described the process of reviewing in detail the case notes of women who have died as an emotional experience; some assessors felt they needed to suppress their feelings about the deaths in order to remain professional. The assessors also expressed frustration at having to work with incomplete notes that contained scanty details of case management, and that antenatal and referral notes were often missing. They commented that these problems were because MDR was not yet institutionalized as an activity at the county or facility level and that doing so will require further training in the process of maternal death review and how it is linked to national MDSR.

Only about half of the maternal deaths reported in 2014 were assessed in the first report of a review of maternal deaths in Kenya.

Identification and Review of Maternal Deaths at County Level

Alongside the national confidential enquiry process, efforts have been made to strengthen maternal death reporting and data-capture processes at county and subcounty levels. MPDSR data collection forms have been integrated into the second version of the DHIS (DHIS2) database, enabling the routine notification, uploading, collection, and analysis of maternal deaths data. However, in 2014, only about 12% of the estimated annual number of maternal deaths were notified through the DHIS2 system.[18] The DHIS records only facility-based maternal deaths, which means deaths that occur in the community are not currently captured, nor is the process of verbal autopsy well-developed. Critical challenges to maternal death reporting and review include lack of understanding of how to operationalize the MPDSR guidelines at county and subcounty level and lack of MPDSR committees at county level and quality improvement committees at health facility level to conduct reviews. While there is some evidence of improved reporting of the number of maternal deaths that occur at health facility level for those deaths that have been reviewed, almost none uploaded completed MDR forms into the DHIS.

In 2014, only about 12% of the estimated annual number of maternal deaths were notified through the DHIS2.

RECOMMENDATIONS FOR ACTION

The first comprehensive report of a review of maternal deaths in Kenya is due to be published in 2017, and will provide an in-depth analysis of the underlying and contributory causes of death, key findings relating to the quality of care provided to women who died, and recommendations for improving the quality of care for each major cause of death. In short, the report states that 484 (51.2%) of the 945 maternal deaths reported in the DHIS in 2014 were assessed; the sample included only maternal deaths that occurred in major referral public and private health facilities in all regions of Kenya during 2014. Of the 484 maternal deaths assessed, 447 (92.4%) received suboptimal care; 394 (81.4%) received sub-optimal care where different management could have made a difference to the outcome; and in 37 (7.6%) of the maternal deaths, the assessors could not identify any suboptimal care. The most frequent gaps in care of women who died at all levels of care were incorrect management when a correct diagnosis was made, infrequent monitoring, and prolonged abnormal observation noted but no action taken. Poor recordkeeping and documentation were noted in most cases of maternal death assessed. These findings, together with detailed analysis of the underlying and contributory causes of death, form the basis of recommendations for action at community, facility, district, and national levels.

Key cross-cutting recommendations include:

- Improving the quality of documentation of care provided to women
- Ensuring maternity care providers receive regular mandatory updates in emergency obstetric care, including adequate training at lower levels of care to improve capacity to resuscitate women and adhere to protocols for transfer of critically ill women
- Reviewing policies to ensure that maternity services are staffed by competent and experienced care providers 24 hours a day and 7 days a week

Specific policy-level recommendations for MDSR include:

- Improving the notification of maternal deaths
- Ensuring regular audits and feedback opportunities at referral hospitals lead to continuous quality improvement

- Strengthening community linkages with health facilities to expedite reporting of maternal deaths

The community-targeted recommendation refers to establishing and following the process for maternal death notification and review at the community level, as set out in the MPDSR guidelines. Community Health Volunteers (CHVs) and Community Health Extension Workers (CHEWs) are responsible for this process, which includes immediate notification of a death by the CHV, confirmation it is a maternal death by the CHEW, filing a death notification form by the link facility in charge, and uploading the information into the DHIS by the facility records officer. The entire process should be completed within 24 hours. The country now has, for the first time, evidence-based recommendations that will form the basis of a national response—the missing 'R' in MDSR in many countries. For each recommendation, the report lists the stakeholder group responsible for implementation along with a timeline, indicators for monitoring progress, and targets to be achieved.

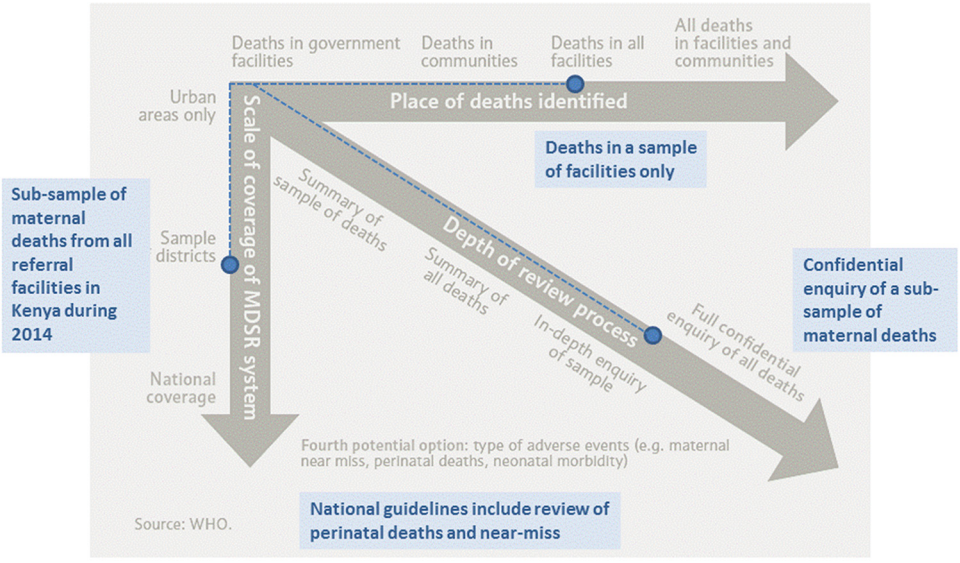
THE WAY FORWARD: TOP-DOWN AND BOTTOM-UP OPERATIONALIZATION OF MPDSR

In Kenya, the success of setting up the national coordination system for confidential review of identified maternal deaths has to some extent overshadowed the development of a bottom-up approach to ensure increased coverage. Yet the development and sustainability of a national confidential enquiry into maternal deaths process will ultimately rest upon both a top-down and bottom-up approach. This coordinated approach will need to ensure the identification of all maternal deaths at both facility and community levels; notification of those deaths by appropriate MPDSR committees at subcounty and county levels; routine facility- and community-based review of maternal deaths; timely uploading of review data into DHIS2 for analysis with aggregation of data; and central review and formulation of recommendations by national assessors and the secretariat.

Development and sustainability of a national confidential enquiry into maternal deaths process will ultimately rest upon both a top-down and bottom-up approach.

Figure 2 maps progress with MPDSR implementation in Kenya onto the phased approach recommended by WHO. It illustrates progress

FIGURE 2. Implementation of Maternal and Perinatal Death Surveillance and Response in Kenya Mapped Onto the World Health Organization Phased Approach



Abbreviation: MDSR, Maternal Death Surveillance and Response.

The WHO phased approach[1] is shown in gray, with implementation in Kenya shown in blue.

along all trajectories, with the potential to expand activities to include deaths in communities and full national coverage of surveillance and response over time. In Kenya, comparatively more progress has been achieved with regard to the depth of the review process, which was in some ways opportunistic, capitalizing on the availability of funding and technical support to establish the national MPDSR committee and secretariat. Since these national-level structures have been set up, rapid overall progress has taken place. However, there is still more to do. Progress in ensuring maternal death notification and review occurs at county level has been slower and more piecemeal. In addition, while the national MPDSR guidelines set out processes for surveillance and review of perinatal deaths and severe acute pregnancy complications, or "near-misses", their addition remains aspirational. In 2014, the numbers of both stillbirths (approximately 35,000) and

BOX 2. Suggested Steps to Facilitate Development of a National Confidential Enquiry Into Maternal Deaths System in Kenya

- **An adequate legal framework.** This is needed to enforce maternal death notification by law, while also reassuring health care providers that the information obtained as part of the Maternal Death Surveillance and Response (MDSR) process will not be used for litigation.[23,24] It is anticipated that a forthcoming national health bill will provide a legal framework for MDSR in Kenya.
- **A clear and systematic way of retrieving files.** This is currently done by a team of centrally based staff, supported by the MOH, who visit health facilities in person to retrieve case notes. While this system works for now, in the long term, facilities will need to be encouraged to take responsibility for routinely sending case notes to the secretariat following a maternal death. A mechanism will also need to be in place to retrieve referral and antenatal care notes for maternal deaths.
- **A more efficient process for anonymizing case notes.** This could include scanning case notes at source, such as at the health-facility level, and emailing scanned copies to a dedicated team, who then use an electronic process to block out relevant details in the notes. Clearly this method has resource implications, but the investment would save time, reduce the need for physical storage space, and, perhaps, improve accuracy of anonymization.
- **Improved quality of data.** More sensitization is needed at the facility level to ensure accurate documentation of care provided to all clients. Maternal and Perinatal Death Surveillance and Response is not yet "institutionalized" as an activity at the county or facility levels, and this will require further training in the process of maternal death review, including the importance of complete and accurate recordkeeping.
- **Improved capacity to accurately identify the underlying cause of death.** Challenges in using the WHO International Statistical Classification of Diseases for Maternal Mortality (ICD-MM) have been reported previously.[25] The MDSR secretariat trained confidential enquiry into maternal deaths (CEMD) assessors in the ICD-MM classification, and developed, tested, and refined a structured tool—the Kenya maternal deaths assessors form—used to review maternal deaths. Specially designed software (Maternal Mortality Audit System, or MaMAS) mirrors the assessors form and has additional capacity for storing, aggregating, and analyzing data extracted from case notes. The original version used in the Republic of South Africa has been refined during the course of the first CEMD in Kenya.
- **Surveillance of maternal deaths.** In Kenya, surveillance of maternal deaths is limited to notification and review of deaths that occur in a health facility. Some counties identify and review maternal deaths in the community, but as yet there is no formal process in place to do this routinely in all counties.
- **Remedial action.** Improved data quality and completeness of case notes will allow assessors to better formulate specific recommendations for improvement at all levels of the health system. This is not an automatic process; it requires interpretation of the findings of a CEMD and discussion among multiple stakeholders. Lessons can be learned from Malaysia, where a systematic and multisector approach is used to identify remedial actions, to which the MOH responds with targeted budget allocation.[26]
- **Sustained source of funding.** Adequate funding is needed to complement current donor funds and to eventually fund the entire enquiry by 2019. If the MOH can commit to funding the CEMD, this will increase participation and confidence in the system by health care providers and encourage ownership by Kenyan health care professionals and the MOH.

neonatal deaths (approximately 34,000) were substantially higher than the number of maternal deaths (approximately 8,000).[19,20] It is likely that notification of these deaths may not be possible or complete. A review of perinatal deaths will need an agreed-upon approach to start at facility level and select a subset of cases for review, or to limit the review to cases that are most likely to be preventable, as set out in the new WHO stillbirth and neonatal review guidelines.[21] In addition, capacity will need to be developed to apply the recently developed cause classification of perinatal deaths (ICD-PM).[22]

In Kenya, a systematic approach was taken to organize structures for sustainability through centrally coordinated confidential enquiry developed and led by a national MPDSR committee and a national MPDSR secretariat embedded within the MOH, and supported by the robust training of a multidisciplinary team of assessors who performed reviews of anonymized case notes. The inauguration of the national committee, appointed by the Cabinet Secretary for Health and chaired by the Director of Medical Services, was a demonstration of the Government's commitment to improving the quality of maternal and newborn health in Kenya. However, in order to ensure the process continues to evolve into a full national enquiry of all maternal deaths, we identified several areas where improvements could be made (Box 2). These include securing longer-term budget allocation and financial commitment from the MOH, securing a national legal framework for MPDSR, and improving processes at the subnational level, such as capacity to accurately classify cause of death, more efficient case note retrieval, and institutionalization of maternal death review at the county and facility levels.

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GLOBAL HEALTH: SCIENCE AND PRACTICE
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ORIGINAL ARTICLE

Using Data to Improve Programs: Assessment of a Data Quality and Use Intervention Package for Integrated Community Case Management in Malawi

Elizabeth Hazel,[a] Emmanuel Chimbalanga,[b] Tiyese Chimuna,[c] Humphreys Nsona,[d] Angella Mtimuni,[e] Ernest Kaludzu,[d] Kate Gilroy,[f] Tanya Guenther[g]

Use of simple wall charts by community and facility health workers to collect and visualize data helped inform data-based decision making for community health education activities, tracking stock-outs, staffing decisions, and other programming issues. Since intervention scale-up, however, use of the wall chart has dropped, demonstrating need for continued investment in supportive supervision.

ABSTRACT

Health Surveillance Assistants (HSAs) have been providing integrated community case management (iCCM) for sick children in Malawi since 2008. HSAs report monthly iCCM program data but, at the time of this study, little of it was being used for service improvement. Additionally, HSAs and facility health workers did not have the tools to compile and visualize the data they collected to make evidence-based program decisions. From 2012 to 2013, we worked with Ministry of Health staff and partners to develop and pilot a program in Dowa and Kasungu districts to improve data quality and use at the health worker level. We developed and distributed wall chart templates to display and visualize data, provided training to 426 HSAs and supervisors on data analysis using the templates, and engaged health workers in program improvement plans as part of a data quality and use (DQU) package. We assessed the package through baseline and endline surveys of the HSAs and facility and district staff in the study areas, focusing specifically on availability of reporting forms, completeness of the forms, and consistency of the data between different levels of the health system as measured through results verification ratio (RVR). We found evidence of significant improvements in reporting consistency for suspected pneumonia illness (from overreporting cases at baseline [RVR=0.82] to no reporting inconsistency at endline [RVR=1.0]; *P*=.02). Other non-significant improvements were measured for fever illness and gender of the patient. Use of the data-display wall charts was high; almost all HSAs and three-fourths of the health facilities had completed all months since January 2013. Some participants reported the wall charts helped them use data for program improvement, such as to inform community health education activities and to better track stock-outs. Since this study, the DQU package has been scaled up in Malawi and expanded to 2 other countries. Unfortunately, without the sustained support and supervision provided in this project, use of the tools in the Malawi scale-up is lower than during the pilot period. Nevertheless, this pilot project shows community and facility health workers can use data to improve programs at the local level given the opportunity to access and visualize the data along with supervision support.

BACKGROUND

Integrated community case management (iCCM), in which community health workers (CHWs) are trained to assess, classify, and treat diarrhea, malaria, and pneumonia in children under 5 years of age, is a globally recognized strategy to reduce childhood illness in high-burden countries.[1] National iCCM programs have been implemented widely around the world; by 2013, 28 of 42 high-burden countries in sub-Saharan Africa were implementing iCCM for malaria, pneumonia, and diarrhea.[2] Various studies have shown that while program strength varies across settings, iCCM programs are capable of providing high-quality care.[3–5]

Malawi was one of the first sub-Saharan African countries to implement iCCM. In 2008, the Integrated

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Management of Childhood Illness (IMCI) unit of the Ministry of Health (MOH) introduced iCCM in approximately 3,500 rural hard-to-reach communities, located 8 or more kilometers from health facilities.[6] iCCM is provided by Health Surveillance Assistants (HSAs), a paid government cadre who serve catchment areas of approximately 2,000 population. All HSAs have a minimum of a 10th-grade education and complete a 10-week training program on preventive and promotive health care.[6] Those selected for iCCM complete an additional 6-day training course using training materials adapted from guidelines from the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF).[6] During the initial scale-up of iCCM, major implementing partners included WHO, UNICEF, and the United Nations Population Fund (UNFPA) jointly; Save the Children; Population Services International; and Concern International. [7]

A strong health information system is one of the building blocks of a functional health system.

A strong health information system is one of the building blocks of a functional health system.[8] Program managers and MOH staff require feasible, timely, reliable, and valid measures of implementation to identify problems, begin quality improvement processes, and determine progress. Among many implementation challenges, country programs have struggled to measure and monitor implementation and overall progress in iCCM. In particular, collecting data on a routine basis from dispersed and hard-to-reach CHWs is a major challenge. Even facility-based routine data on program implementation are often incomplete and of questionable quality, and the collected data are not easily accessible for use in analysis and interpretation.[9–11] Health worker training on data use is limited at all levels of the health system with weak linkages to the decision-making process for program improvement.[12]

At the time of this study, iCCM data were being compiled but not used at the health facility or HSA levels.

At the time of this study, Malawi had a mature national iCCM program (with heavy partner support) and a functioning monitoring system in which iCCM data were integrated with the health management information system (HMIS). A lot of data was being generated but little of it was being analyzed and used for program improvement. Reporting completion and quality varied; districts with partner support tended to have greater reporting than other districts due to outreach activities for poor-reporting village clinics. The data were being compiled but not used at the health facility or HSA levels, and national-level data were aggregated and reported at the district level.

We worked with district health staff and partners to develop and pilot a program to improve data interpretation and use at the health worker level. The objective of the data quality and use (DQU) package was to provide HSAs and health facility and district staff training and tools to analyze and interpret iCCM monitoring data, with the overall goal of improving data quality and empowering health workers to make timely data-based decisions to improve programs. In this article, we describe and evaluate implementation of the DQU package in 2 districts of Malawi.

METHODS

Description of the iCCM Monitoring and Evaluation System

In 2011, the Malawi MOH and partners developed a set of 11 indicators to routinely measure implementation strength of iCCM, covering areas of HSA training, deployment and availability, supervision, supply chain management, and service delivery (Box 1). The iCCM patient registers and reporting forms were updated to reflect these indicators, and district rollout of the revised tools started in November 2011, with a target of reaching 3 new districts per quarter. Figure 1 shows the routine reporting structure and specifies the associated iCCM tools in place during the study period (2012–2013). Each HSA completed Form 1A summarizing data from its iCCM register on cases seen by type of condition, referrals, supplies dispersed, supervision received, and any child deaths in their catchment area. Health facility staff consolidated the data from HSAs and their supervision and mentoring checklists into Form 1B and submitted the form to the district IMCI coordinator. The IMCI coordinator consolidated the data using Form 1C on a quarterly basis.

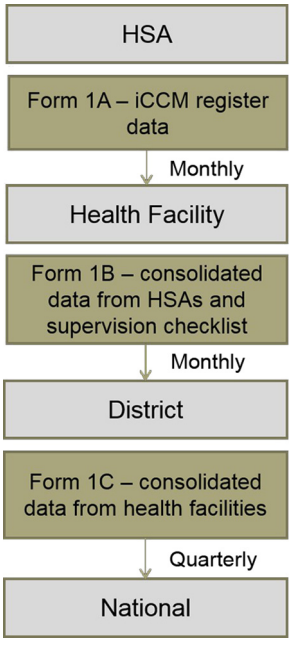
DQU Implementation

We purposefully selected 2 study districts, Dowa and Kasungu, using the following criteria: presence of statistical clerks at the health facility level; close proximity to the capital city to reduce transport costs; implementation of the revised iCCM reporting forms and data for at least 1 month available; and differing partner support. In Dowa, implementation of iCCM was initiated in 2010 with support from Save the Children, and by 2012, 224 HSAs had been trained and deployed to hard-to-reach areas. In Kasungu, iCCM implementation began in 2009 with support from WHO and UNICEF, and 198 HSAs were trained and deployed by 2012.

BOX 1. National iCCM Monitoring Indicators Used in Malawi

1. Number of HSAs trained
2. Number of HSAs deployed
3. Number of "hard-to-reach" areas with a trained HSA
4. Number of iCCM-trained CHWs who have seen a sick child in the past 7 days
5. Number of iCCM-trained HSAs with no stock-outs of greater than 7 days of key medicines within the last 3 months (antibiotic, antimalarial, oral rehydration salts [ORS], zinc)
6. Number of iCCM-trained HSAs with no stock-outs of lifesaving medicines within the last 3 months (antibiotic, antimalarial, ORS)
7. Number of iCCM-trained HSAs supervised in iCCM in the last 3 months
8. Number of iCCM-trained HSAs supervised in iCCM in the last 3 months with reinforcement of clinical practice (case observation, case scenarios, mentoring at health facility)
9. Number of iCCM-trained HSAs residing in their catchment area
10. Number of sick children assessed each month by major condition
11. Number of sick children treated each month by major condition

FIGURE 1. Malawi iCCM Routine Reporting Data Flow



Abbreviations: HSA, Health Surveillance Assistant; iCCM, integrated community case management.

In 2013, Nutley and Reynolds provided a logical framework for how interventions can increase data use and demand.[13] Table 1 presents an overview of the DQU package according to this framework. The DQU package was developed through national- and district-level consultations with the MOH and informed by a baseline assessment of data quality (see next section for details). It was implemented at the health facility and HSA levels. We developed data analysis and interpretation training guidelines based on resources from MEASURE Evaluation.[14] We also developed wall chart templates to display iCCM implementation strength data at the health facility and HSA levels (Supplement 1 and Supplement 2).

We developed wall chart templates to display iCCM data at the health facility and HSA levels.

In December 2012, we conducted a 2-day training of trainers (TOT) with 17 district staff including IMCI program coordinators, deputy coordinators, pharmacy technicians, and HMIS officers. The participants reviewed the materials, provided feedback, and were equipped to provide training to the HSA supervisors and HSAs through demonstration and mock/practice trainings. We gave them an additional 2-day refresher training in February 2013 prior to the package implementation. Two Save the Children staff facilitated the training with support from the MOH.

Beginning in February 2013, all senior HSAs (or other HSA supervisors) and HSAs implementing iCCM (N=426) were trained through 69 health

TABLE 1. Data Quality and Use Package Implemented in Malawi

Processes to Improve Data Demand and Use	Elements of the DQU Package Design and Implementation
1. Assess and improve the data use context	• Participatory baseline data quality assessment, using tools based on the PRISM framework and MEASURE Evaluation data quality audit tools, and involving national and district iCCM managers
2. Engage data users and data producers	• Engagement of HSAs, health facility staff, district manager, and national IMCI unit staff in designing the package training materials and tools
3. Improve data quality *(quality defined as accurate, complete, and timely)*	• Baseline data quality assessment to identify barriers to data quality • Provision of calculators to HSAs to improve accuracy of monthly tallies • Refresher training on how to complete routine registers and reports
4. Improve data availability *(availability defined as data synthesis, communication, and access to data)*	• Development and dissemination of standardized wall charts to display data onsite • Training on analysis, interpretation, and presentation of data for HSAs, health facility, and district staff
5. Identify information needs	• Consultations with national, district, and facility staff and HSAs to document and prioritize information needs for monitoring iCCM • Working with district IMCI coordinators to identify reporting "benchmarks" and "action thresholds" and to agree on response to levels below the agreed-upon action threshold
6. Build capacity in data use core competencies	• General training on data management, use, and interpretation • Involvement of district staff in data collection and supervision to build leadership capacity and to better advocate for data use in their districts
7. Strengthen the organization's data demand and use infrastructure	• Development of written guidance on iCCM data analysis and use • Provision of data display templates
8. Monitor, evaluate, and communicate results of data use interventions	• Evaluation of the DQU package through mixed-methods, pre-post assessment and estimation of cost for scale-up • Dissemination of findings in Malawi and globally to leverage resources to expand to other districts (and countries)

Abbreviations: DQU, data quality and use; HSA, Health Surveillance Assistant; iCCM, integrated community case management; IMCI, Integrated Management of Childhood Illness.

Based on the Nutley and Reynolds logic model to strengthen data demand and use.[13]

facilities. Each training session at a facility took one-half day and the trainers were able to cover 2 facilities per day. The total training time per district was 2 weeks maximum. All participants convened at the catchment health facility for the training. District staff, periodically supervised by study staff, conducted the trainings, which covered refreshers on completing the monthly reporting form and completing the wall charts with instruction, demonstration, and practice. At the conclusion of the training, participants were instructed to complete the wall charts beginning (retrospectively) in January 2013. Due to a funding interruption, participants in Kasungu district were not trained until April 2013 (while those in Dowa district were trained in February 2013).

Implementation of the DQU package was designed to be flexible to the needs and context of each health facility to improve uptake and sustainability. District IMCI coordinators and health facility staff were encouraged to determine many of the implementation details, such as how the wall charts were filled in and where to display them. External supervision of the package implementation was minimal, as we aimed to assess effectiveness in a "real-world" scenario and

determine feasibility for further scale-up. A 1-week supervision field mission to Kasungu district was conducted by study staff to observe template use in health facilities and village clinics. District staff conducted supervisory and mentoring visits as part of their routine supervision activities to HSAs and senior HSAs. At the time of this study, approximately one-third of the HSAs were receiving quarterly supervision with reinforcement of clinical practices.[15] The package was implemented in Kasungu from April 2013, and in Dowa from February 2013, until the endline DQA in July 2013, for a minimum of 3 months of implementation.

DQU Evaluation

We conducted a pre- and post-process evaluation to determine any changes in reporting availability, completeness, and consistency. We also documented use of the wall charts and specific program decisions resulting from the chart data.

Data Collection

We conducted 2 data quality assessments (DQAs), a baseline in 2012 and an endline in 2013. We used a mixed-method tool that included iCCM register reviews and a structured interview guide with open-ended responses. The tools were adapted from the frameworks and assessment tools for data quality audits and for assessing the Performance of Routine Information Systems Management (PRISM).[16–18] This framework and these tools have been used in many settings to measure the strength of routine reporting in health systems. We used 3 data collection forms, one for each level of the health system—the HSA level (Form 1), facility level (Form 2), and district level (Form 3). The forms were in English and the interviews were in Chichewa. The open-ended qualitative interview responses were summarized and recorded in English by the interviewers. All interviewers were fluent in English and Chichewa.

In each district, we selected the district hospital and randomly selected 4 health facilities. The district hospital was selected because it has the largest patient load and the teams already had to travel there for the district coordinator interviews. We interviewed the senior HSAs at the 5 facilities (10 total selected) and 4 HSAs from each selected health facility. The HSAs were randomly selected from a full list of HSAs trained and deployed in iCCM in the hard-to-reach areas obtained from the MOH/IMCI unit and partners. Kasungu and Dowa district health staff were invited to work as data collectors during this exercise to provide valuable input during the study, collecting data from each other's districts to minimize bias.

The tools and protocol for the endline DQA were the same as the baseline DQA. We revisited the previously selected 10 health facilities and HSAs in the catchment area. Any HSA not available during the period of data collection was replaced with a neighboring HSA. Baseline data collection tools were updated to include reviews of the existing data collection and compilation tools and to capture perceptions and use of the DQU package.

Baseline data collection was carried out over a 2-week period in June 2012, and endline data collection during a 2-week period in July 2013. All reviews of data and tools pertained to the previous 2 completed months. Teams visited the district offices and health facilities to apply data collection Form 1 and Form 2. Form 1 collected information for all the health facilities reporting to the district (not just the 10 selected) and Form 2 collected information for all the iCCM-trained HSAs reporting to the 10 health facilities (not just the 40 selected).

The selected HSAs were asked to convene at their health facility and to bring their iCCM register for review; the data collection team used DQA Form 3 for interviews and register reviews. Two senior staff, from the study office and the MOH, attended the interviews in both districts to provide consistency and supervision. Data were collected on paper and electronically scanned for analysis. Interviews were conducted at the selected health facilities.

Finally, to inform further scale-up, we estimated the cost of the intervention by tracking expenditures for key package inputs such as printing, trainings, and supervision.

Data Analysis

Quantitative data entry and cleaning were conducted using Microsoft Excel 2010. STATA 11 was used for the analysis.[19] Single data entry was used and all data in the final analysis were cross-checked against the hard copies. We assessed changes in:

1. Availability of forms submitted for the previous month
2. Completeness of submitted forms
3. Consistency, measured through results verification ratio (RVR)[17]

The RVR indicates the level of consistency of routine reporting systems. In other words, at the HSA level, we compared the number of cases entered in the iCCM registers to what was entered on the reporting form for that month by the HSA and submitted to the facility. At the health facility level, we compared the number of cases from the monthly reporting forms submitted by all the HSAs reporting to that facility with what the facility reported to the district for that particular month. The RVR was calculated for the number of diarrhea, fast-breathing (suggesting pneumonia), and fever illness cases; male and female cases; and number of cotrimoxazole, oral rehydration salts, and lumefantrine-artemether dispensed. We considered an RVR of less than 0.8 (20% overreporting) or more than 1.2 (20% underreporting) to be problematic.

We described changes in the availability and completeness of the routine forms for the previous reporting month: May 2012 for the baseline and June 2013 for the endline. For reporting consistency, we used the most recent month with a form submitted: April or May 2012 and May or June 2013. We used a paired *t* test analysis, taking into account the clustering of HSAs at their catchment facilities, to examine whether the RVRs changed from baseline to endline. To evaluate data display and use, we determined the proportion of HSAs and health facility staff using and displaying the wall charts and the proportion with completed wall charts for the study period.

For the qualitative data, narrative summary was used to describe reported successes, challenges, and the perceived value of the DQU package. Selected quotes are presented in this article that describe how the data were used to improve programs.

The cost of implementing the package was abstracted from Save the Children expenditure data related to the project. We calculated the cost by dividing the total cost of training, printing, and supervision by the number of facilities in both districts to generate an estimated cost per health facility.

Both study districts showed significant improvements in reporting consistency for fast breathing.

Ethical Review

The study was submitted to the Johns Hopkins Bloomberg School of Public Health Institutional Review Board and was deemed as non-human subjects research and exempt from review. We obtained permission from the district health offices before beginning implementation and data collection.

RESULTS

For the 2012 baseline DQA, we interviewed 10 senior HSAs in the 10 selected facilities and 38 iCCM-trained HSAs. One HSA was unavailable for interview and 1 selected health facility only had 3 HSAs trained in iCCM. For the 2013 follow-up DQA, we completed interviews with 9 senior HSAs and 36 HSAs. We were unable to conduct interviews at Dowa hospital. The majority of interviewees in the follow-up were revisited from the baseline 2012 DQA, but there was some turnover (6% [1 of 18] in Kasungu and 32% [5 of 19] in Dowa). HSAs not interviewed in both assessments were excluded (n=6) from the *t* test analysis (sample size for paired *t* test, n=31). Table 2 shows the number of participants in the package, the number selected for the baseline and endline DQA, and the number of respondents with matched data (those interviewed at both baseline and endline).

Data Availability and Quality

Table 3 shows the availability and completeness of the monthly reporting forms at the HSA (Form 1A) and health facility (Form 1B) levels. Availability and completeness of forms at the HSA level was maintained in Kasungu but dropped in Dowa, especially in terms of completeness. A form was considered "complete" only if every section was filled in. In most cases, interviewers found that "incomplete" forms were not missing key data but something minor such as signature. Timeliness (proportion submitted before deadline) was not tracked at the health facilities.

At the health facility level, baseline data from Kasungu were not available due to a data collection error but the endline rates show good reporting. Dowa experienced a large drop in availability of forms, reportedly due to lack of blank forms and supplies.

Figure 2 shows the consistency of routine reporting for child illness at the HSA level at baseline and endline for the most recent reporting month with complete data. Both Dowa and Kasungu showed significant improvements in reporting consistency for fast breathing (i.e., suspected pneumonia cases), from overreporting cases at baseline (RVR=0.82) to no reporting inconsistency at endline (RVR=1.0) (*P*=.02). Other non-significant improvements were measured for fever illness and patient gender.

Changes in reporting consistency were less apparent for drugs dispensed. Reporting quality

TABLE 2. Sample Size for the DQU Intervention and Evaluation, Dowa and Kasungu Districts, Malawi, 2012–2013

	DQU Implementation	Baseline Assessment	Endline Assessment	Matched Data
Districts	2	2	2	2
Health facilities	69	10	9	9
HSAs	426	38	36	31

Abbreviations: DQU, data quality and use; HSA, Health Surveillance Assistant.

TABLE 3. Availability and Completeness of Reporting Forms at the HSA and Health Facility Levels for the Previous Month, Baseline (May 2012) vs. Endline (June 2013)

	Kasungu		Dowa		Total	
	Baseline	Endline	Baseline	Endline	Baseline	Endline
HSA level[a]						
Available	93% (25/27)	96% (23/24)	95% (57/60)	80% (37/46)	94% (82/87)	86% (60/70)
Complete	74% (20/27)	79% (19/24)	95% (57/60)	63% (29/46)	89% (77/87)	69% (48/70)
Health facility level[b]						
Available	Missing	100% (24/24)	100% (23/23)	44% (11/25)	N/A	71% (35/49)
Complete	Missing	100% (24/24)	95% (22/23)	16% (4/25)	N/A	57% (28/49)

Abbreviation: HSA, Health Surveillance Assistant; iCCM, integrated community case management.
[a] Denominators represent all iCCM-trained HSAs associated with selected health facilities that would be expected to submit reports.
[b] Denominators represent all health facilities supporting iCCM that would be expected to submit reports to the district.

was maintained for lumefantrine-artemether and cotrimoxazole but decreased for oral rehydration salts. There was also increased variation among the HSAs (Supplement 3).

The sample sizes for health facility consistency of reporting were too small for this analysis. However, at both baseline and endline, the reporting consistency was adequate but with large variation in consistency for certain indicators, particularly in Dowa district (data not shown).

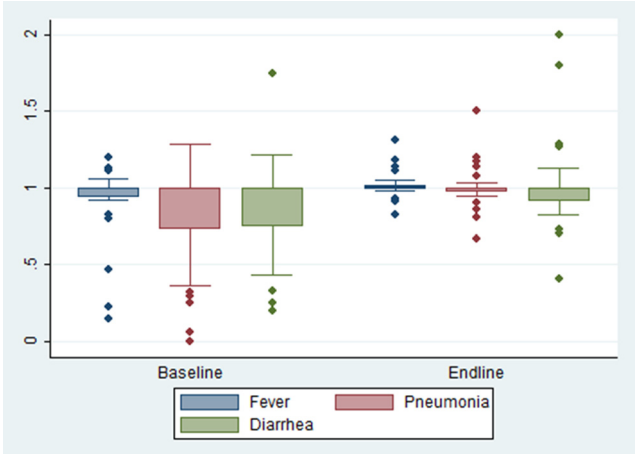
Data Display and Use

Figure 3 shows use of the wall chart template at the HSA and health facility levels at endline. All participants were trained and almost all were using the wall charts. The median time to complete the wall chart for that month was 1 hour. All participants reported that the package training was useful as a job aid and all components would be helpful to scale up in other districts. About half of the HSAs were not displaying the wall charts because their village clinic was not held in a permanent structure. The large majority (90%) of the HSAs and three-quarters of the health facilities had the wall charts completed for every month since January 2013.

Participants were asked whether any program decisions were based on the template data and to give an example. Most HSAs mentioned they used the data from the wall charts to inform their community health education activities. For instance, if HSAs noticed an increase of malaria cases, the HSA would sensitize communities to sleep under mosquito nets.

Most HSAs mentioned they used wall chart data to inform their community health education activities.

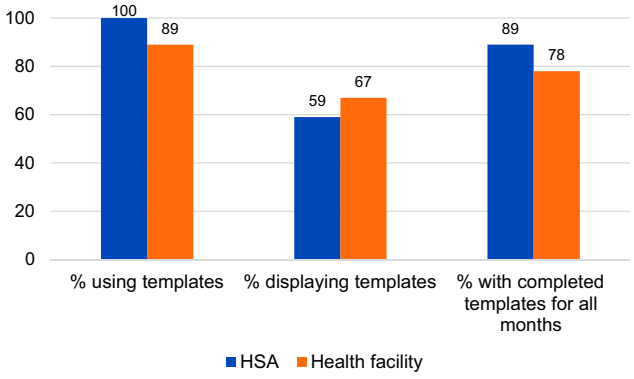
FIGURE 2. HSA Caseload Reporting Consistency at Baseline (2012) and Endline (2013) for Fever, Diarrhea, and Pneumonia, Dowa and Kasungu Districts Combined, Malawi



Abbreviations: HSA, Health Surveillance Assistant; RVR, results verification ratio.

An RVR of 1.00 indicates perfect reporting, while less than 1.00 indicates overreporting and greater than 1.00 underreporting.

FIGURE 3. Wall Chart Template Use at the HSA and Health Facility Levels at Endline (2013), Dowa and Kasungu Districts Combined, Malawi



Abbreviation: HSA, Health Surveillance Assistant.

Yes, when malaria cases or fever cases were high, the village clinic volunteers and the HSA agreed to conduct health education on malaria and consistent use of treated mosquito nets. –Dowa HSA as summarized by interviewer

Participants reported that the ability to show an increase in the number of cases resulted in more preventive actions. Several reported holding community talks to discuss increases in child illness cases. Stock-out data were reported to have

been used to inform communities that they should seek care at the health facilities in the short-term until the HSA stocks were replenished. HSAs reported using the wall chart data to lobby their supervisors for more drugs.

In a couple of cases, HSAs asked communities to build permanent structures to house sick-child clinics so they had a place to provide iCCM services and display the wall charts. Participants in this study said that it was very valuable to have the data displayed so that communities could see the information.

> *Yes, [the] Village Clinic Committee used the information after getting satisfied with the importance of the templates [wall charts]. The village clinic committee and the community had agreed to contribute money and buy a clinic door [for displaying the wall charts to the community].* –Dowa HSA summarized by interviewer

Senior HSAs at the health facilities reported using their template data to make staffing decisions, e.g., deploying HSAs to vacant areas and asking the district to allocate additional iCCM-trained HSAs. One respondent indicated that the wall charts helped to better track the number of stock-outs and ensure timely reporting by the HSAs.

Another senior HSA reported that an unusually high number of pneumonia cases were reported, so the supervisor convened a meeting and provided refreshers on following the iCCM manual and counting respiratory rates. At the health facilities, participants liked that the data were now available to all, whereas before it was kept by 1 person and not everyone had access to it. The benchmarks and action thresholds were reported to provide helpful guidance.

> *It [wall charts with action thresholds] reminds you if you are not doing good to pull up socks and if you are doing good to continue. It is easy to interpret.* –Kasungu senior HSA summarized by interviewer

Costs

The total implementation cost of this activity was US$11,833 or US$172 per health facility. This included all costs of the TOT, the health facility/HSAs trainings in both districts, supplies and materials, and the 1-week supervisory visit. Costs such as transportation, per diems, refreshments, and printing are included, but staff salaries were not included.

DISCUSSION

Our results show that provision of wall charts to community and facility health workers to organize and view monthly iCCM reporting data, along with additional training, leads to more data-based decision making. We also found evidence of improvements in reporting consistency but not in availability or completeness of reporting. It is important to note that even at baseline, on average, we found adequate reporting consistency for most indicators despite a few HSAs with very poor reporting. This finding is similar to a study in Mozambique that also found adequate reporting of facility-based records.[20]

Provision of wall charts to community and facility workers to organize and view monthly data leads to more data-based decision making.

In terms of feasibility, the DQU package was well received from the HSAs to the MOH program managers at the national level. The training takes only a half-day per health facility, can be facilitated by district health staff, and requires minimal supplies. Costs will vary based on location, but we consider it an inexpensive investment in the Malawian context. This package could easily be embedded in many community-based health programs.

Our study demonstrated that program support and district management were important mediators of the effectiveness of the DQU package. There was turnover of iCCM supporting agencies and of district staff in the middle of the package implementation, which may have influenced the findings. During the baseline DQA, support from Save the Children for iCCM in Dowa included a district-based project officer who followed up with facilities to obtain complete reports and to resupply iCCM forms, but the project closed in March 2013, prior to the endline DQA. During the baseline DQA, Kasungu received support through WHO and UNICEF, although they did not provide direct staff to assist with reporting. Also, the district had not yet begun supervision and mentoring with the revised checklists during the study period, but by the endline DQA this activity was underway in the sampled health facilities. We found a higher rate of turnover in Dowa district including turnover in the Deputy IMCI coordinator position (personal communication, Humphreys Nsona, Program Manager, IMCI Unit, Ministry of Health, Malawi) found at endline. This data use intervention is promising, but turnover and other issues at the district level may limit the potential effect of any data improvement program and must be continually monitored and addressed.

Program support and district management were important mediators of the effectiveness of the data quality and use intervention.

BOX 2. Modifications to the DQU Implementation in 2016

- Updating the malaria graph to chart rapid diagnostic test positive (RDT+) cases after the introduction of RDTs
- Addition of a graph to capture newborn home visits
- Combining the individual wall charts into a single large poster format for durability and ease of display
- Dropping provision of calculators to reduce the cost of the intervention since most HSAs now have mobile phones with a calculator function

Health Surveillance Assistants in Malawi review iCCM data using wall chart templates.

As of September 2016, the DQU package was being implemented in 15 of Malawi's 29 districts and had been adapted for use in Mozambique and Nigeria.

Since this study, Malawi has scaled up use of the open-source software District Health Information System 2 (DHIS 2)—an electronic and web-based health information system—replacing the previous paper-based system.[21] The DHIS 2 software integrates the community-based iCCM data with the facility-based information on child illness treatment. We developed district-level Excel-based electronic data display for the DQU package, but it was not used, partly due to the shift to DHIS 2 that was happening concurrently. There is the potential for similar data visualizations to be integrated into the dashboard function of DHIS 2 to automatically generate the graphs based on data entered at the district level. Unfortunately, the system is not available at the health facility level due to computer and Internet connectivity shortages. Health workers at the facility and community levels still require a paper-based system for organizing and visualizing their data.

There have been ongoing efforts on the behalf of partners and the MOH to expand implementation of the DQU package while modifying it to address updates to the iCCM program and other community-based packages implemented by HSAs through the WHO Rapid Access Expansion Programme (RAcE) (Box 2). As of September 2016, the DQU package was being implemented in 15 of Malawi's 29 districts and had been adapted for use in iCCM programs in Mozambique and Nigeria.

Unfortunately the scale up of DQU as part of RAcE shows more inconsistent use of the tools. In late 2016, Save the Children conducted a survey of 66 HSAs and only 50% of these had been trained in the package and had received the wall chart templates. Of those trained and who had received the wall chart templates, only 40% had updated data for the last 3 months and only 57% had wall charts displayed (personal communication, T Guenther, Advisor, Save the Children, February 2017). Continued use of the wall charts will require additional investments in supervision and reinforcement. However, if the wall charts are embedded into other community-based programs,

supervision and reinforcement could be done during routine supervision or mentoring visits.

There is increased global recognition of the importance of accurate, timely, and available data in improving the health of children in low- and middle-income countries. Sustainable Development Goal 17.18 aims to increase capacity for generating health data.[22] Limited use and dissemination of data have been identified as a major barrier to effective HMISs.[11,23] Since this study, others have documented data use and quality improvement interventions such as enhanced planning and reporting tools in Ghana; electronic database dashboards showing relevant facility, district, and provincial data in Mozambique; electronic patient record systems in Rwanda; and quarterly data use workshops in Tanzania.[24,25]

Limitations

This study had important limitations. First, we purposively selected districts close to the capital to reduce transportation costs and these districts are not representative of all of Malawi. More remote districts may have less supervision, training, and access to other health system supports, so the study findings may not be generalizable. Additionally, the period of implementation was at minimum 3 months. It is possible the study findings would be different had we been able to evaluate the intervention after 6 or 12 months of implementation. Furthermore, the HSAs and health facility staff were informed of the endline DQA in advance of the study. It is possible they completed and displayed the wall charts only because they knew there would be a follow-up observation. Finally, examples of data-based decision making were self-reported and we were unable to verify any of the examples given. However, through routine supervision, the staff noted that the wall charts were being filled in on a monthly basis.

CONCLUSION

Routine data quality is a continual concern for monitoring iCCM programs. If health staff have better access to the data and assistance with interpretation and analysis, monitoring data may be seen as more valuable and the quality more important. This pilot project shows that given the opportunity to access and visualize the data along with supervision support, community and facility health workers can use their data to improve programs at the local level.

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ORIGINAL ARTICLE

National Assessment of Data Quality and Associated Systems-Level Factors in Malawi

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Nearly all facility registers were available and complete. But accuracy varied, with antenatal care and HIV testing and counseling performing the best and family planning and acute respiratory infections data less well. Most facilities visibly displayed routine health data and most hospitals and district health offices had staff trained in health management information systems, but training was lacking at the facility level as were routine data quality checks and regular supervision.

ABSTRACT

Background: Routine health data can guide health systems improvements, but poor quality of these data hinders use. To address concerns about data quality in Malawi, the Ministry of Health and National Statistical Office conducted a data quality assessment (DQA) in July 2016 to identify systems-level factors that could be improved.

Methods: We used 2-stage stratified random sampling methods to select health centers and hospitals under Ministry of Health auspices, included those managed by faith-based entities, for this DQA. Dispensaries, village clinics, police and military facilities, tertiary-level hospitals, and private facilities were excluded. We reviewed client registers and monthly reports to verify availability, completeness, and accuracy of data in 4 service areas: antenatal care (ANC), family planning, HIV testing and counseling, and acute respiratory infection (ARI). We also conducted interviews with facility and district personnel to assess health management information system (HMIS) functioning and systems-level factors that may be associated with data quality. We compared systems and quality factors by facility characteristics using 2-sample *t* tests with Welch's approximation, and calculated verification ratios comparing total entries in registers to totals from summarized reports.

Results: We selected 16 hospitals (of 113 total in Malawi), 90 health centers (of 466), and 16 district health offices (of 28) in 16 of Malawi's 28 districts. Nearly all registers were available and complete in health centers and district hospitals, but data quality varied across service areas; median verification ratios comparing register and report totals at health centers ranged from 0.78 (interquartile range [IQR]: 0.25, 1.07) for ARI and 0.99 (IQR: 0.82, 1.36) for family planning to 1.00 (IQR: 0.96, 1.00) for HIV testing and counseling and 1.00 (IQR: 0.80, 1.23) for ANC. More than half (60%) of facilities reported receiving a documented supervisory visit for HMIS in the prior 6 months. A recent supervision visit was associated with better availability of data (P=.05), but regular district- or central-level supervision was not. Use of data by the facility to track performance toward targets was associated with both improved availability (P=.04) and completeness of data (P=.02). Half of facilities had a full-time statistical clerk, but their presence did not improve the availability or completeness of data (P=.39 and P=.69, respectively).

Conclusion: Findings indicate both strengths and weaknesses in Malawi's HMIS performance, with key weaknesses including infrequent data quality checks and unreliable supervision. Efforts to strengthen HMIS in low- and middle-income countries should be informed by similar assessments.

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INTRODUCTION

National health management information systems (HMISs) collect data on routine health activities in a country's health system, and are one of the 6 building blocks of a health system. The World Health

Organization (WHO) defines a well-functioning HMIS as one that "ensures the production, analysis, dissemination, and use of reliable and timely information on health determinants, health system performance, and health status."[1]

Routinely collected health services data are often overlooked in low- and middle-income countries because they are assumed to be of limited completeness, timeliness, representativeness, and accuracy.

High-quality data on the services provided by health facilities are necessary to make informed decisions regarding resource allocation, planning, and programming. However, this potentially rich source of data is often overlooked in low- and middle-income countries (LMICs), because it is assumed to be of limited completeness, timeliness, representativeness, and accuracy.[2] Low confidence in the quality of routine health data negatively impacts its use by program managers and other decision makers.[3–4]

In place of routine health data, governments and development partners tend to rely on data from intermittent surveys that are typically organized and funded by international organizations.[5] Parallel monitoring and evaluation systems for specific service areas or health conditions may also be established and used by partners to supplement data collected through the HMIS. There are many advantages to using routine data instead of survey data, including power to describe all administrative levels in the country, near-real time accessibility, and reduced cost.[5–6]

WHO and other partners have called for adequate investment in health information systems in all countries by 2030.

Recognizing the lack of trust in routine health data and the demand for reliable health data by donors and governments, in 2010 the heads of 8 multilateral and private organizations called on governments and partners to invest in improved information systems for health.[7] At the Summit on the Measurement and Accountability for Results in Health, held in 2015, the World Bank, U.S. Agency for International Development (USAID), WHO, and other partner organizations issued a "Five-Point Call to Action" that, among other things, called for adequate investment in health information and statistical systems in all countries by 2030.[8] The data collection mechanisms used by HMISs in LMICs may be of varying quality due to human error, measurement error, or missing values. The WHO recommends that data quality assessments (DQAs) be carried out regularly to assess HMIS performance. Findings from DQAs can be used to understand the strengths and weaknesses of routine health data and the HMIS, and can help to determine the reliability of this information.[9]

Findings from previous studies of HMIS functioning in LMICs provide insight into the current status of data quality in developing countries. A review of DQAs conducted in 23 countries using the Performance of Routine Information System Management (PRISM) framework developed by MEASURE Evaluation found that a lack of standardization of data management procedures contributed to poor data quality in many countries.[10] Data quality—including the accuracy, timeliness, and completeness of data—ranged from 34% to 72% and use of data for decision making ranged from 30% to 53%.[10] In one review of immunization data from 41 low-income countries, summary reports included less than 80% of immunization data recorded in patient registers.[11] A systems assessment of the HMIS in Benin found several organizational factors that were associated with better data quality, including availability of material resources for HMIS activities and supervision for HMIS within the past 6 months.[12] Two previous DQAs conducted in Malawi found poor data accuracy between facility and community registers and reports, and identified weaknesses in quality controls, among other systems factors in need of strengthening.[13–14]

Malawi is a low-income country located in sub-Saharan Africa with a population of approximately 17 million.[15] After suffering from a human resources emergency from the mid-1990s to 2009,[16–17] Malawi's health system has now begun to rebound. Life expectancy at birth increased from 43 years in 1994 to 63 years in 2014.[15] In addition, HIV incidence has dropped: in the early 2000s, Malawi had one of the highest rates in the world, with an estimated 14.2% of adults aged 15–49 infected, whereas today the estimated adult prevalence stands at 9.1%.[18] Malawi has also demonstrated great progress in reducing the number of new HIV infections among children: between 2009 and 2015, estimated HIV infections in children dropped by 71%, and 80% of pregnant women with HIV now access antiretroviral treatment to prevent mother-to-child transmission.[19] The infant and under-5 mortality rates have also dropped precipitously since 1990, and Malawi now has lower mortality rates among infants and children than many of its neighbors in the Africa region. Infant deaths within the first year of life fell from 143 per 1,000 live births in 1990 to 43 per 1,000 in 2015, and under-5 deaths dropped from 245 per 1,000 live births in 1990 to 64 per 1,000 in 2015.[20] Communicable diseases continue to be the leading cause of death,[20] and with only 46% of women receiving the recommended 4 antenatal care visits,[21] significant progress is still needed to improve the health status of Malawi's population.

All HMIS and monitoring and evaluation (M&E) activities for the Ministry of Health of Malawi are overseen by the Central Monitoring and Evaluation Division. Each district health office has an HMIS officer, seconded from the National Statistical Office, to oversee the collection and reporting of data from the district to the central level. In 2010, Malawi adopted the District Health Information System 2 (DHIS 2) software for its HMIS. DHIS 2 is a web-based, open-source information system used at the district and central levels.[22] Most facilities continue to use paper forms to collect and report data to the district level; however, electronic registers have been gradually introduced in limited facilities, beginning in 2008. Malawi recently piloted a data quality application developed by WHO and Statistics Norway within DHIS 2, which allows trained users of the system to monitor completeness of data and to depict time trends that may indicate under- or overreporting of data and/or a real increase in reported cases.

Recognizing a gap in information about the quality of Malawi's routine health data, the government and development partners expressed a desire to better understand HMIS performance. Both the *Malawi Health Sector Strategic Plan 2011–2016* and Malawi's HMIS policy call for regular DQAs.[23–24] The DQA described in this article is the first nationally representative DQA to have been carried out under these plans at the health center, hospital, and district levels. This assessment aimed to characterize the quality of routine data generated by Malawi's health sector and to elucidate systems-level factors that may be associated with data quality, with the goal of informing improvements in data quality and increasing use of routine health data.

METHODS

Study Setting and Design

We conducted this study in July 2016 using stratified random 2-stage sampling. We first selected, at random, 3 districts from each of Malawi's 5 zones. We then randomly selected 25% of health centers, excluding village clinics and dispensaries, in each selected district, with a minimum of 4 health centers; this did not include the district hospital, which was purposively selected. For one of the districts that was selected, the Ministry of Health divides it into 2 separate administrative units; we therefore included both administrative units, bringing the total districts selected to 16. In 3 of the selected districts, there was no district hospital; therefore, the rural hospital was purposively selected instead. Data were also collected in the district health office (DHO) of every selected district.

Dispensaries and village clinics were excluded because they provide fewer services than health centers, and the data from these facilities are often aggregated and reported to the nearest health center prior to submission to the district. We also excluded facilities that serve primarily police and military, because access to these facilities is restricted and because these facilities do not provide all services included in this assessment, such as diagnosis of acute respiratory infections. In addition, the 4 central (tertiary-level) hospitals located in Blantyre, Lilongwe, Mzuzu, and Zomba, and the national mental hospital, also located in Zomba, were excluded because they have their own data structures and reporting tools that are not generalizable to other facility types, and because they do not provide all of the services that were included in this DQA. We included all facilities under Ministry of Health auspices, including those managed by the Christian Health Association of Malawi (CHAM) and Adventist Health Services because they are supposed to collect and report data in the same manner as government-managed facilities. While many private facilities do report their routine health data to the Ministry of Health, it was not possible to collect data at these facilities because they are not directly governed by the Ministry of Health and access is thus restricted. Therefore, they were excluded from the sample.

This article reports on the first nationally representative data quality assessment we are aware of conducted at multiple service levels in Malawi.

Data Collection

We adapted a set of Data Quality Review tools developed by WHO, in conjunction with the Global Fund to Fight AIDS, Tuberculosis and Malaria; Gavi; and USAID/MEASURE Evaluation.[9] We added 31 questions on display of information, data use, and supervision from MEASURE Evaluation's PRISM tools.[25]

Our data collection instrument was comprised of 2 sections. The first section included 15 data verification questions for antenatal care, family planning, and HIV testing and counseling, and 17 data verification questions for acute respiratory infection. At facilities, recounts from the registers for 4 service areas of interest were compared with the total included on the facility's monthly report for 3 months (March, April, and May 2016). The 4 indicators of interest were:

We assessed the quality of data in 4 service areas: antenatal care, family planning, HIV testing and counseling, and the outpatient department (with a focus on acute respiratory infection data).

1. Number of pregnant women who completed 4 ANC visits (ANC)
2. Number of units of injectable contraceptives (Depo-Provera) administered (FP)
3. Number of positive HIV tests 1 and 2 (defined as 2 consecutive, positive tests) (HTC)
4. Number of acute respiratory infection (non-pneumonia) cases in children under-5 (ARI)

These indicators will henceforth be referred to by their abbreviated name or acronym. At DHOs, we compared monthly report totals for all facilities in the district with the total in DHIS 2 for the same indicators during the same time period.

The second section of the assessment tool was a systems assessment. This assessment consisted of an interview with the facility in-charge or most senior health worker available at health centers and hospitals, and the district HMIS officer at DHOs. This interview was comprised of 113 questions at facilities and 58 questions at DHOs, and explored systems-level factors that may be associated with data quality in 9 areas:

1. Monitoring and evaluation structure and function
2. Indicator definitions and reporting guidelines
3. Data collection tools and reporting forms
4. Display of information
5. Internal data quality checks
6. Supervision
7. Data maintenance and confidentiality
8. Data use
9. Use of computerized registers

Data Analysis

Data quality was analyzed across 3 dimensions: availability, accuracy, and completeness.

We analyzed data quality across 3 dimensions: availability, accuracy, and completeness.[26]

The **availability** dimension assessed the availability, at time of assessment, of registers and reporting forms for ANC, FP, HTC, and ARI for March, April, and May 2016. Each service area uses a separate register and a separate reporting form. FP, HTC, and ARI data are required to be reported to the DHO within 5 days after the last day of the month. ANC visits are reported to the DHO 6 months after the first ANC visit. This interval was based upon national survey data demonstrating that most women in Malawi do not begin ANC until the second trimester of their pregnancy.[19] Therefore, the 6-month delay increases the likelihood that reports will capture the total number of ANC visits that a woman completes during her pregnancy. For this DQA, the September, October, and November 2015 ANC registers were reviewed and compared with the March, April, and May 2016 reports for this service area.

The **completeness** dimension evaluates the extent to which registers and reports include all data of interest. A register or report was considered complete if it had data recorded for the entire month, without any known days of service provision completely without data.

Some facilities did not provide all services of interest; therefore, both availability and completeness are represented as a percentage of all documents that are expected. Denominator values ranged from 18 to 24 (no selected facility provided fewer than 3 of 4 service areas of interest).

Accuracy at facilities was calculated as a "verification ratio," defined as the ratio between the data collector's recount of the 3-month register total and the sum of the monthly report totals for 3 months as recorded on the facility copy. At DHOs, verification ratios were calculated using only May 2016 data, in accordance with WHO recommendations[8]; specifically, totals from all monthly reports for May 2016 for the 4 indicators of interest were compared with totals in DHIS 2 for May 2016. In addition, verification ratios were calculated comparing register totals with totals recorded in DHIS 2 to understand the accuracy of data as they are transmitted from the facility, to the district health office, to the central level.

Two-sample *t* tests were performed to test the statistical significance of differences in the availability, completeness, and accuracy of data between facilities, by facility characteristic. Welch's approximation was applied when unequal variance between groups existed.

Systems assessment questions were grouped into functional areas to assess facility HMIS performance. We calculated the percentage of facilities that answered yes to each question. A matrix was then created, in which responses were color-coded to identify "hot spots" for recommended Ministry of Health action. Cut-offs among the levels of the matrix were designed to detect meaningful differences in facility performance (Table 1) enabling the Ministry of Health to prioritize its efforts to improve the HMIS.

Stata/IC 14.2 was used for this analysis (StataCorp, College Station, TX).

TABLE 1. Key for Hot Spot Table Coloring Scheme Indicating Systems Assessment Results and Recommended MOH Actions

Percent of Facilities Responding Positively to Question[a]	Corresponding Color	Interpretation
80–100	Green	No specific action recommended. MOH can seek to identify actions that may improve or sustain facility compliance.
60–80	Yellow	MOH should undertake actions to improve compliance. The timing and nature of the action depend on the functional area and how critical the component is to HMIS functioning.
<60	Red	MOH should seek to immediately identify underlying reason for low compliance and undertake action to increase compliance in the short-term.

Abbreviations: HMIS, health management information system; MOH, Ministry of Health.
[a] "Positively" is defined as responding in affirmation to the question. For most questions, this included only those facilities that answered "yes"; depending on the context of the question, it may also include facilities that answered "partly." This is indicated in the Results section of the article. Eight questions about stock-outs of registers and reports were worded in the inverse, so "no" answers were considered to be responding "positively."

Ethical Review

Data collection was determined by the Institutional Review Boards of the Johns Hopkins Bloomberg School of Public Health and the Malawi National Health Sciences Research Committee to be exempt from full review. However, we felt that it was important to ensure participants understood what they were being asked to do; therefore, we informed them of the aims of the project, what we were asking them to provide, and that participation was optional. We also answered any questions and requested their consent to proceed with the study.

RESULTS

We selected 90 health centers of 466 total health centers in Malawi; 13 district hospitals of 23 total; 3 rural hospitals of 21; and 16 district health offices in 16 of Malawi's 28 districts. Of these, 73 health centers were managed by the government of a total 340, 16 were managed by CHAM of 108, and 1 was managed by Adventist Health Services of 18 (Table 2). Of the hospitals included, all 13 district hospitals and 1 rural hospital were managed by the government of 48 total; the other 2 rural hospitals were managed by CHAM of 43 total managed by CHAM (Table 2). (There are also other types of hospitals, besides district and rural hospitals, for a total of 113 hospitals in the country.) There were no significant differences between the selected health centers and health centers nationally for mean outpatient attendance (P=.40), urban/rural location (majority rural; P=.55), or managing authority (P=.11). When compared with all hospitals, the selected district and rural hospitals had statistically significantly higher outpatient attendance (P=.01) and were statistically significantly more likely to be managed by the government (P<.01). But like the rest of the country, nearly all selected hospitals were in rural areas (P=.57).

Data Verification

Median scores and interquartile ranges (IQRs) were calculated for each data quality dimension to reduce the influence of potential outliers. District hospitals and DHOs had median scores that indicated that nearly all facility registers and reports were available and complete, with a median (IQR) availability score of 0.96 (0.88, 1.00) and 0.94 (0.71, 1.16), respectively, and a median completeness score of 0.92 (0.79, 1.00) and 0.99 (0.98, 1.00) (Table 3). Health centers did nearly as well, with a median availability score of 0.92 (0.79, 1.00) and median completeness score of 0.88 (0.71, 1.00). Rural hospitals had lower performance in these areas, with a median availability score of 0.75 (0.71, 0.79) and a median completeness score of 0.75 (0.67, 0.83), indicating that some documents were unavailable and/or incomplete at the time of the DQA.

Across the 4 service areas that we assessed, HTC and ANC showed the highest levels of accuracy between registers and reports (Table 4), perhaps because of partner support. In health

Nearly all facility registers and reports were available and complete in district hospitals, health centers, and district health offices.

Antenatal care and HIV testing and counseling service areas had the highest levels of accuracy between registers and reports while acute respiratory infection data had the lowest accuracy scores.

TABLE 2. Characteristics of Health Centers and Hospitals Selected for the Data Quality Assessment Compared With All Health Centers and Hospitals in Malawi, 2016

	Selected Health Centers (n=90)	All Health Centers (N=466)	*P* Value	Selected District Hospitals (n=13)	Selected Rural Hospitals (n=3)	All Hospitals (N=113)	*P* Value[a]
Monthly outpatient department attendance, median (IQR) (March–May 2016)	2240[b] (1371, 3174)	2264 (1371, 3213)	.40	9595[c] (7276, 14737)	1202 (779, 7032)	5308 (2686, 9331)	.01
Location			.55				.57
Rural, No. (%)	87 (97)	455 (98)		13 (100)	3 (100)	111 (98)	
Urban, No. (%)	3 (3)	11 (2)		0 (0)	0 (0)	2 (2)	
Managing authority			.11				<.01
Government, No. (%)	73 (81)	340 (73)		13 (100)	1 (33)	48 (42)	
CHAM, No. (%)	16 (18)	108 (23)		0 (0)	2 (67)	43 (38)	
Adventist Health Services, No. (%)	1 (1)	18 (4)		0 (0)	0 (0)	22 (20)	

Abbreviations: CHAM, Christian Health Association of Malawi; IQR, interquartile range.
[a] Comparing combined district and rural hospitals with all hospitals.
[b] For 18 selected facilities, there were missing outpatient attendance data for at least 1 month.
[c] For 2 facilities, there were missing outpatient attendance data for at least 1 month

TABLE 3. Data Quality Dimension Scores for Availability and Completeness, by Facility Type, Malawi, 2016

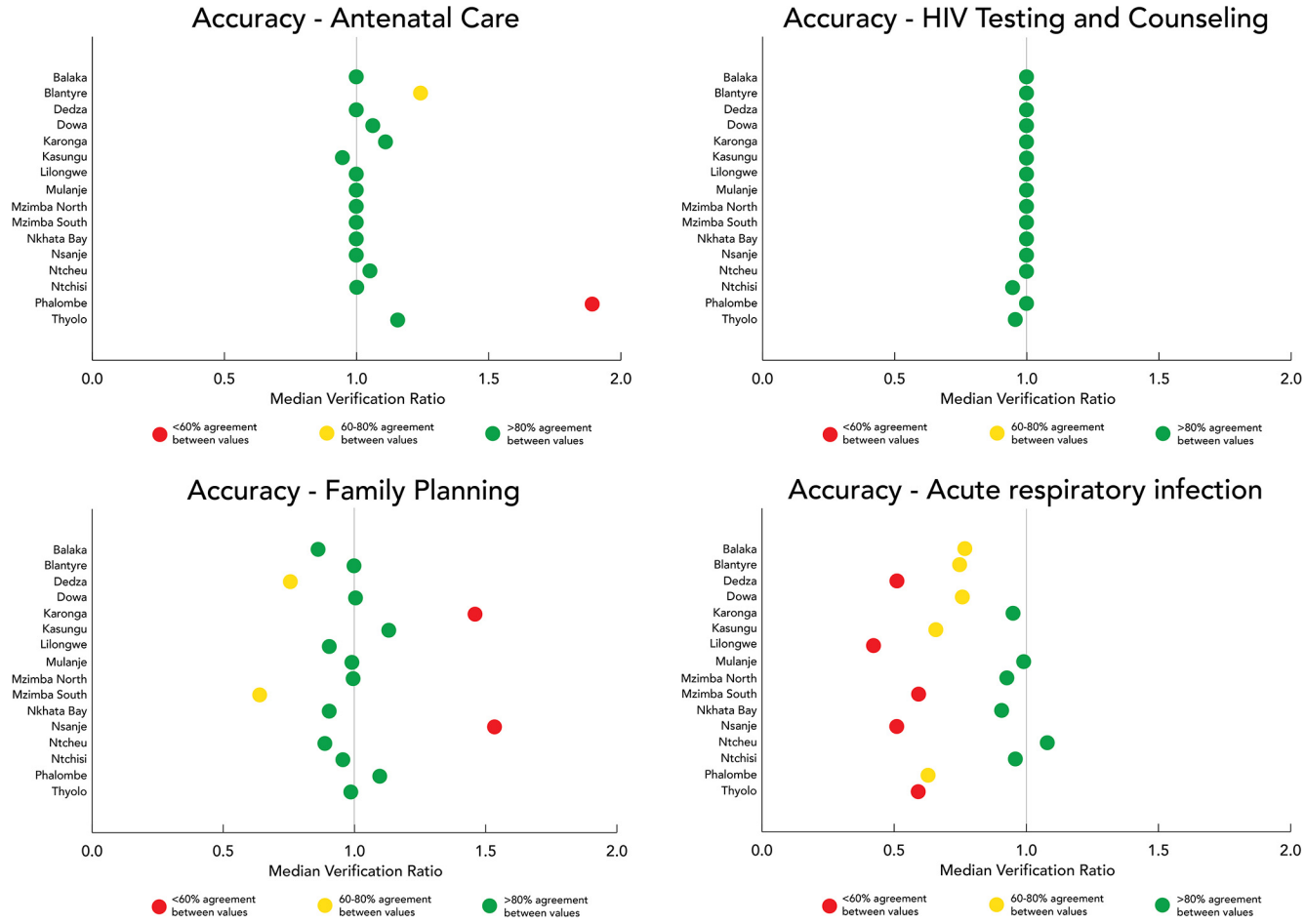
	Health Centers (n=90)	District Hospitals (n=13)	Rural Hospitals (n=3)	DHOs (n=16)
Availability score, median (IQR)	0.92 (0.79, 1.00)	0.96 (0.88, 1.00)	0.75 (0.71, 0.79)	0.94 (0.71, 1.16)
Completeness score, median (IQR)	0.88 (0.71, 1.00)	0.92 (0.79, 1.00)	0.75 (0.67, 0.83)	0.99 (0.98, 1.00)

Abbreviations: DHO, district health office; IQR, interquartile range.

centers, both ANC and HTC had a median verification ratio of 1.00, indicating that the register and report totals were identical. In district hospitals, the median verification ratio for ANC was also 1.00, although the HTC verification ratio was substantially lower (0.77 [0.61, 0.93]). At rural hospitals, the median score for HTC was 0.99 (0.93, 1.00) and for ANC, 1.08, but ANC verification ratios at rural hospitals varied widely, from 0.00 to 2.50. The family planning indicator showed similarly high accuracy scores, with a median of 0.99 (0.82, 1.36) at health centers and 0.93 (0.80, 1.08) at district hospitals. Only 1 rural hospital that was selected provided family planning services; the verification ratio at that hospital was 0.23. The ARI indicator showed the lowest accuracy scores, ranging from a median of 0.08 (0.07, 0.42) at rural hospitals to 0.87 (0.33, 1.18) at health centers. Substantial variation was seen in district verification ratios for family planning and ARI (Figure 1), but with a few exceptions all districts showed good consistency between registers and reports for ANC and HTC indicators.

Accuracy between facilities, DHOs, and the central level was assessed through verification ratios between facility registers and DHIS 2, and DHO reports and DHIS 2. For the former

FIGURE 1. Data Accuracy Verification Ratios for Antenatal Care, HIV Testing and Counseling, Family Planning, and Acute Respiratory Infection Indicators by District, Malawi, 2016



measurement, averages were calculated by facility; for the latter measurement, averages were calculated by DHO. Accuracy between DHO reports and DHIS 2 was high, with a median verification ratio of 1.00 for all service areas (Table 4). Accuracy between facility registers and DHIS 2 showed greater variability across service areas: while ANC and HTC had median verification ratios of 1.00, family planning and ARI had lower verification ratios (0.94 and 0.73, respectively).

Systems Assessment

Findings from the systems assessment were divided into 9 functional areas. Table 5 displays a key finding from each functional area, by level of the health system. For the full details on each functional area, see the Supplement. Overall, less than 60% of health centers, hospitals, and DHOs had adequate performance in 8 of the 10 functional areas. In particular, only about 40% of health centers, hospital, and DHOs performed routine internal data quality checks and regular supervisory visits from the district were lacking (52% of health centers and 63% of hospitals reported regular supervision). The 2 functional areas in which facilities and DHOs demonstrated adequate performance were visual displays of routine health data and staff responsibilities. Over 90% of facilities, and 81% of DHOs, displayed information on maternal health, child health, facility utilization, disease surveillance,

TABLE 4. Data Accuracy Verification Ratios Comparing DHIS 2 to Facility Registers and DHIS 2 to DHO Reports by Facility Type, Malawi, 2016

	Facility Registers				
	Health Centers (n=90)	District Hospitals (n=13)	Rural Hospitals (n=3)	DHO Reports to DHIS 2 (n=16)	Facility Registers to DHIS 2 (n=106)
ANC ratio, median (IQR)	1.00 (0.97, 1.13)[a]	1.00 (0.88, 1.06)	1.08 (0.00, 2.50)	1.00 (0.98, 1.13)	1.00 (0.96, 1.10)
FP ratio, median (IQR)	0.99 (0.82, 1.36)[b]	0.93 (0.80, 1.08)	0.23[c]	1.00 (0.95, 1.08)	0.94 (0.70, 1.07)
HTC ratio, median (IQR)	1.00 (0.99, 1.05)	0.77 (0.61, 0.93)	0.99 (0.93, 1.00)	1.00 (0.96, 1.01)	1.00 (0.97, 1.05)
ARI ratio, median (IQR)	0.87 (0.33, 1.18)	0.61 (0.20, 0.94)	0.08 (0.07, 0.42)	1.00 (0.83, 1.00)	0.73 (0.27, 1.05)

Abbreviations: ANC, antenatal care; ARI, acute respiratory infection; DHIS 2, District Health Information System 2; DHO, district health office; FP, family planning; HTC, HIV testing and counseling; IQR, interquartile range.
[a] n=89.
[b] n=86.
[c] Only 1 selected rural hospital provided family planning services.

TABLE 5. Key Findings for Systems Assessment Functional Areas, by Health Systems Level, Malawi, 2016

Functional Area	Indicator	Health Centers (n=90) No. (%)	Hospitals (n=16) No. (%)	DHOs (n=16) No. (%)
Staff responsibilities	Staff members have received training for HMIS-related functions	52 (58)	13 (81)	15 (94)
Indicator definitions	Written definitions for all 4 indicators of interest (ANC, FP, HTC, ARI) available in facility or DHO	39 (43)	12 (75)	9 (56)
Reporting guidelines	Reporting guidelines available at facility that describe what should be reported, how reports are to be submitted, to whom, and when	90 (34)	8 (50)	6 (38)
Data use	Regularly use data to calculate indicators	48 (53)	12 (75)	12 (75)
Registers and reporting forms	No stock-outs of any registers or reporting forms during the past 12 months	23 (26)	6 (38)	-
Registers and reporting forms	Sufficient copies of data collection tools available in the DHO to meet the needs of all health facilities in the district	-	-	7 (44)
Display of routine data	One or more information displays present at time of assessment[a]	83 (92)	15 (94)	13 (81)
Internal data quality checks	Consistency checks of collected data routinely conducted	37 (41)	7 (44)	7 (44)
Supervision	Regular supervisory visits from district	47 (52)	10 (63)	4 (25)
Computerized registers	Facility uses computerized registers	9 (10)	15 (94)	-

Abbreviations: ANC, antenatal care; ARI, acute respiratory infection; DHO, district health office; FP, family planning; HMIS, health management information system, HTC, HIV testing and counseling.
[a] Evaluated the following displays: maternal health, child health, facility utilization, disease surveillance, map of catchment area, summary of demographic data.

and/or demographic characteristics, and/or displayed a map of the facility's catchment area. More than three-quarters (81%) of hospitals and 94% of DHOs (but only 58% of health centers) reported having staff trained in HMIS-related functions. In Table 5, the presence of computerized registers for one or more functional areas was not color-coded because this was not considered to be a measure of facility performance.

Finally, we assessed differences in data quality dimensions for other facility characteristics that we hypothesized may be associated with data quality (Table 6). In our sample, 50% of facilities employed a statistical clerk; employment of a statistical clerk was not significantly associated with any data quality dimension. More than half (60%) of all facilities reported a documented supervisory visit within the last 6 months, which was associated with lower accuracy of ANC register and report data (P=.03) but with a higher level of data availability (P=.05). Regular supervision from the central level was associated with a higher HTC verification ratio (P=.04). Use of data by the facility to track performance toward targets was

Use of data by the facility to track performance was associated with both improved availability and completeness of data.

TABLE 6. Association of Selected Facility Characteristics With Data Quality Dimensions, Mean (*P* Value)

	Data Quality Dimension					
			Accuracy Difference			
Facility Characteristic	Availability Score Difference	Completeness Score Difference	ANC	FP	HTC	ARI
Partner support	1.27 (.12)	0.02 (.57)	0.04 (.78)	0.11 (.54)	−0.07 (.30)	−0.04 (.82)
Statistical clerk employed	0.03 (.39)	0.01 (.69)	−0.08 (.58)	−0.08 (.65)	−0.07 (.25)	−0.36 (.07)
Managing authority[a]	0.08 (.07)	0.08 (.09)	−0.22 (.15)	−0.58 (.26)	−0.03 (.49)	−0.11 (.71)
Facility location[b]	−0.13 (.25)	−0.09 (.42)	−0.14 (.08)	−0.05 (.84)	−0.18 (.18)	−0.12 (.79)
Regular supervision visits from district	−0.02 (.43)	−0.01 (.78)	0.18 (.16)	0.07 (.67)	−0.08 (.18)	0.22 (.21)
Regular supervision visits from central level	0.04 (.22)	0.04 (.31)	−0.02 (.87)	−0.14 (.47)	0.13 (.04)	0.19 (.33)
Supervisory visit within last 6 months	0.07 (.05)	0.03 (.35)	−0.39 (.03)	−0.09 (.60)	0.06 (.37)	0.21 (.29)
Consistency checks of data routinely conducted	−0.08 (.64)	0.05 (.76)	−0.05 (.45)	0.09 (.14)	−0.15 (.43)	0.14 (.46)
Facility uses computerized registers for one or more service areas	0.02 (.66)	−0.00 (.96)	-	-	-	-
Facility uses computerized registers for designated service area (ANC, FP, HTC, outpatient department)	-	-	−0.23 (.23)	−0.58 (.31)	−0.05 (.77)	−0.32 (.15)
Facility has appropriate and adequate space for secure organization and storage of registers and reports	0.02 (.73)	0.02 (.65)	−0.66 (.18)	0.15 (.62)	0.05 (.65)	−0.08 (.78)
Facility uses its data to track performance toward meeting targets	0.06 (.04)	0.08 (.02)	0.07 (.59)	−0.27 (.13)	0.08 (.24)	−0.03 (.88)
Programmatic decisions taken by the facility are based on analyzed data/ results	0.04 (.23)	0.02 (.56)	-0.37 (.13)	−0.21 (.38)	−0.01 (.94)	0.08 (.71)

Abbreviations: ANC, antenatal care; ARI, acute respiratory infection; CHAM, Christian Health Association of Malawi; FP, family planning; HTC, HIV testing and counseling.
[a] Difference between facilities managed by the government and facilities managed by CHAM or Adventist Health Services.
[b] Difference between urban and rural facilities.

associated with both improved availability (P=.04) and completeness of data (P=.02).

DISCUSSION

This study, which evaluated the quality of the routine health data generated by Malawi's HMIS, identified both strengths and weaknesses of the system. We found that facilities in Malawi were likely to display their routine health data within the facility and that most hospitals and DHOs have trained HMIS staff. Accuracy between ANC registers and reports, and between reports and DHIS 2, was good. However, we found room for improvement in several areas, including:

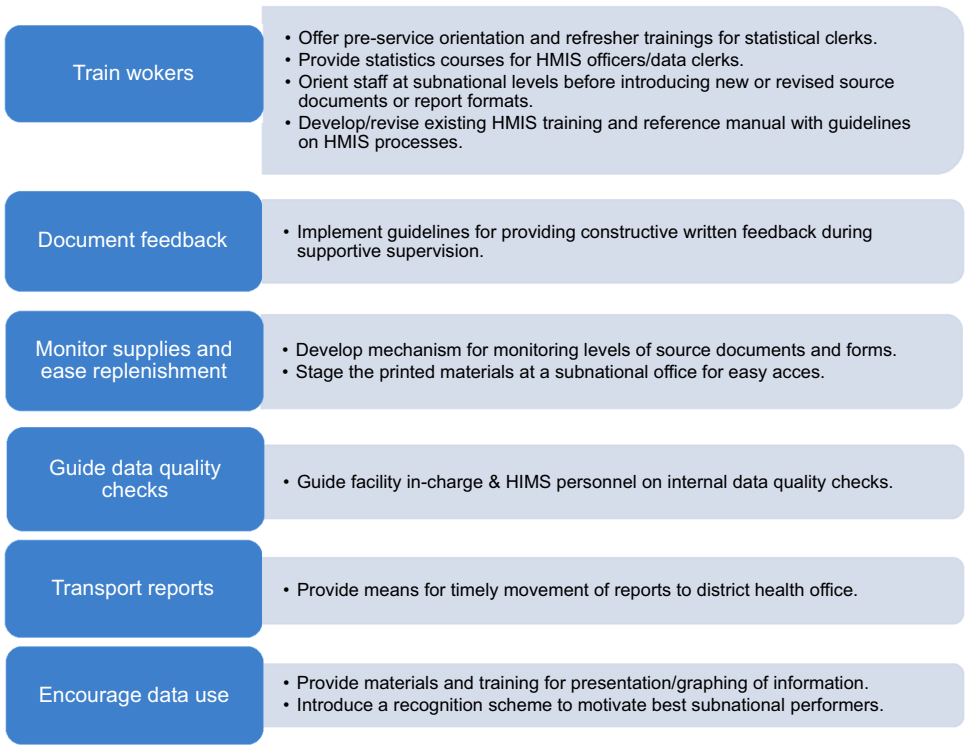
Differences in data quality across service areas should be explored further.

1. The availability, completeness, and accuracy of data for family planning, HTC, and ARI services
2. Data quality checks at the facility level
3. The comprehensiveness and reliability of HMIS supervision
4. Staff training for HMIS at the facility level

Identification of these weaknesses provides guidance for HMIS strengthening activities planned by the Ministry of Health of Malawi and development partners (Figure 2).[27]

Facilities and DHOs performed well in selected areas of data quality, particularly in accuracy between registers, reports, and DHIS 2 for the number of women completing 4 ANC visits during the time period of interest. However, data quality was poor in other service areas and dimensions; the availability, completeness, and accuracy of ARI data is in particular need of improvement. Further exploration of the reasons for differences in performance across service areas, including ease of use of the various registers, is needed. Discrepancies between registers and DHIS 2 data

FIGURE 2. Data Quality Assessment Recommendations to Strengthen the HMIS



Abbreviation: HMIS, health management information system.

Source: Malawi Ministry of Health (2007).[27]

for family planning and ARI have implications for program planning and policy at the national level, allocation of resources to the district level, and monitoring of key health indicators. Because these discrepancies were noted between registers and DHIS 2, and not between reports and DHIS 2, we can conclude that issues with facility aggregation, and not district entry of data into DHIS 2, is likely the cause of this discrepancy.

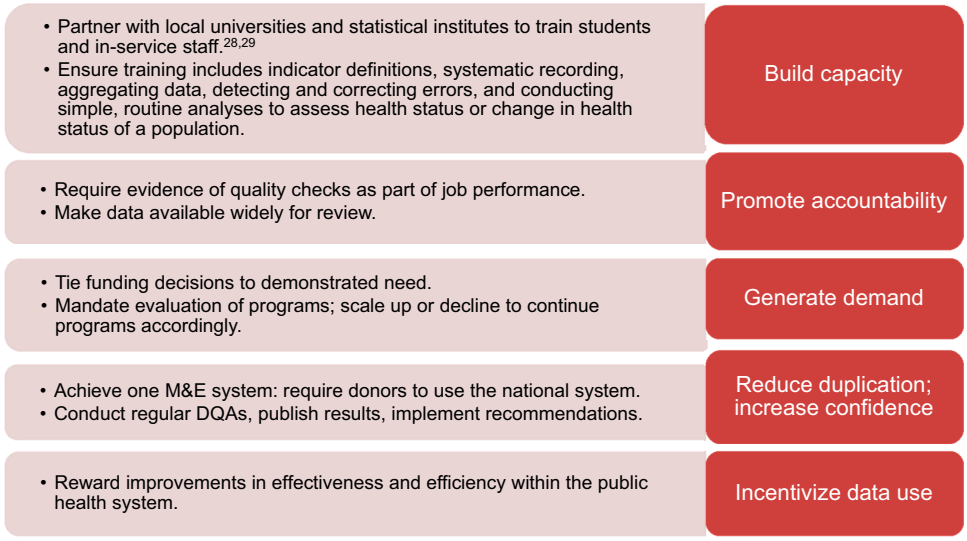
DHOs showed the highest performance in the data quality dimensions. This may be explained by two primary characteristics. Firstly, DHOs are more likely to have trained staff in their offices to carry out data entry and recording activities. In addition, the data entry process is arguably simpler in DHOs than in facilities, because DHIS 2 will automatically calculate monthly summaries, whereas staff in facilities must count and sum individual cases. However, DHOs faced one significant data quality issue. The 75th percentile of availability scores for DHOs was greater than 1 (more than 100%). This is likely because DHOs did not know the number of reports that they should receive from facilities each month, and therefore provided an underestimate of the true figure. It was not possible to independently verify the number of monthly reports that should be submitted each month to the DHO; HMIS officers informed us that the number of facilities providing and reporting services is not constant from month to month, and the Master Facility Register is updated only intermittently, when funding is available from development partners (personal communication with P. Naphini, MOH DHIS-2 Data Manager, National Evaluation Platform-Malawi, June 27, 2017). Therefore, the Ministry of Health should prioritize the identification of the facilities that fall under the jurisdiction of each DHO for the HMIS. This initiative will improve tracking of the availability and completeness of data.

We hypothesized that various functional areas of the health system and facility characteristics were associated with data quality. External partner support, employment of statistical clerks at health centers and hospitals, regular supervision from the district, and the use of computerized registers at the facility were not significantly associated with better performance in any data quality dimension. The Ministry of Health and donors should further examine the lack of association between external partner support and data quality, as it may indicate a need to revisit the effectiveness and appropriateness of partner activities. However, this finding may reflect partners' choices of districts or other confounding factors. The lack of association between employment of a statistical clerk and data quality could suggest that, in addition to other influential factors, statistical clerks may not be adequately trained, supported, or supervised. Therefore, prior to investment in the recruitment of more statistical clerks, as recommended in the National Statistical Strategic Plan, the Ministry of Health should revisit its training and retention strategies for these employees. Finally, while receipt of a supervisory visit within the past 6 months was associated with better data quality, regular district supervision was not. The Ministry of Health should explore strategies for improving supervision, including the use of checklists and joint visits with the zonal or central levels. Facilities may also benefit from regular feedback on their submitted reports, in addition to in-person visits. In the absence of trained facility staff, DHOs should provide analyses of facility data; this will better equip facilities to use their data for planning. DHOs and the central level can also use the WHO data quality app within DHIS 2 to provide an analysis of data quality to the facilities.

Prior to investing in recruiting more statistical clerks, the Ministry of Health should revisit its training and retention strategies for these employees.

The systems assessment permitted us to evaluate the performance of various HMIS functional areas across facility types. The systems assessment revealed poor performance of health centers, hospitals, and DHOs in most functional areas; display of information was the only exception for all system levels. Disaggregation of facility performance in the various functional areas by district or zone can help the Ministry of Health to prioritize geographic areas for intervention. In addition, our findings of the association of various systems-level factors with data quality may assist the Ministry of Health in identifying the most effective programs for improving quality. Use of data by the facility to track performance was associated with higher availability and completeness of data. This relationship may indicate that facilities that use their routine data were more likely to review those data for these attributes and to place greater value in the quality of these data. Promotion of data use is an important part of the cycle of quality improvement. We have included it in our DQA recommendations[27] (Figure 2) and have featured it in the agenda for building country leadership for data use (Figure 3).[28] Use of data was not, however, associated with higher accuracy of data, perhaps because only a small number of facilities reported conducting regular accuracy checks on their collected data. Regular accuracy checks were not statistically significantly associated with

FIGURE 3. Agenda for Building Country Leadership for Data Use, Malawi



improved performance in any data quality dimension. This lack of association may be explained by the quality and content of the internal data checks that facilities perform on a routine basis. Because these routine checks were self-reported, we could not verify their existence or quality; however, at health centers, less than 60% of staff designated to conduct HMIS activities had been trained in HMIS functions. Therefore, they may lack the skills needed to properly assess data quality and to carry out the appropriate checks for accuracy between registers and reports. Training should be implemented to ensure staff members know how to confirm the accuracy and completeness of data.

The findings of the systems assessment allowed us to evaluate compliance with Malawi's HMIS policy, which was introduced in October 2015. Because this DQA was conducted only 8 months after introduction of HMIS policy, these data could serve as a baseline to assess improvement. Repeated DQAs will enable the Ministry of Health to monitor progress of HMIS strengthening activities, as outlined in the HMIS policy. Results of this DQA should be shared with program managers, M&E officers, and other decision makers, in order to provide an empiric measure of data quality in Malawi. Especially if improvements are seen, reporting results of subsequent DQAs could improve the confidence of potential data users in the quality of the routine health data generated by this system.

Findings from this study enrich the existing literature on data quality in low-income countries because they explore data quality across multiple service delivery areas and levels of the health system.

This DQA complements other DQAs that were previously conducted in Malawi. A DQA conducted for integrated community case management (iCCM) found a generally well-functioning M&E system for iCCM but quality controls were lacking and there were gaps in the completeness and accuracy of reporting by Health Surveillance Assistants.[14] Our DQA found similar issues at higher levels of the health system and in other service areas. Our findings also build on the findings of a previous study that examined the consistency of Malawi's reporting of under-5 deaths with survey data. This study found that concordance of reporting data with "gold-standard" survey data was low, ranging from 35% to 65% in 2 districts.[13] In conjunction with the findings of our DQA, these previous studies can be used to paint a clear picture of data quality throughout the health system. From the lowest cadre of health workers to the central level, these 3 studies demonstrate that the accuracy, completeness, and reporting of routine health data is in need of improvement in Malawi.

Nationally representative studies on the quality of DHIS data are rarely published. Findings from this study enrich the existing literature on data quality in low-income countries because they explore data quality across multiple service

areas and levels of the health system. In addition, these study findings point to key systems-level factors that influence data quality. With a few exceptions, including DQAs conducted in Liberia and Côte d'Ivoire,[10] previous DQAs conducted in sub-Saharan Africa have been more limited in their scope, examining only 1 service area, 1 type of health setting, or a limited number of districts. While performance on data quality dimensions are limited in their generalizability to other countries, given the variability of health systems, the findings of this data quality and systems assessment can be used to drive evidence-based improvements in the HMIS of other similar countries. For example, the lack of association between the use of computerized registers at the clinic level and data quality may indicate the need to accompany the introduction of these electronic systems into HMISs with training and data use initiatives. Furthermore, we show here that conducting comprehensive, high-quality data quality and systems assessments is feasible in a low-income country. Other LMICs that wish to gather information about current HMIS functioning to strengthen their HMISs can replicate this assessment methodology.

Limitations

This study had limitations that warrant further discussion, many of which may be addressed in future assessments of this type. Firstly, the median outpatient department attendance at the selected district hospitals was higher than in hospitals of all types in the country, and the median attendance at the selected rural hospitals was lower than in hospitals of all types; therefore, caution should be exercised when generalizing these findings to hospitals of differing sizes. In addition, because the selected hospitals were statistically significantly more likely to be managed by the government rather than the faith-based entity (CHAM), attention should be paid to the management structure of the target hospitals when designing and implementing interventions. We did not power our assessment to allow for comparisons among hospitals. Also, we did not have access to records from village clinics, Health Surveillance Assistants, or private providers during the DQA. This limited our ability to provide a complete picture of data quality, particularly at health centers and district hospitals where data from these providers is included in monthly reports. Thirdly, because we did not include private providers or lower-level health facilities in the DQA, it is important to remember that the findings of this study represent only health centers and hospitals managed by the government, CHAM, and Adventist Health Services, and the district health offices. Finally, this analysis does not address validity and representativeness of routine health data. Validity measures the agreement of routine health data with a "gold standard," usually defined to be survey data. Representativeness examines how well routine health data reflects the underlying disease state of the population.[5,9] These dimensions will be analyzed in later studies through a comparison of these indicators with survey data, after we are able to analyze the 2015 Malawi Demographic and Health Survey data.

CONCLUSION

Data quality is a multifaceted concept that cannot be boiled down to a binary measure; attempts to improve data quality should consider each dimension of quality. As one of the 6 building blocks of a health system, as defined by WHO, health information interacts with the other areas of the health system, including human resources, financing, and governance. Therefore, interventions to address the quality of data must approach the problem from multiple angles while also considering the systems-level implications of HMIS improvement.

Based on the findings from this study, we recommended that the Malawi Ministry of Health focus on training staff at all levels of the health system in HMIS, improving HMIS-focused supportive supervision, ensuring internal data quality reviews, and encouraging data use to inform programming (Figure 2).[27]. In addition, the National Evaluation Platform's agenda for building country leadership for data use focuses on improving the enabling environment for data improvement and use (Figure 3).[28,29]

The results of this assessment are already informing decision makers and program managers in Malawi's health sector of ways to improve the use of routine health data in policy and programming. Because the assessment and improvement of data quality is a continuous process, a task force has been named by the M&E Technical Working Group to examine findings and recommendations from this assessment and to develop an appropriate intervention package to address the identified issues. Using these findings, the Ministry of Health and M&E Technical Working Group are working with the Gates Foundation,

WHO Health Data Collaborative, and other stakeholders both in-country and internationally to improve data quality and use nationwide.

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ORIGINAL ARTICLE

Family Planning in the Context of Latin America's Universal Health Coverage Agenda

Thomas Fagan,[a] Arin Dutta,[a] James Rosen,[b] Agathe Olivetti,[a] Kate Klein[a]

Latin American countries have expanded family planning along with universal health coverage (UHC). Leveraging UHC-oriented schemes to increase family planning program coverage, equity, and financing requires:

- **Prioritizing poor and indigenous populations**
- **Including family planning services in all benefits packages**
- **Ensuring sufficient supply of commodities and human resources to avoid stock-outs and implicit rationing**
- **Reducing nonfinancial barriers to access**

ABSTRACT

Background: Countries in Latin America and the Caribbean (LAC) have substantially improved access to family planning over the past 50 years. Many have also recently adopted explicit declarations of universal rights to health and universal health coverage (UHC) and have begun implementing UHC-oriented health financing schemes. These schemes will have important implications for the sustainability and further growth of family planning programs throughout the region.

Methods: We examined the status of contraceptive methods in major health delivery and financing schemes in 9 LAC countries. Using a set of 37 indicators on family planning coverage, family planning financing, health financing, and family planning inclusion in UHC-oriented schemes, we conducted a desk review of secondary sources, including population surveys, health financing assessments, insurance enrollment reports, and unit cost estimates, and interviewed in-country experts.

Findings: Although the modern contraceptive prevalence rate (mCPR) has continued to increase in the majority of LAC countries, substantial disparities in access for marginalized groups remain. On average, mCPR is 20% lower among indigenous women than the general population, 5% lower among uninsured women than insured, and 7% lower among the poorest women than the wealthiest. Among the poorest quintile of women, insured women had an mCPR 16.5 percentage points higher than that of uninsured women, suggesting that expansion of insurance coverage is associated with increased family planning access and use. In the high- and upper-middle-income countries we reviewed, all modern contraceptive methods are typically available through the social health insurance schemes that cover a majority of the population. However, in low- and lower-middle-income countries, despite free provision of most family planning services in public health facilities, stock-outs and implicit rationing present substantial barriers that prevent clients from accessing their preferred method or force them to pay out of pocket.

Conclusion: Leveraging UHC-oriented schemes to sustain and further increase family planning progress will require that governments take deliberate steps to (1) target poor and informal sector populations, (2) include family planning in benefits packages, (3) ensure sufficient financing for family planning, and (4) reduce nonfinancial barriers to access. Through these steps, countries can increase financial protection for family planning and better ensure the right to health of poor and marginalized populations.

INTRODUCTION

Over the past 50 years, countries in Latin America and the Caribbean (LAC) have successfully expanded access to family planning services. The modern contraceptive prevalence rate (mCPR) has increased in every country in the LAC region, and by more than 30 percentage points in countries such as El Salvador, Honduras, Nicaragua, Paraguay, and Peru.[1] For 2015, the mCPR for the region is estimated at 66.7%, and unmet need for family planning is estimated at 10.7%.[2] The region has seen corresponding decreases

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in the total fertility rate, which has fallen from 5–6 children per woman to just 2.2, nearing the replacement fertility level of 2.1. This decline was driven by improvements in access to family planning services, such as the subsidized provision of contraceptives through social marketing and the inclusion of family planning services in the basic package of services provided by government-supported health facilities. Over this period, support from international organizations and donors, including the United States Agency for International Development (USAID), the International Planned Parenthood Federation, and the United Nations Population Fund (UNFPA), was critical in strengthening family planning programs. Improvements in education, income levels, and infant and child mortality rates have further contributed to the decline in the total fertility rate.[1]

The success of family planning programs in many LAC countries did not occur overnight, but has rather been part of a steady process of development of countries' health systems as they advance toward universal health coverage (UHC). In recent decades, many LAC countries have recognized health as a fundamental—and often constitutional—right of their citizens and embraced the goals of UHC.[3] (A review of this process in the LAC region is beyond the scope of this paper.) UHC implies an assurance of financial protection against the cost of health care (i.e., the ability to access services without facing financial hardship) and provision of quality services across a full range of promotive, preventive, curative, rehabilitative, and palliative interventions, for all people.[4] Such services can be provided through any variety of health financing and delivery channels, including social or private health insurance and public or private facilities.

As part of the movement toward UHC, many countries in the LAC region made efforts to reform their health financing to increase the pooling of funds, guaranteed access to an essential package of services, and financial protection from the cost of health services for the vulnerable. These reforms were based on other, longer-term efforts in primary health care strengthening, regulation, and social mobilization. Broadly, LAC countries have used 3 types of financing mechanisms—which this paper henceforth refers to as UHC-oriented schemes—as the means to further these goals:

- Social health insurance
- Private health insurance
- Public tax-funded provision

Access to family planning in Latin America has resulted in increased use of modern methods and decreases in the total fertility rate.

State-supported social health insurance has been a mechanism for increasing health care coverage in the region.

Social health insurance (SHI) schemes have been a primary mechanism for increasing health insurance coverage in many LAC countries. These schemes are state-supported and are typically financed through payroll contributions from formal-sector workers. In addition to these "contributory" schemes, high- and upper-middle-income countries in the region have expanded SHI to include "subsidized" schemes, with the state subsidizing enrollment for informal workers and the poor.[5] Such subsidized schemes ensure greater financial protection and a higher quality of services for poor and vulnerable populations.[5] On occasion, governments have set up and substantially financed autonomous insurance schemes focused on the poor, for example in Peru. Henceforth, this paper refers to these as "other government-supported schemes." Private health insurance (PHI) plays only a small role in health financing in LAC countries and covers mainly higher-income individuals. These PHI schemes can be stand-alone or supplementary to SHI. They are usually supported by voluntary contributions from formal-sector employees and/or their employers, or from those with otherwise higher income status.

Many governments continue to provide health services through public facilities, often for free. The idea of a comprehensive public health care network financed through tax revenue and provided free to all residents (similar to the National Health Service model in the United Kingdom) represents theoretically near-universal financial protection from the cost of health care. In practice in many LAC countries, particularly lower-income countries, free provision is insufficient, alone, to ensure adequate range and quality of services. These limitations to public tax-funded provision, within the context of family planning services, are discussed in this article. Additional health financing modalities may, therefore, be needed to cover all population groups and sufficiently meet the goals of UHC.

In practice, free provision of health services at public facilities is not enough to ensure people's access to a sufficient range of services.

SHI is the primary mechanism for health sector financing in much of the LAC region, and the term "social health insurance" is often used interchangeably with the term "universal health coverage." However, it is important to note that SHI arose separately from and before broad, UHC-oriented efforts. Nascent SHI schemes in LAC began with a focus on hospital care, curative

interventions, and protection against catastrophic health care expenditures.[6] Only with the recent adoption of explicit UHC-oriented goals has the focus begun to shift to include primary and preventive services, including family planning.

Before their SHI schemes matured, some countries' family planning programs benefited from high levels of sustained external support, primarily from USAID.[1] Improvements in family planning access over the 1990s and 2000s in many LAC countries were due to a variety of factors and not only the expansion of UHC-oriented schemes.[1,7] However, integration of family planning into UHC-oriented efforts has been suggested as a possible way to continue the improvement in family planning access and use[8] as well as to provide sustainable family planning financing in countries with high mCPR, especially where external financing has tapered off (this is referred to as "graduation").

Theoretically, UHC-oriented schemes, including SHI, should promote financial protection in the context of the cost of family planning—if the related benefits are included in the scheme—by increasing prepayment and by subsidizing fully or partially the cost of health services, including premium payments, for some groups. This can help ensure effective family planning access for poor and vulnerable women, including those from indigenous groups. Examining recent evidence can help to determine if this has been the case in countries with mature family planning and UHC programs functioning in parallel, as well as to discern lessons from and for other countries on the path to UHC.

Theoretically, UHC-oriented schemes can help ensure that poor and marginalized women, including indigenous women, have access to family planning.

Many LAC countries, especially in Central America and the Caribbean, have recently graduated from or are currently facing graduation from external support for family planning. There is thus a need to consider long-term plans for sustainably financing the scale-up of family planning access and use. For these countries, learning about the recent links between family planning access and UHC-oriented health insurance schemes in the region becomes critical.

However, despite extensive literature on both UHC and family planning progress in LAC countries, as well as on the recent family planning graduation of some LAC countries, little analysis exists to link ongoing family planning efforts to the broader LAC UHC agenda. The purpose of our analysis is therefore to better understand the relationship between the coverage of UHC-oriented schemes and family planning. To our knowledge, this is the first effort to systematically examine the status of family planning within UHC schemes. Including family planning within UHC-oriented schemes involves not only legal status (i.e., the inclusion of family planning in the benefits package), but also the consistent availability of family planning both within and across facilities, the availability of a range of methods, and appropriate co-pays (i.e., co-pays that do not expose clients to financial hardship) for accessing contraceptive methods.

The purpose of this analysis is to understand the relationship between universal health care coverage and family planning.

By considering family planning in the context of UHC, LAC and other countries may make more informed decisions on how to integrate family planning into UHC-oriented schemes. Our analysis examines the following key questions for a selected sample of countries in the LAC region:

1. What is the current level of coverage for SHI and other risk-pooling mechanisms, and how does this vary by geography, ethnicity, and income level? What variation exists between countries in their progress toward UHC, and toward universal family planning access as a subset of UHC?
2. What is the status of family planning services within major insurance and health financing schemes? Where family planning services are included, what is the actual coverage and level of access (e.g., methods and availability)? What is the level of financial protection offered for family planning within these schemes (i.e., are co-pays required)?
3. What drives variation in the status of family planning services within insurance schemes both within and across LAC countries? What lessons can be learned from the linkages of family planning and reproductive health and UHC reforms in the region, especially to inform policies in other countries in the region with lagging family planning indicators? What broad lessons can be learned as implications for countries in other regions?

METHODS

We purposively selected and analyzed 9 countries throughout the LAC region—3 each from South America, Central America, and the Caribbean. These countries were selected to exhibit a range of income levels, UHC-related progress, and family planning access. For each country, we collected data using a standardized set of 37 indicators across 4 key areas: family planning coverage; family planning financing; health financing; and family planning inclusion in UHC-oriented schemes.

A full list of the indicators used is available in Supplement 1.

The team performed a desk review of existing literature on family planning and health financing in the countries of interest, and in LAC broadly. Key data sources included population-level surveys, primarily Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys; health financing assessments; and insurance enrollment reports. DHS and other survey data were further cross-tabulated to examine inequalities in access based on socioeconomic and insurance status, ethnicity, geography, and other factors.

The team also conducted key informant interviews with in-country experts in family planning. These interviews informed our assessment of the current status and inclusion of contraceptive methods within public health service provision and SHI and PHI schemes. The team used additional data, including estimates of out-of-pocket (OOP) spending on family planning provided by the Netherlands Interdisciplinary Demographic Institute, to conduct its own estimates of total family planning expenditures. Methods for these estimates are discussed in Supplement 2.

FINDINGS

The following section summarizes our key findings on family planning access, UHC progress, and the inclusion of family planning in UHC-oriented schemes for each of the study countries.

Chile

Chile is the only high-income country in our sample. As of 2013, Chile had a total fertility rate of 1.79, which is below both replacement level and the level of many other economically developed countries.[9] However, family planning uptake in Chile has been relatively slow, with mCPR increasing from 43% in the mid-1980s to only an estimated 62% by 2016 (Figure 1), while unmet need is still at 13% (2016)—above the regional average of 10.7%.[10] Of modern methods, the pill and intrauterine devices (IUDs) are the most popular, accounting for 40.2% and 37.5% of overall use, respectively (Figure 2).[10] Chile has relatively little disparity in access to family planning services along lines of geography or wealth.

Chile's health insurance expansion has achieved near-universal coverage through the country's UHC-oriented scheme, Fondo Nacional de Salud (FONASA), which covers 76% of the population, and Instituciones de Salud Previsional (ISAPRES), which is privately financed (primarily by employers) and covers 17% of the population (Table). Beneficiaries of both schemes have access to services that address 80 priority health conditions.[22] FONASA covers all major family planning methods, and all FONASA primary care clinics provide family planning free of charge, with the exception of sterilization. Wealthier beneficiaries have a co-pay for sterilization, ranging from approximately $20 to $50, based on income group.[23] Under ISAPRES, coverage of contraceptive methods and associated co-pays varies greatly by plan, with some plans providing family planning with small or no co-pays while others requiring clients to pay fully OOP for family planning. Additionally, many clients choose to pay OOP for pills and condoms in pharmacies. Experts identified wait times in FONASA facilities as another reason for OOP payments, despite broad insurance coverage (personal communication with Eduardo Soto Fernandez, Nurse-Midwife Advisor, National Women's Health Program, Life Cycle Department, Ministry of Health, August 2016).

Interviews with in-country experts informed our assessment of how family planning is included in current health insurance schemes.

Given Chile's existing near-universal insurance access, further increases in mCPR will require addressing programmatic challenges to family planning, including reducing nonfinancial barriers to sterilization and making services more responsive to groups such as adolescents (personal communication with Eduardo Soto Fernandez, Nurse-Midwife Advisor, National Women's Health Program, Life Cycle Department, Ministry of Health, August 2016).

Colombia

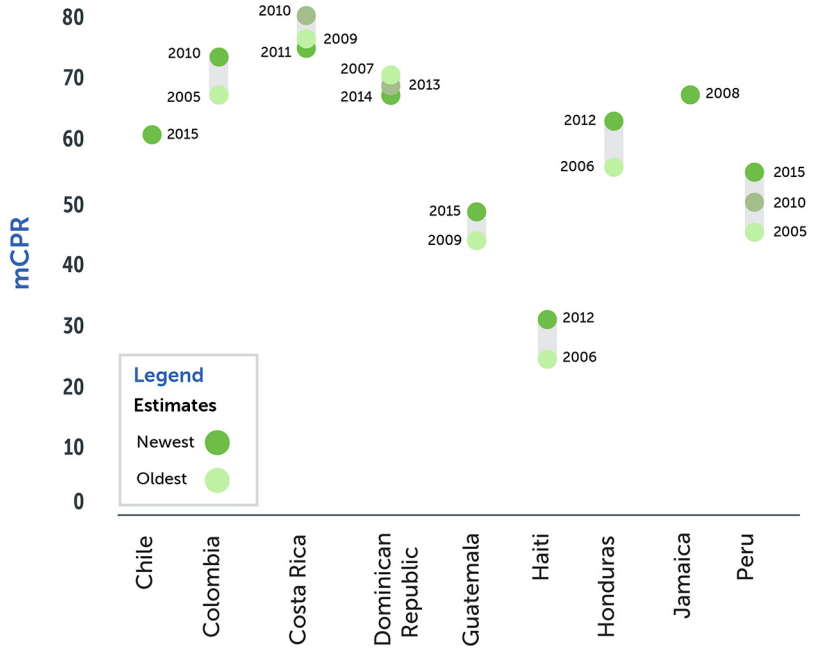
Colombia reached replacement-level fertility by 2010. Female sterilization accounts for nearly half of the method mix (Figure 2) behind the country's high mCPR (73%) (Figure 1).[24] Landmark legislation in 1993 established what is now a near-universal 2-tiered compulsory SHI scheme. A contributory scheme for formal-sector workers, funded by payroll taxes, covered 43% of the population in 2015; a subsidized scheme for the poor, funded through general taxation and other sources, covered 49% of the population.[25]

Colombia's 2-tiered insurance scheme, which includes a contributory and a subsidized program, covers more than 90% of the population.

Both the contributory and subsidized schemes cover the same minimum package of health services, including all major family planning methods, free of charge (Figure 3).[26] However, in practice, many health facilities—particularly in remote areas of the country—lack the full range of methods (personal communication with Nora Quesada, Regional Director for Latin America and

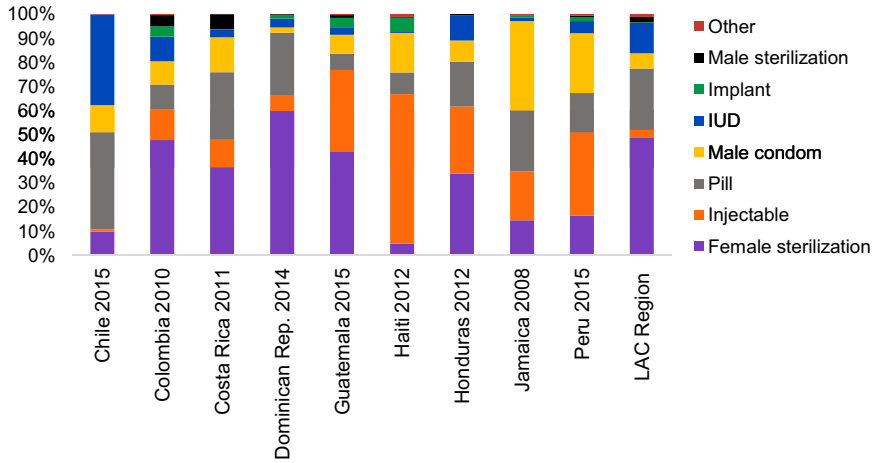
Despite near-universal insurance coverage, Chile has a lower mCPR than many countries in the region.

FIGURE 1. mCPR by Country Among Women Married or in Union (2005–2015)



Abbreviation: mCPR, modern contraceptive prevalence rate.

FIGURE 2. Contraceptive Method Mix by Country Among Contraceptive Users Married or in Union (2008–2015)



Abbreviations: IUD, intrauterine device; LAC, Latin America and the Caribbean.

the Caribbean, John Snow, Inc., August 2016). Rural areas lack diversity of providers, and hence many members of subsidized schemes rely on public facilities alone and have otherwise more limited ability to choose providers.[27] Moreover, a substantial number of facilities lack personnel trained in providing all family planning methods.[28] Wait times for sterilization can be up to 3 months, far in excess of the 5-day maximum mandated by the Ministry of Health and Social Protection.[28] Colombians who can afford it may obtain supplementary insurance through a prepaid plan that allows broader choice in providers and minimal wait times for surgeries, including sterilization.

Despite high insurance coverage, OOP spending on family planning is estimated to be substantial in Colombia (personal communication, Karin Vrijburg, Researcher, NIDI, and Erik Beekink, Project leader, UNFPA-NIDI Resource Flows Project on Family Planning, NIDI, June, 2016). In addition, equity in access to family planning services remains an issue as unmet need for family planning is almost twice as high among the poorest women as among the wealthiest.[29]

TABLE. Estimated Health Insurance Coverage by Major Insurance Schemes, Selected Latin American and Caribbean Countries

	SHI and/or Other[a]	PHI	Total[b]
Chile (2015)[11]	77%	17%	94%
Colombia (2015)[12]	97%	6%	97%
Costa Rica (2013)[13]	94%	—	94%
Dominican Republic (2013)[14]	28%	29%	57%
Guatemala (2014)[15,16]	18%	5%	23%
Haiti (2014)[17]	3%	4%	7%
Honduras (2015)[18]	19%	3%	19%
Jamaica (2013)[19,20]	19%[c]	19%	<38%
Peru (2015)[21]	73%	2%	73%

Abbreviations: PHI, private health insurance; SHI, social health insurance.
[a] Aggregate of SHI and other government-supported insurance schemes, as applicable.
[b] Total insurance coverage may be lower than the sum of SHI and PHI coverage, due to overlap of covered populations.
[c] National Health Fund coverage only—limited benefits and not SHI.

Costa Rica

Costa Rica has achieved substantial improvements in access to family planning, with among the highest mCPRs in the region—74.7% (Figure 1).[30] However, poor and indigenous Costa Ricans have lower mCPR—and, conversely, higher unmet need—than the general population (Figure 4). The country's national SHI scheme, the Caja Costarricense de Seguridad Social (CCSS), covers 94% of the population.[13] While CCSS allows the poor to enroll free of charge, in 2013 CCSS began to deny services to unenrolled individuals unless they pay OOP or their life is in danger.[31]

CCSS, which was first founded in 1941, assumed responsibility for all public health service provision, including family planning, in the early 1990s.[32,33] CCSS provides the 6 most common contraceptive methods—female and male sterilization, oral and injectable contraception, IUDs, and male condoms[34]—free of charge to enrollees (Figure 3). The high level of coverage and the status of family planning under CCSS suggests that Costa Rica's high mCPR has been closely tied to CCSS's expansion. However, financial challenges and higher demand for CCSS services have put a strain on service delivery and increased wait times, particularly for specialized and inpatient services.[35] Such wait times may help to explain why, despite near-universal coverage under CCSS, an estimated one-quarter of family planning clients obtain family planning services in the private sector (personal communication, Karin Vrijburg, Researcher, NIDI, and Erik Beekink, Project leader, UNFPA-NIDI Resource Flows Project on Family Planning, NIDI, June, 2016). Costa Ricans who must pay OOP tend to face higher prices for family planning services than in other LAC countries (personal communication, Karin Vrijburg, Researcher, NIDI, and Erik Beekink, Project leader, UNFPA-NIDI Resource Flows Project on Family Planning, NIDI, June, 2016), and we estimate that the one-quarter of family planning clients who access services in the private sector account for 62% of family planning spending in Costa Rica.

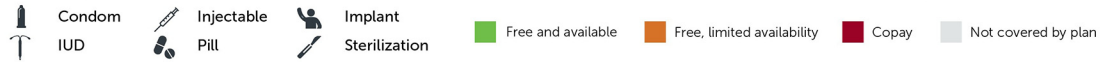
Despite the legal status of family planning as a covered benefit under CCSS, guaranteeing the timely availability of a full range of methods will be necessary to ensure full financial protection for family planning, and the financial stability of CCSS will be critical to sustaining the high level of family planning use that Costa Rica has already achieved.

Despite high insurance coverage in Colombia, there is substantial out-of-pocket spending on family planning.

Procurement and distribution of a full range of methods is necessary to ensure access to family planning, even in the context of near-universal insurance coverage.

FIGURE 3. Availability of Family Planning Methods by Country and Insurance Status

Country	Health Financing Summary	Availability of Family Planning Methods by Insurance Status		
		Uninsured	Social Health Insurance and/or Other	Private Health Insurance
Chile	Near universal insurance coverage; very few uninsured	Unknown	Free in all public schemes; referral for IUD and sterilization	Covered by Isapres through private providers
Colombia	Near universal insurance coverage; few uninsured	Free in public facilities	Free in both contributory and subsidized regimes	Increases method selection and availability ($10 copay)
Costa Rica	Near universal insurance coverage; very few uninsured	Must pay out of pocket	Free through CCSS	Generally not covered by private schemes
Dominican Republic	Public provision of services through MoH; moderate coverage of both public and private insurance	Free in public facilities	Free through SENASA and other public schemes	Sterilization is only method regularly covered by private schemes
Guatemala	Public provision of services; low insurance coverage	Free public provision; method availability by facility level	Free in IGGS facilities; postpartum sterilization	Generally not covered by private schemes
Haiti	Public provision of services; heavily donor dependent	Limited availability in public facilities	Free through public schemes but often unavailable	Unknown
Honduras	Public provision of services; low insurance coverage	Free in public facilities	Must pay out of pocket (not included in IHSS benefit package)	Generally not covered; some plans cover sterilization
Jamaica	Public provision of services; low insurance coverage	Free in public facilities	Not covered by NHF	Generally not covered; some plans cover sterilization
Peru	Public provision of services and high insurance coverage	Free in public (MINSA) facilities	Free through both public schemes (SIS, EsSalud)	Generally not covered by private schemes

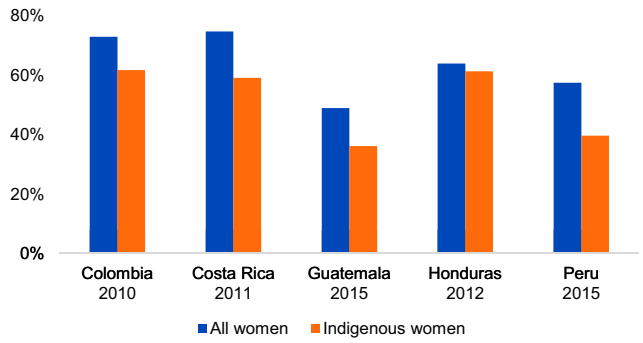


Abbreviations: CCSS, Caja Costarricense de Seguridad Social (national SHI scheme); IGSS, Instituto Guatemalteco de Seguridad Social (national SHI scheme); IHSS, Instituto Hondureño de Seguridad Social (national SHI scheme); IUD, intrauterine device; OOP, out of pocket; PHI, private health insurance; SeNaSa, Seguro Nacional de Salud; SHI, social health insurance.

Dominican Republic

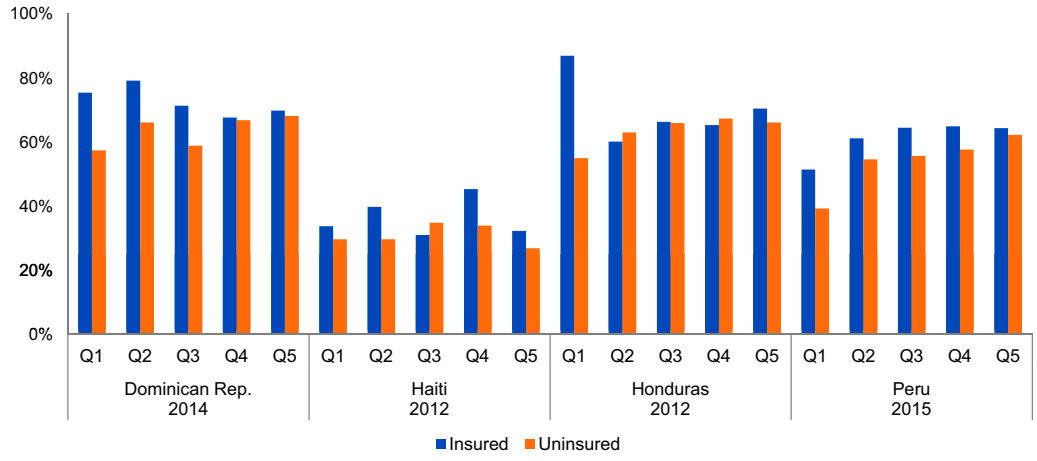
Over 40 years, the Dominican Republic achieved a more than 3-fold increase in mCPR, which peaked at 70% in 2007 (Figure 1).[36] Since USAID graduation in 2009, contraceptive prevalence has plateaued and integration of family planning into the country's major health financing mechanisms has achieved mixed results. Insurance coverage, which more than doubled between 2007 and 2013, is divided roughly equally between public and private providers, at 28% and 29% of the population, respectively.[14] The primary public scheme, the Seguro Nacional de Salud (SeNaSa), provides the 6 most common contraceptive methods free of charge. It is dependent on the Ministry of Public Health for commodities, however, and the ministry itself provides family planning services free of charge. Private insurers, which play a major role in health financing, generally fail to cover family planning, with the exception of postpartum sterilization (personal communication with Sonia Anderson, Country Director, Capacity Plus, June 2016).

FIGURE 4. mCPR in 5 Countries by Indigenous Status Among Women Married or in Union (2010–2015)



Abbreviation: mCPR, modern contraceptive prevalence rate.

FIGURE 5. mCPR in 4 Countries by Insurance Status and Wealth Quintile (Q1=Poorest, Q5=Wealthiest) Among Women Married or in Union (2012–2015)



Abbreviation: mCPR, modern contraceptive prevalence rate.

In the Dominican Republic, insured women in the poorest 2 wealth quintiles have the highest mCPR (77%), in part due to SeNaSa's high coverage among poor women (Figure 5).[37] Forty-one percent of women in the poorest quintile are covered by SeNaSa, compared with 14% in the wealthiest quintile.[14] On the other hand, mCPR does not vary much with insurance status among the wealthiest 2 quintiles, likely due to the exclusion of family planning from private insurance benefits packages. Poor, uninsured women remain particularly vulnerable and face the lowest mCPR. Expanding financial protection for health care to these women, while ensuring

In the Dominican Republic, modern contraceptive prevalence is highest among poor women covered by state-supported insurance.

the inclusion of family planning in benefits packages for women currently insured, will be critical for the Dominican Republic to reach universal access to family planning services.

Guatemala

Family planning access in Guatemala continues to be plagued by stark inequalities and systemic weaknesses in the health sector. In Guatemala, the mCPR is only 48.9% (Figure 1), and it is substantially lower for rural, indigenous (Figure 4), and young women, at 43.2%, 36.1%, and 31.3%, respectively.[38] Use of traditional methods is particularly high, at 19% of total contraceptive use, and is highest among indigenous women, at 28%. Both cultural and programmatic factors create barriers to family planning access. In particular, the cancellation of the Extension of Coverage Program in 2014 left many in rural areas—nearly 30% of the country's population—without access to basic health services, including family planning.[16,39]

It is estimated that 60% of family planning services in Guatemala are provided in public facilities, yet stock-outs are common.

Currently, an estimated 60% of family planning services in Guatemala are provided in public facilities (personal communication, Karin Vrijburg, Researcher, NIDI, and Erik Beekink, Project leader, UNFPA-NIDI Resource Flows Project on Family Planning, NIDI, June, 2016). The Ministry of Public Health and Social Assistance provides condoms and injectable and oral contraception at primary care facilities, and IUDs, implants, and sterilization at some secondary-level facilities. Since 2004, Guatemala has allocated 15% of taxes on alcoholic beverages to fund family planning and reproductive health; of the total amount, 30% is designated for family planning commodities. However, use of these funds for family planning is inconsistent, and stock-outs are frequent.[40] As a result, many clients seek their method of choice in the private sector. Private insurance coverage is minimal in Guatemala, and even the country's SHI scheme, the Instituto Guatemalteco de Seguridad Social (IGSS), which covers approximately 18% of the population,[16] plays a relatively minor role in contraceptive provision.

Haiti

Haiti has one of the highest rates of unmet need for family planning in the world.

Haiti, one of the world's poorest countries, has a total fertility rate of 3.5.[41] From 1994 to 2012, the mCPR in Haiti rose from 13.2% to 31.3% (Figure 1), driven by strong donor support, which increased access to services and strengthened the procurement system for family planning commodities. Despite this increase, Haiti has one of the highest rates of unmet need for family planning in the world, at 35%.[41] There is minimal variation in mCPR between rural and urban areas or by geographic region, and low use of methods such as IUDs and sterilization (Figure 2) may suggest a lack of trained medical personnel in many facilities. Government health expenditures represented just 7% of total health expenditures (THE) in 2013.[42] Thus, Haiti continues to rely heavily on donor funding (64% of THE) and OOP spending (30%). Two public institutions, Office d'Assurance Accidents du Travail, Maladie et Maternité (OFATMA) and Office National d'Assurance-Vieillesse (ONA), offer health insurance and social security: OFATMA for formal sector employees, and ONA for the elderly and disabled. Haiti also has 9 private insurance providers. Together, public and private schemes cover 7% of the population, with much lower coverage rates in rural areas (Table).

Despite a 2014 law mandating free contraceptive methods in all public health facilities, the lack of funding means that certain methods are often unavailable.[43] OFATMA covers family planning services, but these services are not always available in the network of affiliated clinics.[44] Overall, over half of family planning services are paid for OOP in the private sector. Poor financial protection for health care contributed to 3%–4% of Haitians facing catastrophic health expenditures in 2013.[45] One promising step forward was the creation of a free health insurance card, "La Carte Rose," in 2012 to facilitate access to high-quality health care, including obstetric and gynecologic services.[46]

While La Carte Rose may be one option for ensuring more comprehensive and reliable reproductive, maternal, newborn, and child health services, including family planning, low rates of insurance coverage and the lack of inclusion of family planning services and commodities in existing insurance schemes remain major challenges for Haiti.

Honduras

Honduras has made substantial recent progress in family planning use, with mCPR having increased from 56% in 2006 to 64% in 2012 (Figure 1).[47] Variations in family planning use are most pronounced between urban and rural areas, with the country's most rural

region, Gracias a Dios, having an mCPR of only 49%.[47]

OOP spending is the primary source of family planning financing—composing approximately three-quarters of total family planning expenditures—and there is an important need to improve financial protection for family planning. Although public facilities provide condoms, implants, oral and injectable contraception, and sterilization services free of charge, stock-outs are a major problem, with 70% of facilities registering a stock-out of at least 1 contraceptive commodity in the past 6 months.[48] Insurance coverage is low, with 19% of Hondurans enrolled in the national SHI scheme, the Instituto Hondureño de Seguridad Social (IHSS), and just 3% covered by PHI.[18,47] Neither private schemes nor IHSS play a major role in family planning provision; IHSS does not formally include family planning planning in its benefits package. As a result, most clients seeking family planning services in the private sector, which provides 43% of the modern methods available, must pay OOP.

As Honduras has transitioned away from donor financing, with formal graduation from USAID support in 2015, there have been continued efforts to link family planning with national priorities and strategies, including the reduction of maternal mortality.[49] Additionally, Honduras has recently adopted a plan to address unmet need for family planning in rural areas, and ongoing efforts toward decentralization may have positive impacts on family planning programs. However, there remains a need for increased family planning financing. Experts also cite a need for improvements in strategic planning for family planning at the national level (personal communication with Julio Zúniga, Country Director, Pasmo Honduras, June 2016).

Jamaica

In Jamaica, the mCPR among women married or in union increased from 62.9% in 1997 to 68.2% in 2008 (Figure 1), while the total fertility rate among this population has fallen.[50] Paradoxically, mCPR is highest (71%) among the poorest quintile of women and lowest (65%) among the second wealthiest quintile.[51]

Most Jamaicans depend on the public sector for subsidized services or pay OOP for health care; for most contraceptive methods, they pay well above the regional average (personal communication, Karin Vrijburg, Researcher, NIDI, and Erik Beekink, Project leader, UNFPA-NIDI Resource Flows Project on Family Planning, NIDI, June, 2016). Poor households primarily access health services in public facilities (63%), while wealthy households favor private providers (76.6%), data that highlight the importance of public health and family planning services to ensuring equity in family planning access.[52] Among women who obtained contraceptives from government sources in 2008, just over half (51.2%) reported that family planning services were available at any time.[52] With the exception of isolated PHI schemes that cover limited numbers of people, health insurance in Jamaica does not include family planning benefits. The country has no formal SHI program. As part of the social security program managed by the Ministry of Labour and Social Security, retired formal-sector workers can access specific benefits covering the cost of visits, services, and prescriptions, alongside co-payment. There is also a program (Jamaica Drugs for the Elderly Programme [JADEP]) that provides free medicines for 10 conditions for those over 60 years of age. The National Health Fund, established in 2003, is a statutory entity that provides a limited benefit subsidizing the cost of pharmaceuticals provided at public and private facilities for 16 chronic diseases. It now covers 19% of the population, and family planning is not a benefit.[53] Ostensibly, primary health care services are provided for free at all government health facilities. Jamaica abolished user fees in public facilities in 2008, and this has increased use of health care, but the effects on family planning access and use are uncertain.[53]

In Honduras, individuals' out-of-pocket spending composes approximately 75% of total family planning expenditures.

Most health insurance in Jamaica does not cover family planning.

Peru

In Peru, total fertility fell from 4.3 in the mid-1980s to 2.5 by 2015.[21] At the same time, mCPR has increased rapidly, from 23% of married women in the early 1980s to 53% by 2015 (Figure 1).[21] However, Peru's mCPR remains substantially below the regional average of 67% in South America.[2] Use of contraception is much lower in the highland and jungle regions than the coastal region of the country, and lower among non-Spanish-speaking, indigenous women (Figure 4).[54]

The Seguro Integral de Salud (SIS) is a government-supported insurance scheme funded by general taxes that provides a basic package of services for those below the poverty line. It was implemented in 2007 and now covers 45% of women of reproductive age. It is autonomous

from Peru's mandatory SHI scheme for formal sector workers and their dependents, EsSalud, which is funded by payroll taxes and covers 26% of women of reproductive age.[21]

SIS beneficiaries can obtain all major contraceptive methods free of charge from any Ministry of Health facility. Sterilization, however, is largely unattainable because of barriers put in place in response to allegations of forced sterilization in the late 1990s. EsSalud members also pay nothing OOP for family planning services, but EsSalud facilities provide a more limited range of methods. Private insurance plans do not consistently cover family planning services, and many EsSalud beneficiaries as well as clients with private insurance are funneled to free government clinics.[54] As a result, these clinics reportedly face oversaturation, underfunding, and stock-outs. This implicit rationing of family planning services contributes to high OOP spending on family planning, which accounts for an estimated 70% of total family planning expenditures in Peru. OOP costs present a substantial barrier to family planning access for the poor, for whom family planning costs may represent a disproportionate burden. Other marginalized groups also face limited access to family planning, either because of geography, ethnicity, or age.[55]

Peru's private health insurance schemes often do not cover family planning, resulting in overcrowding and excess demand in public facilities.

Across countries reviewed, modern contraceptive use was lowest among the most vulnerable and marginalized populations, particularly indigenous, poor, and uninsured women.

Expansion of the family planning method mix provided through EsSalud and more complete coverage of the poor and near-poor by SIS may help to alleviate some of the pressure on public facilities. At the same time, Peru must pursue additional efforts to reach poor, indigenous, and otherwise marginalized women by increasing investment in health services in rural areas, adopting more culturally sensitive family planning practices, and rebuilding public confidence in family planning services.

DISCUSSION

The country-level analysis revealed several major trends across our 4 areas of study.

Family Planning Coverage

The 9 countries in our study demonstrated varying levels of family planning progress. The population-weighted average mCPR in our sample of countries is 60.9%, compared with 66.7% regionally,[2] and it varied from 31.3% in Haiti (the lowest in the region) to 74.7% in Costa Rica (the highest in the group and among the highest in the region). However, over the past 10 years, the gap in mCPR across LAC has narrowed. In 5 of the 9 countries studied, mCPR increased substantially in the last decade, and this was predominantly in those countries with lower initial contraceptive prevalence (Figure 1). On the other hand, in some of the countries with higher initial mCPR, such as Costa Rica and the Dominican Republic, the mCPR has begun to plateau.

We found less variation in unmet need for family planning across the countries observed, with the exception of Haiti, which had an unmet need of 35.3%—more than twice that of the next highest country in our sample (Guatemala, 14.1%). Use of traditional methods was observed to be highest in countries with large indigenous populations, including Peru and Guatemala. In the latter, traditional methods accounted for 20% of the overall method mix in 2014.[36] The percentage of total demand satisfied by modern family planning methods ranged from 45% in Haiti to 89% in Costa Rica.

Modern contraceptive use was lowest among the most vulnerable and marginalized populations, particularly indigenous, poor, and uninsured women. Indigenous populations across the 5 countries with available data had an mCPR that was on average 20% lower than the general population (Figure 4). Generally, countries with the largest indigenous populations reported the greatest inequities. Costa Rica and Colombia, with smaller indigenous populations, have achieved substantial success in the expansion of family planning. However, they still face some challenges in reaching their poor and indigenous populations. To address these inequities, many LAC countries are beginning to take steps to address sociocultural barriers to family planning uptake among indigenous women. Strategies have included using tailored demand creation strategies such as peer promotion, culturally appropriate communication and behavior change strategies, integration of family planning with water and sanitation projects, and cash transfer programs.[56]

The modern contraceptive method mix varied across countries in our sample in ways that may not always be representative of the LAC region (Figure 2). Female sterilization was the most common method within the sample, accounting for on average approximately 34% of family planning users, compared with the LAC average of 49%.[2] Injectable contraception was the second most common method at 20% of users, compared with 3% regionally. In each country, the 2 most popular methods accounted for at least 60% of

use, and in all countries except Colombia, the top 3 methods accounted for at least 75% of use. The method mix in the countries was thus slightly more concentrated than in the LAC region overall, where, on average, the top 2 and 3 methods accounted for 56% and 69%, respectively, of method mix. Notably, the countries with high insurance coverage and benefits that included all major modern contraceptive methods did not necessarily exhibit a more diverse method mix. For example, in Chile the top 2 methods accounted for 89% of the method mix. This may suggest that factors other than cost and availability of methods, such as information or cultural preferences, play an important role in determining method mix.

Family Planning Financing

In recent years, financing for family planning programs has shifted from external to domestic sources, with most LAC countries having graduated from external donor funding.[1,57] In 7 of the study countries—Haiti and Jamaica were excluded due to a lack of data—we estimate that approximately one-third of expenditures on family planning services, on average, came from government sources (Supplement 2), while public facilities accounted for more than half (55%) of the family planning methods provided. This should not be taken to mean that public facilities are more efficient and do more with less. There may be variation in method mix by source. For example, a majority of clients who seek sterilization services do so in public facilities, while condoms are most commonly purchased in private facilities. Public funds primarily finance services in government-operated facilities—either public or belonging to SHI programs. In Chile, Colombia, and the Dominican Republic, where private facilities are included within the SHI network and reimbursement for services is made by SHI schemes, the share of public family planning expenditures may be higher.

Despite the inclusion of family planning services in most countries' benefits packages, through either SHI or public facilities, OOP payments were a substantial portion of national family planning expenditures. In Guatemala, Honduras, and Peru, on average, 70% of family planning expenditures were private. This appears to be out of line with trends in THE. Among our sample of countries, OOP spending averaged less than one-third of THE; in 7 of the 9 countries, OOP spending was less than 35% of THE.[58] (OOP as a share of THE was highest in Peru, at 52%.) Higher costs for family planning commodities and services in private facilities explain why OOP spending remains substantial, despite the fact that public facilities were cited as the primary source of family planning methods in population-level surveys for 8 of the 9 countries (Haiti was the exception). Even in countries where insurance coverage is high, including Chile, Costa Rica, and Colombia, continued high OOP spending suggests that there may be a need to examine insurance benefits in the context of family planning to understand if the included services match the methods demanded.

Health Financing

Financial protection from the cost of health care in the LAC region is typically available through 3 types of health financing modalities: SHI or other government-supported insurance, PHI, and tax-funded public health services, usually provided by the ministry of health. Eight of the 9 countries in our sample (all except Jamaica) have some form of SHI, financed primarily by contributions from formal sector employers and their employees through payroll taxes. In 5 countries—Chile, Colombia, Costa Rica, the Dominican Republic, and Peru—the SHI program includes a subsidized scheme that serves the poor and in some cases the non-poor workers in the informal sector (e.g., Chile's FONASA). In some of these countries with dual-track schemes (e.g., Chile and Colombia), enrollees in the contributory scheme had access to a broader range of health facilities, including the private sector, compared with enrollees in the subsidized scheme. However, in most countries, the packages of services in the SHI scheme have over time been equalized across all covered individuals, and usually include all major family planning methods. The SHI schemes in Guatemala, Haiti, and Honduras remain contributory only (i.e., limited to public and other formal sector employees who pay in). In these countries, less than 20% of the population is covered by an SHI scheme (Table).

8 of the 9 countries in our sample have some form of state-supported health insurance scheme.

Coverage through private insurers was limited within our sample. PHI coverage was less than 10% in 6 of the 9 countries; Chile was the only country to explicitly incorporate PHI schemes into its UHC agenda (with ISAPRES). Due to low total insurance coverage rates in some of our sampled countries, on average, nearly half of the people across the sample relied on public services or OOP payment for health care. Reliance on public health services or OOP spending was

Although most countries' benefits packages included family planning, out-of-pocket spending remained a substantial part of total family planning expenditure.

particularly high in Central America and the Caribbean. Although usually provided free of charge, public health services frequently face insufficient funding and stock-outs of essential medicines and supplies, which result in implicit rationing and poor quality of care.[16,48,59] Many uninsured people, therefore, are forced to pay OOP for health services in private facilities or pharmacies. For the poor—who are also less likely to be enrolled in SHI due to informal employment or unemployment—these costs can cause substantial financial hardship.

Family Planning Inclusion in UHC-Oriented Schemes

Family planning services have been relatively well-integrated into UHC-oriented schemes in LAC countries.

Our study found that family planning services have been relatively well-integrated into UHC-oriented schemes. However, variation exists across both countries and schemes (Figure 3). Eight of the 9 countries in the study provided public family planning services for free, typically in facilities operated by the ministry of health, typically catering to the uninsured. Only in Costa Rica were family planning services in public facilities limited to those enrolled in formal insurance schemes. In theory, the family planning services provided included all or most major contraceptive methods, yet not all facilities were equipped to provide all methods, and stock-outs were a major problem in many facilities and countries, particularly in low- and lower-middle-income countries. As a result, many uninsured clients were forced to pay OOP for family planning commodities in the private sector.

Family planning coverage varied substantially by countries' income level.

Coverage of family planning under government-supported SHI schemes varied substantially by countries' income level. In 5 of the 6 high- and upper-middle-income countries in our sample, the SHI schemes comprehensively covered family planning services (Jamaica was the exception). Generally, co-pays or user fees were not required. Some facilities did experience implicit rationing due to wait times, referrals, and sporadic stock-outs. In the 2 lower-middle-income countries in our sample, SHI schemes generally did not provide sufficient family planning coverage; they either provided a limited range of methods (Guatemala) or required clients to pay for FP fully OOP (Honduras) in scheme-linked facilities.

PHI played a relatively minor role in purchasing of family planning services, with Chile and Colombia being the only 2 countries in our sample where PHI regularly covered family planning. In other countries, sterilization was the only method regularly covered by private schemes.

Across our sample of countries, clients who paid OOP for contraceptive commodities faced costs ranging from $1 to more than $200 per couple-year of protection (personal communication, Karin Vrijburg, Researcher, NIDI, and Erik Beekink, Project leader, UNFPA-NIDI Resource Flows Project on Family Planning, NIDI, June, 2016). Permanent contraceptive procedures (i.e., sterilization) and long-acting reversible contraceptive methods, such as IUDs, tended to have the lowest costs per couple-year of protection but often carried large up-front OOP costs due to the need for facility-based services. In some countries, facility-based services, such as sterilization, had a one-time cost of more than $300, which presents a substantial financial barrier to poor clients. Data on the OOP cost of implants were lacking, which may present a lower-cost alternative to other long-acting methods. However, implants accounted for, on average, 2% of contraceptive method use in our sample of counties, and just 0.2% regionally. High OOP costs overall highlight the importance of financial protection for family planning for the poorest clients as well as the potential value of SHI and other UHC-oriented schemes in improving access and equity in family planning programs.

Enrollment in government-supported insurance schemes (rather than reliance on public health facilities) was associated with improved access to and uptake of modern family planning methods.

Our analysis does not attempt to draw a causal link between coverage status under UHC-oriented schemes and family planning use. We found that enrollment in government-supported insurance schemes (rather than reliance on public provision through ministry of health facilities), and particularly in SHI schemes, was associated with improved access to and uptake of modern family planning methods. In the 4 countries where population-level data were available, insured women, on average, had a mCPR 5.1 percentage points higher than uninsured women. The relationship between insurance coverage and family planning use appeared to be even more pronounced among the most financially vulnerable women (Figure 5).

Among the poorest quintile of women, insured women had a modern contraceptive prevalence rate 16.5 percentage points higher than those that were uninsured.

Among the poorest quintile of women, insured women had an mCPR 16.5 percentage points higher than those that were uninsured. Unsurprisingly, among uninsured women, the average mCPR in the highest income quintile was 10.5 percentage points higher than in the lowest. Paradoxically, among insured women, mCPR was actually higher on average—by 2.7 percentage points—among the poorest women than the wealthiest (Figure 5). In some cases, such as in

the Dominican Republic, this may be due to the failure of PHI plans, which typically cover wealthier beneficiaries, to include family planning in their benefits package.

CONCLUSIONS AND RECOMMENDATIONS

In the sample of high- and upper-middle-income LAC countries we studied, SHI and other government-supported health insurance schemes have been the major conduit for implementation of UHC goals. These schemes have been, by and large, successful in integrating family planning services into their benefits packages. In sampled low- and lower-middle-income countries, where the SHI schemes remain confined to public and formal sector employees, inclusion of family planning services as benefits has been limited and sporadic. Family planning users in low- and lower-middle-income countries remain primarily dependent on public facilities and OOP payment for family planning services. As a result, poor and marginalized clients often continue to face financial hardship when seeking family planning services.

SHI and allied insurance schemes do present a pathway for further improvements in family planning access and use, alongside ensuring sustainable financing of family planning programs in LAC. Particularly in lower-middle-income countries, expansion of SHI beyond the formal sector must also be accompanied by the explicit inclusion of comprehensive family planning services within the benefits package. At the same time, although PHI covers only a small portion of the population in most LAC countries, better family planning coverage (i.e., inclusion in benefits packages and expanded choice of methods) by these schemes can help to diversify choice and provide options for non-poor informal-sector workers who must otherwise seek services in potentially overwhelmed public facilities. Countries will need to take a comprehensive view of UHC—not only as SHI-led but also as encompassing both public provision and private insurance—to achieve sustainable financing of family planning.

Albeit with caveats, the broad success of several LAC countries in simultaneously scaling up both family planning and SHI programs can serve as an example to other countries, both within and outside the region, as they consider including equitable family planning access in their UHC goals. However, SHI and other government-supported schemes are not a panacea for increasing family planning access and ensuring sustainable family planning financing. Our analysis does not infer any causal relationship between increase in health insurance coverage and improved access to family planning or increased use of modern methods. However, this study suggests that for insurance schemes—public and private and other (i.e., provision of services by the ministry of health)—to positively impact family planning uptake and sustainability, deliberate and explicit steps must be taken to ensure family planning is included in these schemes.

Deliberate and explicit steps must be taken to ensure family planning is included in UHC-oriented schemes.

For a relationship between insurance coverage and family planning access to exist, insurance schemes must (1) target poor and informal sector populations, for whom OOP spending on family planning presents a substantial financial barrier; (2) include family planning, either explicitly or implicitly, in the covered package of services; (3) ensure sufficient human resources and commodities to prevent stock-outs and implicit rationing of family planning services (if services and commodities are provided through the public sector), or ensure that reimbursements for family planning services include commodities (if commodities are purchased by providers) and are sufficient to ensure availability of both services and method choice; and (4) reduce nonfinancial barriers to access, including those due to geography, cultural factors, service quality, and range of methods, to ensure that couples can use their insurance to access their preferred contraceptive method. In many countries, scale-up of insurance schemes will coexist with government provision of services, especially to the poor, through public facilities. In those contexts, it will also be critical to ensure that enrollees in formal insurance schemes are not funneled to public facilities, causing crowding out of services for the uninsured.

Better inclusion of family planning in private health insurance schemes can help to diversify method choice and provide options for informal-sector workers.

A limitation of our study, driven by resources, is that we did not look closely at variations in purchasing methods for family planning services (e.g., whether family planning was included under capitation or was purchased fee-for-service) under SHI and other government-supported schemes. Purchasing methods have influence on provider incentives and can affect access to and inclusion of family planning services.

This analysis constitutes a first step in associating family planning with UHC progress, particularly in LAC. Financing-related analyses are only part of the set of studies required

When those covered by insurance are sent to public facilities for family planning methods, overcrowding leads to lack of access for the uninsured.

Unique challenges remain in LAC countries to improve access to family planning.

to situate sustainable family planning programs within the context of UHC, particularly as many countries continue to transition from external to domestic funding sources. While many LAC countries have adopted a view of health as a fundamental right of citizens and have allocated funds to ensure access to services for poor and vulnerable populations, there remain unique challenges that continue to limit access to family planning. Full implementation of a rights-based approach to health will require nuanced strategies for including family planning in SHI and other UHC-oriented schemes. Although countries beyond LAC can learn lessons from the overall success and limitation of family planning-UHC linkages in the region, LAC countries with lagging family planning indicators can also apply these lessons to address gaps in family planning inclusion in their own SHI and UHC-oriented schemes.

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ORIGINAL ARTICLE

Upgrading Supply Chain Management Systems to Improve Availability of Medicines in Tanzania: Evaluation of Performance and Cost Effects

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Investments in a national logistics management unit and electronic logistics management information system resulted in better data use and improvements in some, but not all, management practices. After 1 year, key improvements included reduced stock-out rates, stock-out duration, and expiry rates. Although the upgraded systems were not inexpensive, they contributed to greater system efficiency and generated modest savings that defrayed much of the investment and maintenance costs.

ABSTRACT

Background: To address challenges in public health supply chain performance, Tanzania invested in a national logistics management unit (LMU) and a national electronic logistics management information system (eLMIS). This evaluation examined the impact of those 2 key management upgrades approximately 1 year after they were introduced.

Methods: We used a nonexperimental pre-post study design to compare the previous system with the upgraded management system. We collected baseline data from August to November 2013. We conducted round 1 of post-implementation data collection during April and May 2015, about 1 year after implementation of the upgrades. We evaluated key indicators of data use and reporting; supply chain management practices such as storage and supervision; supply chain performance including stock-out and expiry rates; and supply chain cost and savings. We analyzed the data using a range of techniques including statistical testing of baseline and round-1 results, and cost, cost-effectiveness, and return on investment analysis.

Results: The upgrades were associated with improvements in data use, accessibility, visibility, and transparency; planning, control, and monitoring; support for quantification; stock-out rates; stock-out duration; commodity expiry; and forecast error. The upgraded system was more costly, but it was also more efficient, particularly when adjusting for the performance improvements. The upgrades also generated substantial savings that defrayed some, but not all, of the investment costs.

Conclusion: Upgrades to Tanzania's supply chain management systems created multiple and complex pathways to impact. One year after implementation, the LMU and eLMIS brought about performance improvements through better data use and through improvements in some, but not all, management practices. Furthermore, the upgrades—while not inexpensive—contributed to greater system efficiency and modest savings.

INTRODUCTION

Universal health coverage includes access to safe, effective, high-quality, and affordable essential medicines and vaccines for all.[1] In Tanzania, the steadily improving performance of the public health supply chain has contributed to a dramatic reduction in mortality from HIV, malaria, and tuberculosis[2] for vaccine-preventable deaths,[3,4] and expanded access to contraception.[5] Nonetheless, in recent decades, the complexity of the public health supply chain, and the volumes and varieties of health care products, have greatly increased. This has resulted in a fragmented system that has been difficult to coordinate and has hampered product availability.[6]

In 2014, to address these challenges, Tanzania made a major investment to upgrade its management systems for the public health supply chain. The government established a national logistics management unit (LMU)

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Tanzania invested in 2 supply chain system upgrades—a national logistics management unit and an electronic logistics management information system.

to oversee all key public health commodities by organizing, monitoring, and supporting all supply chain activities within all the logistics systems in the country. The LMU centralizes and harmonizes the management of disparate program supply chains, promotes greater efficiency in supply chain management, and ensures better customer service.[7] Tanzania also introduced a national web-based electronic logistics management information system (eLMIS) to support the aggregating, reporting, and visualizing of data collected from the paper-based system. Several other countries have converted from a paper-based to an electronic system.[8] This article describes the results from an evaluation of these key management upgrades approximately 1 year after introduction.

In Tanzania, the Ministry of Health, Community Development, Gender, Elderly and Children (MOHCDGEC) has overall responsibility for the public health supply chain that serves more than two-thirds of Tanzania's 49 million people.[9] This supply chain includes the quasi-autonomous Medical Stores Department (MSD), which has its headquarters in the capital of Dar es Salaam and operates 9 zonal stores. It also includes MOHCDGEC-operated facilities, consisting of 20 regional vaccine stores, 137 district stores, and 5,500 service delivery points (SDPs)—hospitals, health centers, and health posts—where clients get their medicines and vaccines. The value of medicines and other commodities moving through the public health supply chain each year is around 300 billion Tanzanian shillings (TSh) (about US$200 million at 2013 exchange rates).

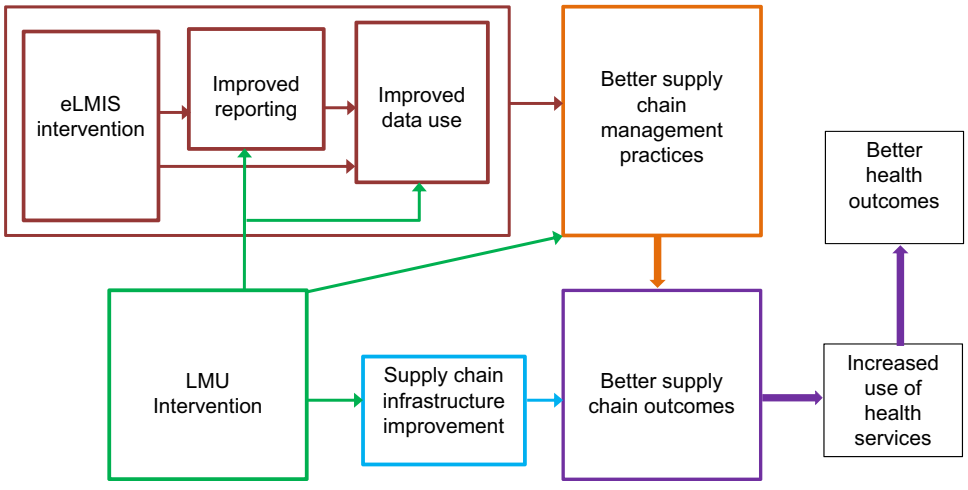
We hypothesized that the MOHCDGEC implementation of the upgraded management systems would affect performance and, ultimately, health outcomes, in several ways (Figure 1). The LMU would contribute to improvements in reporting and data management; management practices through consolidation of oversight; supply chain infrastructure; and supply chain outcomes. The eLMIS would enhance management through improved reporting and data use.

METHODS

Study Design

We used a nonexperimental pre-post study design to compare the previous system with the upgraded management system. We could not use an experimental design because the eLMIS was not piloted before the introduction. Baseline data collection took place from August to November 2013. A post-implementation round 1 of data collection took place in April and May 2015, approximately 1 year after implementation.

FIGURE 1. Conceptual Framework for the Management Upgrade Interventions



Abbreviations: eLMIS, electronic logistics management information system; LMU, Logistics Management Unit.

We analyzed supply chains for 2 commodity groups that account for most of the throughput in Tanzania: (1) antiretroviral drugs and HIV tests, and (2) reproductive health, malaria, and essential medicines that form the integrated logistics system (ILS). We also examined a subset of 38 commodities for many of the management and supply chain performance indicators (Supplement 1).

Data Collection and Measures

Survey Instruments

We used 3 types of survey instruments to collect data: distribution and dispensing of commodities survey, performance and cost survey, and data use and management practice survey (Table 1).

The distribution and dispensing of commodities survey collected data from a nationally representative sample of 220 health facilities at baseline in August and October 2013, and in April 2015 for the round 1 analysis. To develop this survey, we repurposed End-Use Verification (EUV) surveys, which monitor stock availability and dispensation of ILS commodities on a quarterly basis across a nationally representative sample of health facilities. We added questions on additional performance indicators and cost and expanded the focus to HIV commodities.

We administered the performance and cost survey in October 2013 and April 2015 at 17 district offices, 9 MSD zonal stores, and MSD headquarters. This survey collected information related to data reporting, data use, supply chain management practices, and supply chain outcomes.

The third survey was on data use and management practices, which we administered to central-level supply chain stakeholders, including the MOHCDGEC, development partners, and implementing technical assistance partners. At baseline in October and November 2013, we conducted 14 such surveys at the central level, including 3 for the HIV program, 5 for malaria, 3 for essential medicines, and 3 for family planning and maternal and child health (MCH). During round 1 in May 2015, we conducted 16 surveys at the central level, including 4 for the HIV program, 5 for malaria, 3 for essential medicines, and 4 for family planning and MCH.

We also gathered national-level data from in-person interviews with individual supply chain stakeholders, including government staff, development partners, and technical assistance agencies staff who are considered to be some of the primary users of data, and a review of performance and financial databases.

We used surveys to collect data on supply and distribution, performance and cost, and data use and management practices.

Additional Data Sources for Supply Chain Outcomes

In addition to the surveys, we collected data from MSD's enterprise resource planning system (Epicor 9) and reports on forecast and actual consumption to measure the impact of the upgrades on key supply chain outcomes including stockouts, inventory levels, commodity expiries, and consumption forecasts.

Total Supply Chain Cost Model

To evaluate the impact on costs, we built a total supply chain cost model for multiple tiers and key supply chain functions. In addition to cost surveys at the district and SDP levels, we relied on financial records for MSD central and zonal costs. We obtained the salary, equipment, vehicle, and other price data from MOHCDGEC and other financial records. We determined the commodity throughput value, defined as the average of receipts and issues, using Epicor 9; to estimate any missing

TABLE 1. Survey Instruments

Survey	Sample	Timing
Distribution and dispensing of commodities	Nationally representative sample of 220 SDPs	Baseline: August, October 2013 Round 1: April 2015
Performance and cost	17 district offices 9 MSD zonal stores MSD headquarters	Baseline: October 2013 Round 1: April 2015
Data use and management practice	16 central-level supply chain stakeholders	Baseline: October–November 2013 Round 1: May 2015

Abbreviations: MSD, Medical Stores Department; SDPs, service delivery points.

price data, we used various program quantification reports or publicly available international price databases. We valued inputs in the local currency, TSh, or in US dollars, as appropriate.

Investment Costs and Savings

We conducted a cost-benefit analysis to measure savings associated with process improvements. Investment cost data came primarily from implementing partners' financial reports. To measure savings, we used data related to lower purchase prices for products and lower expiry.

Data Analysis

Survey Measurements

We analyzed the impact of the LMU and eLMIS management upgrades on reporting by combining indicators of timeliness, quality, and reporting rates into a composite index by product group, scaled from 0 to 100. We averaged the scores across facilities in the same tier and combined them into a single reporting score. Data on the reporting indicators came from the logistics data management and inventory control surveys, an EUV facility survey, and existing databases. For round 1, the eLMIS provided additional data on reporting.

To measure the impact on data use, we constructed a composite index for each dimension—transparency, timeliness, visibility, and accessibility—on a scale from 0 to 100. We calculated these scores based on interviews with the supply chain stakeholders.

We also measured 7 areas of management practice: quantification, storage, transportation, inventory management, logistics data management, monitoring and control, and design and planning. Data for the management practice indicators came from specially designed surveys applied at baseline and round 1 and modeled on the Logistics System Assessment Tool.[10] We constructed management practice composite indices on a 0 to 100 scale; calculated scores for each facility; then averaged scores across facilities by level, program, and the entire supply chain. We combined the 7 management practice indicators into a single "super-index" for management practice, using weights from a study on health care supply chain personnel.

We evaluated the impact of the upgrades on key supply chain outcomes by measuring the percentage of SDPs stocked out of commodities at the time of the survey; percentage of SDPs stocked out for more than 7 days; and percentage of SDPs with inventory levels below minimum, between minimum and maximum levels, or over maximum.

Supply Chain Outcomes

Combining data from the EUV surveys and MSD's enterprise resource planning system, Epicor 9, we measured the average level of commodity expiries as a percentage of annual throughput (Supplement 2). Using reports on forecast and actual consumption, we measured the accuracy of consumption forecasts, defined as the deviation of the forecast from actual consumption, as a percentage of actual consumption.

Total Supply Chain Cost Model

Following the standard USAID | DELIVER PROJECT approach,[11] we built a total supply chain cost model by measuring costs at each tier—central, zonal, district, and SDP—and for each of the 4 key supply chain functions—procurement, storage, transport, and management. We reported results in both TSh and US dollars, at an exchange rate of TSh 1,570 per US dollar. We reported all costs in constant 2013 prices. We valued inputs at their market or economic cost. We extrapolated from survey information to estimate a total national supply chain cost. Combining costs with throughput, we also calculated a cost per unit of throughput value. We conducted a cost-effectiveness analysis that focused on average cost-effectiveness adjusted for supply chain performance. The study compared costs and cost-effectiveness for 2013 with costs and cost-effectiveness for the 1-year period from April 2014 to March 2015.

Sensitivity Analysis

Because of limitations in the survey approach, or missing or incomplete data, there was substantial uncertainty around throughput, cost, and performance values. We used a Monte Carlo approach in a sensitivity analysis to help determine the extent to which changes in these values might substantially alter the findings (Supplement 3).

Cost-Benefit Analysis

To conduct the cost-benefit analysis, we compared investment costs with savings associated with process improvements. Investment costs were the total value of resources applied toward development and implementation of both the LMU and eLMIS, including one-time upfront costs and ongoing operations costs. We measured savings associated with lower purchase prices for

products, lower expiry, and absorption of existing staff, supervision, and training costs. Although designers of the upgrades believed that the eLMIS and LMU would generate savings related to price reduction from fewer emergency orders and lower inventory holding costs, we did not have data to measure these savings.

We used the data related to inventory value, product price, and product expiry quantities to measure and document baseline values and to calculate ratios for each area of expected savings. We measured return on investment by comparing cumulative savings with investment (or cost) over a defined time horizon. To estimate expected net benefit and return on investment, we applied savings rates at 1 year after the upgrades were implemented to the baseline values to calculate expected cost savings from process improvements. For savings beyond the first year after the interventions were implemented, we used estimated values to simulate cost savings.

Changes to the Distribution System

It is worth noting that some changes to the supply chain distribution structure occurred separately but simultaneously with the rollout of the LMU and eLMIS. It was not possible to completely disentangle the effects of these broader structural changes on supply chain performance in our analysis. Specifically, the HIV supply chain employed supply chain management assistants before implementing the management upgrades. These assistants provided SDP support for HIV logistics data reporting—support that the ILS did not have. The management upgrades expanded the assistants' management approach across the various program supply chains. In addition, during the baseline year, the supply chain completed a shift from a 4-tier (MSD central, MSD zone, district, SDP) to a 3-tier (MSD central, MSD zone, SDP) distribution approach, with direct delivery between the last 2 tiers. We address this issue further in the discussion on limitations.

Ethics

All data collection and analysis were conducted according to international principles of maintaining privacy and confidentiality of personal information.

RESULTS

After investing in the LMU and eLMIS, results showed some improvements to Tanzania's overall supply chain performance after approximately 1 year of implementation; however, the full impact of these interventions remains to be seen. Our findings show that data use improved overall, and some management practices improved. Key supply chain outcomes improved, especially reduction of stock-out rates, stock-out duration, and expiry rates at health facilities. The upgrades also contributed to modest savings and greater system efficiency.

The evaluation showed overall improvements in data use, management practices, key outcomes, cost savings, and greater system efficiency.

Reporting

Statistical comparison showed no difference in scores for reporting on HIV commodities between the baseline and round 1. For example, at the SDP level, reporting on HIV commodities at baseline was 76 and at round 1, 80; at the district level, the scores were 83 and 70, respectively; and at the zonal store level, 75 at both time points.

For ILS commodities at the SDP and district levels, results showed significantly worse reporting scores—dropping from 79 to 67 at the SDP level and from 90 to 67 at the district level. Conversations with Tanzania field operatives suggested that the reduction in reporting performance was temporary, resulting from the interruption in routines, responsibilities, and relationships accompanying the management upgrades at the SDP and district level. Expectations were that the reporting would return to pre-upgrade levels and would eventually improve. For zonal stores, the reporting scores (71) were similar between baseline and round 1, as with HIV commodities.

Data Use

Overall scores on the 4 dimensions of data use—transparency, timeliness, visibility, and accessibility—increased for all 4 major commodity groups from baseline to round 1: HIV (from 64 to 79); ILS malaria (from 73 to 83); ILS essential medicines (from 60 to 77); and ILS family planning and MCH(from 49 to 83). Large increases in the data visibility score (that is, whether the data are appropriate for the decision-making needs of the stakeholder) drove the overall increase in data use scores (Table 2).

Management Practices

SDP Level

Scores across SDP management practice areas were similar at baseline and round 1, except the score for storage for HIV commodities, which decreased in round 1 (P=.047) (Table 3). At baseline, the general management score incorporated

TABLE 2. Data Use Scores, Baseline Versus Round 1, by Product Group

Product Group and Time Period	Data Use Dimension				
	Accessibility	Visibility	Timeliness	Transparency	Average
HIV					
Baseline	71	21	62	100	**64**
Round 1	81	81	63	92	**79**
ILS Malaria					
Baseline	76	74	72	71	**73**
Round 1	82	88	71	92	**83**
ILS Essential Medicines					
Baseline	65	34	71	71	**60**
Round 1	61	100	56	92	**77**
ILS Family Planning and MCH					
Baseline	53	51	56	36	**49**
Round 1	86	86	70	92	**83**
Average					
Baseline	66	45	65	70	**62**
Round 1	77	89	65	92	**81**

Abbreviations: ILS, integrated logistics system; MCH, maternal and child health.

the degree to which facility workers received training and the amount of time spent during supervisory visits. HIV commodities showed a particularly high score of 92 in this area, arguably due to the activities of the supply chain management assistants. The management scores for ILS commodities did not improve, although the assistants' activities were expected to expand to include ILS commodities.

District Level

For district-level logistics data management, which focused on management of activities that support collection and dissemination of logistics data, the scores were similar at baseline and round 1 (Table 3). General management scores—which covered whether facility workers received training, whether performance metrics existed and were shared, and whether performance evaluation meetings took place—were also similar, except for HIV commodities, which improved from baseline to round 1 (P=.01).

Medical Stores Department Zonal and Central Levels

For both HIV and ILS commodities, zonal-level transportation scores improved from the baseline to round 1 across multiple component areas, including use of transport vehicles and adherence to schedules (Table 3). (Use of paired t test and a higher significance-level threshold are justified here because almost all the population of the zonal stores was used and some measurement error was assumed.) However, for both HIV and ILS commodities, logistics data management scores deteriorated from the baseline to round 1, as a result of lower performance related to the collection of issues data from districts and SDPs, and sharing of data from the zones with the MSD Central and MOHCDGEC. Storage scores for ILS commodities decreased from baseline to round 1, which was driven by lower performance across multiple component areas. Scores for additional program management practices—including quantification; design and planning; and monitoring and control—showed a greater than 10-point

TABLE 3. Scores on Management Practice Indicators, Baseline Versus Round 1, by Level and Product Group

Level and Product Group	Management Practice Area											
	Storage		Inventory Management		Transportation		Logistics Data Management		Other Management[a]		Super Index Score	
	Baseline	Round 1	Baseline	Round 1	Baseline	Round 1	Baseline	Round 1	Baseline	Round 1	Baseline	Round 1
SDP level												
HIV	80	75**	62	63	—	—	71	72	92	93	77	78
ILS	67	66	68	68	—	—	65	63	67	67	62	67
District level[b]												
HIV	75	—	77	—	54	—	46	45	51	75**	63	69
ILS	73	—	77	—	53	—	63	52	67	74	63	66
Zonal level												
HIV	91	89	82	81	62	75*	81	51***	61	67	75	74
ILS	98	83*	84	81	63	74*	69	52	40	50	65	68

* $P<.10$; ** $P<.05$; *** $P<.01$.

Abbreviations: ILS, integrated logistics system; SDP, service delivery point.

[a] Other management practices comprise design and planning as well as monitoring and control.

[b] Because of the shift to direct delivery from zonal stores to SDPs at round 1, round-1 storage, inventory management, and transportation scores were absent.

improvement in scores between the baseline and round 1 for 6 of the 10 comparisons.

Super Index Management Scores

Combining scores across management domains showed a small improvement from baseline to round 1: for HIV products, scores increased, on average, from 71 to 73; for ILS, from 63 to 67; and for HIV and ILS combined, from 67 to 70. The improvement happened at all tiers of the supply chains and for all commodity groups, except HIV commodities at the zonal stores, which showed a small decrease.

Supply Chain Outcomes

Inventory Availability

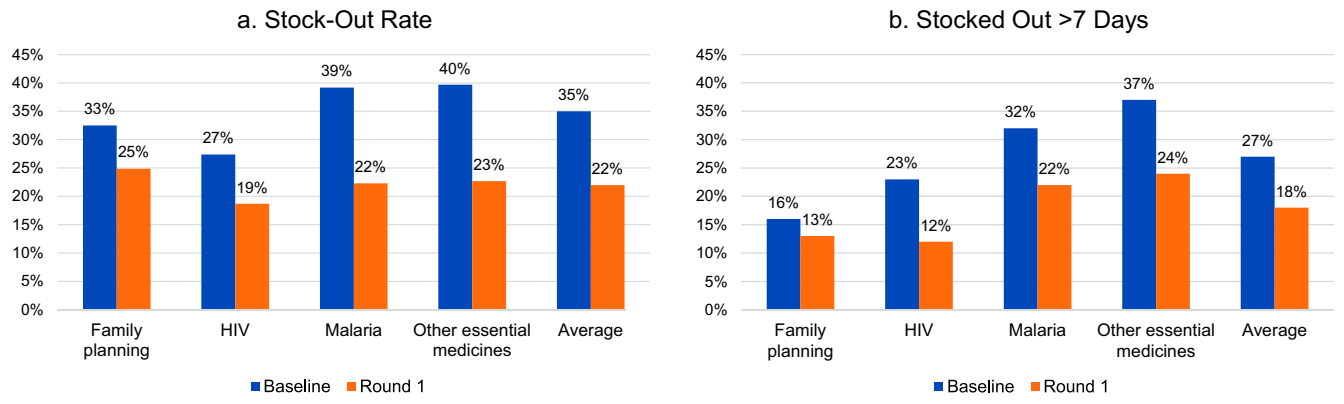
Stock-out rates decreased for all 4 product groups by 13 percentage points, on average, from 35% to 22% (Figure 2). Using logistic regression, controlling for delivery groups for ILS facilities, ILS subcommodities, and zone, the odds of stocking out fell by 49% from baseline to round 1 ($P<.001$). Using ordinary least square regression with the same controls, the odds of having stock-outs fell by 13.1 percentage points from baseline to round 1. The duration of stock-outs, measured by the percentage of facilities reporting stock-outs of greater than 7 days, also decreased substantially for all 4 product groups, by about 10 percentage points between baseline and round 1. On average, the percentage of facilities with stock-outs greater than 7 days dropped from 27% to 18% (Figure 2). Using logistic regression, controlling for delivery groups for ILS facilities, ILS subcommodities, and zones, the odds of stocking out for greater than 7 days fell by 44%, from baseline to round 1 ($P<.001$). Using ordinary least square regression with the same controls, the odds of having stock-outs for greater than 7 days fell by 10 percentage points from baseline to round 1. (Logistic regression is the more appropriate model for regression with percentages as dependent variables. However, ordinary least square regression was used to provide more accessible interpretation of the impact of introducing the upgraded system.)

Stock-out rates and duration of stock-outs decreased significantly for all 4 product groups.

Inventory Levels

The upgraded system maintained levels of appropriate inventory very similar to what we saw before the upgrade (20% versus 18%). Similarly, levels of high inventory were 28% at

FIGURE 2. Stock-out Rates and Stock-Out Duration Greater Than 7 Days, Baseline Versus Round 1, by Product Group



round 1 versus 25% at baseline. This suggests that improvement in stock-out performance was not because the facilities were holding higher levels of stock.

Forecasting accuracy improved overall, especially for family planning commodities.

Forecasting Accuracy

The evaluation revealed a statistically significant decrease between baseline and round 1 in forecast error for family planning commodities, 177% versus 23%. The forecast error for HIV commodities was 33% versus 27%. Forecast error for malaria commodities increased between baseline and round 1, from 12% to 28%. For all commodities combined, we found a statistically significant decrease in forecast error, from 135% to 24% ($P<.001$).

Expiries

Expiry rates at the central and zonal levels did not change noticeably overall (2.39% to 2.45%) (Table 4). SDP expiry rates fell significantly by 0.6 percentage points ($P<.001$), with a lower bound of 0.15 percentage points (data not shown).

TABLE 4. Average Central and Zonal Expiry Rates as Percentage of Throughput, Baseline Versus Round 1

	Expiry Rate (%)	
Product Group	**Baseline**	**Round 1**
HIV	1.17	0.12
Essential medicines	3.36	3.58
Family planning and MCH	2.45	1.46
Malaria	2.66	3.41
ILS	3.10	3.44
Average	**2.39**	**2.45**

Abbreviations: ILS, integrated logistics system; MCH, maternal, newborn, and child health.

Annual Cost

Total Cost

The annual national cost of public health supply chain operations was TSh 62 billion (US$40 million) at baseline; it increased by about 7% to TSh 67 billion (US$43 million) at round 1 (Table 5). Approximately US$1.7 million of the cost increase was the cost of the upgrades; the rest of the increase was probably the result of the higher throughput handled by the system. Annual commodity throughput, adjusted for price changes, increased by 23% from TSh 242 billion (US$154 million) at baseline to TSh 298 billion (US$190 million) at round 1.

Cost Breakdowns

Of the 4 main supply chain functions, storage had the highest cost, followed by management, transport, and procurement (Table 5). MSD headquarters and zonal stores were the largest contributors to cost, 32% and 27%, respectively, at baseline,

TABLE 5. Supply Chain Costs by Main Supply Chain Function, Baseline Versus Round 1

	TSh in billions (US$ in millions)	
Supply Chain Function	**Baseline**	**Round 1**
Procurement	0.4 (0.3)	0.3 (0.2)
Storage	29.7 (18.9)	31.7 (20.2)
Transport	12.0 (7.6)	11.1 (7.0)
Management	20.2 (12.9)	23.8 (15.1)
Total	**62.3 (39.7)**	**66.9 (42.6)**

TABLE 6. Comparison in Number of Facilities Served, by Supply Chain Tier, Baseline Versus Round 1

Supply Chain Tier	Baseline	Round 1	% Increase
District	125	164	31%
Dispensary	3,851	4,630	20%
Health center	449	493	10%
District hospital	154	191	24%
Regional hospital	16	21	31%
Referral hospital	4	4	0%

and a slightly lower 31% and 25%, respectively, during round 1 (data not shown). District offices were the next-largest tier by cost, accounting for 21% at baseline and 24% during round 1. SDPs followed, making up 17% of the total at baseline and 14% during round 1. The increase in total annual costs between baseline and round 1 came mainly from increases of approximately TSh 3 billion in district-office and development-partner costs.

Average cost per facility in the sample decreased between the baseline and round 1, almost entirely due to a reduction in the cost of managing logistics records (data not shown). Thus, the increase in total annual costs at the national level came primarily from the increase in the number of districts and SDPs served by the supply chain (Table 6).

Cost-Effectiveness

Before adjusting for performance improvements, cost as a percentage of throughput value at round 1 was lower than at baseline: 22.5% versus 25.7% (Table 7). When adjusting for the observed performance improvement, the gap was even larger: 28.5% at round 1 versus 37.9% at baseline.

Sensitivity Analysis

The sensitivity analysis found overlap in the baseline and round 1 95% confidence intervals for total cost and cost per product value (unadjusted) (Table 8). For total value and cost-per-product value (performance-adjusted), no overlap was seen in the confidence intervals.

Cost-Benefit Analysis

Investment Costs

The total start-up investment cost of the LMU and eLMIS through July 2014 was US$2.4 million (Table 9). The ongoing operational cost totaled US$2.9 million in year 1, which is projected to rise slightly in subsequent years. Early-stage investments of about US$1.2 million benefiting any country were not included in the upfront costs for Tanzania.

Operational Savings and Return on Investment

Reduced drug purchase prices; lower expiry rates; and absorption of existing staff, supervision, and training costs generated a savings of US$2.5 million in the first year, after upgrades. Savings are projected to increase to US$3.1 million by year 5 (Table 10). The simple return on investment ratio was negative. However, it is projected to trend positive over time (Table 10).

Sensitivity Analyses

Projected savings do not assume potential increases in savings rates based on continuous improvement, nor do they include areas of potential savings if data were not available during the study. Sensitivity analyses that used the high range for the expected savings, and assumed a small increase in savings rates based on continuous improvement, produced a positive return on investment by year 5 (data not shown).

Average cost per facility decreased between the survey rounds, almost entirely due to a reduction in the cost of managing logistics records.

Operational savings of US$2.5 million were seen in the first year.

DISCUSSION

This study examined the effects of introducing supply chain upgrades—the LMU and eLMIS—to the public health supply chain of Tanzania. The

TABLE 7. Cost-Effectiveness Comparison Measures

Measure	Baseline	Round 1
Supply chain cost (TSh)	62.3 billion	66.9 billion
Value of throughput (TSh)	242 billion	298 billion
% point product availability	68	78
Supply chain cost as % of value of throughput	25.7%	22.5%
Supply chain cost per performance-adjusted throughput value	37.9%	28.5%

TABLE 8. Results of Sensitivity Analysis Using Monte Carlo Simulation for Cost, Throughput, and Cost-Effectiveness Measures

	Baseline		Round 1	
Cost, Throughput, and Cost-Effectiveness Measures	Mean (SD)	95% CI	Mean (SD)	95% CI
Total cost (Tsh billion)	62.6 (2.2)	58.3, 67.0	69.0 (3.1)	62.9, 75.1
Total throughput value[a] (TSh billion)	242.4 (5.6)	231.4, 253.3	297.7 (7.3)	283.4, 311.9
Cost as a percentage of product value, unadjusted	25.9% (1.1%)	23.7%, 28.0%	23.2% (1.2%)	20.9%, 25.5%
Cost as a percentage of product value, performance-adjusted[a]	38.2% (1.8%)	34.6%, 41.7%	29.4% (1.6%)	26.3%, 32.4%

Abbreviations: CI, confidence interval; SD, standard deviation.
[a] Parameter for which there was no overlap in the 95% confidence interval for the baseline and round 1 measures.

upgrades were associated with a positive impact on key supply chain outcomes, especially stock-out rates and stock-out duration. Encouragingly, the decrease in stock-outs did not appear to happen because of increased overstocking. The upgrades were also associated with a large relative decrease in expiry rates.

Results from the analysis of data-use and management practices gave additional evidence of a causal link. Improvements in data use, accessibility, visibility, and transparency, as well as improvements in planning, control, and monitoring and support for quantification, may have resulted directly from the LMU's efforts to consolidate oversight and improve management efficiency. Management practices beyond the organizational boundaries of the LMU and supply chain infrastructure changed little, perhaps because the lead time for such downstream improvements is longer than the 1-year duration of this study.

Substantial savings from the upgrades defrayed some of the investment costs.

The explanation for the positive results was multilayered, as expected by the designers of the upgrades. One year after their implementation, the upgrades appear to have affected supply chain performance primarily through better data use and through improvements in some, but not all, management practices. Through its increase in zonal personnel and an expansion of its mandate to include commodity groups beyond HIV, the LMU also may have had a direct influence on supply chain outcomes at the district and facility levels.

The upgraded system was more costly but also more efficient, particularly when adjusting for the performance improvements. The upgrades also generated substantial savings that defrayed some, but not all, of the investment

TABLE 9. Upfront Investment and Ongoing Operating Costs of the eLMIS and LMU (US$)

	Actual		Projected			
Category	**Start-up**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Total eLMIS and LMU	**2,358,278**	**2,867,981**	**3,041,408**	**2,958,068**	**2,862,776**	**2,922,023**
Total eLMIS	**1,768,395**	**698,110**	**772,552**	**633,727**	**481,102**	**481,102**
Development and rollout	1,768,395					
Operations		698,110	772,552	633,727	481,102	481,102
Total LMU	**589,883**	**2,169,871**	**2,268,856**	**2,324,341**	**2,381,674**	**2,440,921**
Design	124,693	—	—	—	—	—
Project implementation and technical assistance	208,279	—	30,000	30,000	30,000	30,000
Existing staffing, supervision, training[a]	—	1,206,032	1,237,960	1,270,847	1,304,720	1,339,609
Incremental staffing	—	533,758	549,771	566,264	583,252	600,749
Incremental supervision and training	114,215	264,322	264,027	264,027	264,027	264,027
Vehicles, transport, equipment, etc.	—	91,687	101,760	107,866	114,338	121,198
Office space, equipment, supplies, utilities for LMU	142,696	74,072	85,338	85,338	85,338	85,338

Abbreviations: eLMIS, electronic logistics management information system; LMU, logistics management unit.
[a] Personnel and supervision/training activities that were included in the organization's budget before the management upgrades were implemented.

costs. Placed next to the improvements in supply chain performance, these savings were a substantial "bonus."

Notably, observed improvements happened during a challenging period: MSD debt levels increased at this time, which further hampered the organization's operations. Major shifts in procurement modalities and global availability affected stock levels of some antiretrovirals and antimalarials.

Limitations

The study results have some important methodological limitations. First, the national rollout of the LMU and eLMIS precluded randomization. Some changes to the supply chain distribution structure occurred shortly before or during implementation of the management upgrades. We tried to mitigate this limitation by considering factors other than the introduction of the eLMIS and LMU that might have influenced supply chain performance and cost. Although it is impossible to completely disentangle the impact of all of these factors, our comprehensive measurement of performance across different functions of the supply chain provided us with sufficient insight to trace the mechanisms that connect these factors to improving supply chain outcomes.

Second, although we based composite reporting, data-use, and management practice indicators on previously well-established methods, it was a subjective exercise that introduced possibilities for error or bias. Furthermore, to the extent that our estimate of national supply chain cost relied on survey data, true national costs may differ from our estimates. Despite training, simplification of data collection forms, and quality control, the survey methodology introduced possibilities for errors that may affect the robustness of the cost results. The sensitivity analyses, in part, addressed these limitations.

Finally, the evaluation examined young and still-maturing interventions. Thus, it is entirely reasonable to expect that the full impact of these investments will only be seen in 2, 3, or even 5 years after their initial rollout.

TABLE 10. Estimated Cost Savings and Return on Investment After Implementation of the Upgraded Management System (US$)

	Year 1	Year 2	Year 3	Year 4	Year 5
Improved pricing for products purchased					
Annual government drug purchases	47,714,539	61,782,129	70,716,350	79,651,204	88,586,058
Average drop in drug costs from better management practices	668,004	864,950	990,029	1,115,117	1,240,205
Reduced product waste from expiry					
Current annual drug throughput subject to expiry	166,707,098	123,202,782	134,928,853	145,538,815	155,590,406
Change in expiry rate after better management practices	625,152	462,010	505,983	545,771	583,464
Summary cost savings					
Estimated cost savings due to better management	1,293,155	1,326,960	1,496,012	1,660,887	1,823,669
Absorbed existing staff, supervision, and training	1,206,032	1,237,960	1,270,847	1,304,720	1,339,609
Total estimated cost savings	2,499,187	2,564,921	2,766,859	2,965,607	3,163,278
Total costs	2,867,981	3,041,408	2,958,068	2,862,776	2,922,023
Total estimated net savings (savings minus costs)	(368,794)	(476,487)	(191,209)	102,831	241,255
Estimated cumulative savings	(2,727,072)[a]	(3,203,559)	(3,394,768)	(3,291,937)	(3,050,682)
Simple return on investment	−52%	−39%	−30%	−23%	−18%

[a] Includes US$2,358,278 in start-up costs.

CONCLUSIONS

The results confirmed the designers' expectations that management upgrades would create multiple and complex pathways to impact. One year after implementation of upgrades to key supply chain systems, the LMU and eLMIS appeared to have worked primarily through better data use and through improvements in some, but not all, management practices. Furthermore, the upgrades—while not inexpensive—contributed to greater system efficiency and modest savings.

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ORIGINAL ARTICLE

Large-Scale Evaluation of Quality of Care in 6 Countries of Eastern Europe and Central Asia Using Clinical Performance and Value Vignettes

John W Peabody,[a,b,c] Lisa DeMaria,[a] Owen Smith,[d] Angela Hoth,[a] Edmond Dragoti,[e,f] Jeff Luck[g]

When providers in 6 different countries were asked how they would care for the same patient, there was wide variation within and between countries. Nevertheless, 11% of the physicians scored over 80%, suggesting good quality of care is possible even with resource constraints. Use of validated clinical vignettes, which can be applied affordably at scale, could help improve quality of services in low- and middle-income countries.

ABSTRACT

Background: A significant determinant of population health outcomes is the quality of care provided for noncommunicable diseases, obstetric, and pediatric care. We present results on clinical practice quality in these areas as measured among nearly 4,000 providers working at more than 1,000 facilities in 6 Eastern European and Central Asian countries.

Methods: This study was conducted between March 2011 and April 2013 in Albania, Armenia, Georgia, Kazakhstan, Kirov Province in Russia, and Tajikistan. Using a probability proportional-to-size sampling technique, based on number of hospital beds, we randomly selected within each country 42 hospitals and their associated primary health care clinics. Physicians and midwives within each clinical area of interest were randomly selected from each hospital and clinic and asked how they would care for simulated patients using Clinical Performance and Value (CPV) vignettes. Facility administrators were also asked to complete a facility survey to collect structural measures of quality. CPV vignettes were scored on a scale of 0% to 100% for each provider. We used descriptive statistics and *t* tests to identify significant differences in CPV scores between hospitals and clinics and rural vs. urban facilities, and ANOVA to identify significant differences in CPV scores across countries.

Results: We found that quality of care, as concurrently measured by performance on CPV vignettes, was generally poor and widely variable within and between countries. Providers in Kirov Province, Russia, had the highest overall performance, with an average score of 70.8%, while providers in Albania and Tajikistan had the lowest average score, each at 50.8%. The CPV vignettes with the lowest scores were for multiple noncommunicable disease risk factors and birth asphyxia. A considerable proportion (11%) of providers performed well on the CPV vignettes, regardless of country, facility, or structural resources available to them.

Conclusions: Countries of Eastern Europe and Central Asia are challenged by poor performance as measured by clinical care vignettes, but there is potential for provision of high-quality care by a sizable proportion of providers. Large-scale assessments of quality of care have been hampered by the lack of effective measurement tools that provide generalizable and reliable results across diverse economic, cultural, and social settings. The feasibility of quality measurement using CPV vignettes in these 6 countries and the ability to combine results with individual feedback could significantly enhance strategies to improve quality of care, and ultimately population health.

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INTRODUCTION

Eastern Europe and Central Asia (ECA), which encompasses 30 countries, is diverse both culturally and linguistically, with little but geography tying them together.[1] Following the breakup of the Soviet Union,

ECA health systems faced severe challenges. Scarce resources, weak governance structures, and a lack of accountability inherited from the past have plagued efforts to improve access, quality, and efficiency. Social and economic upheavals associated with transition have compounded the challenges.[2] Since 2000, substantial investments to improve health care access in the region have focused on rebuilding and restoring health facilities.[1,3,4] Despite investments, poor quality of care has been entrenched, frustrating obvious opportunity to rapidly improve the health status of the ECA population.[2,4]

A significant determinant of population health outcomes is the quality of care provided specifically for noncommunicable, obstetric, and pediatric services.[5–8] Access to and use of high-quality primary care prevents and reduces development of noncommunicable diseases and associated complications following an acute illness.[9] Similarly, high-quality intrapartum and perinatal care decreases incidence of postpartum bleeding and puerperal and neonatal sepsis.[10–12] Improving quality—and, in turn, health outcomes—yields at least 2 important economic benefits. First, better health among the working population improves productivity and reduces dependency burden on families.[13] Second, reduced government and private spending for avoidable acute care, as well as for disability arising from avoidable disease, frees resources that can be allocated for education and other productive investment.[14,15]

Available evidence indicates that worldwide quality of clinical care services—what providers do when they see a patient—is often poor as measured against evidence-based standards and varies widely between and within countries, as well as between and within clinics and hospitals.[13,16,17] Adequately trained and motivated clinical providers, even if they have only basic equipment and supplies, can offer high-quality care for a wide range of acute and chronic diseases,[18] but to be of use, the delivery of quality care must be *measured.* Care quality, moreover, can be improved in developing and emerging countries in a short period of time, and by the existing workforce, without massive investments in new facilities or human capital.[19] Nevertheless, a dearth of data exists on clinical practice quality in many parts of the world, especially in the ECA region.[5,20]

In 2011, the World Bank undertook an ambitious cross-national and intra-country analysis of the quality of care in 6 ECA countries: Albania, Armenia, Georgia, Kazakhstan, Kirov Province in Russia, and Tajikistan. Similar to other projects of this scale,[21–24] the purpose of this study was to produce national and cross-national comparative quality of care data. This was accomplished using Clinical Performance and Value (CPV) vignettes, which are simulations of clinical scenarios, to measure the quality of clinical services—sometimes referred to as care processes—among 3,584 doctors and 384 midwives in 1,039 facilities from 391 hospitals and 648 associated primary health care (PHC) clinics. The findings presented in this article show a comprehensive concurrent evaluation of quality provided in the ECA region and provide policy makers with insights into where quality improvement is needed. The results also identify to hospitals and facilities who, in the aggregate, is providing the best (or worst) care and can give individual doctors and midwives an opportunity to evaluate and improve their own practice through individualized feedback.

CPV vignettes are simulations that have been uniquely validated against standardized patients. The vignettes can be administered on paper or electronically. Each provider is presented with the same case, or vignette, and asked to take the (simulated) patient's history, do an examination, order the necessary tests, make a diagnosis, and specify a treatment plant—thereby simulating a patient visit and providing an opportunity to evaluate the physician's knowledge and care processes. Other, more limited types of vignettes have not always corresponded well to actual clinical practice,[25,26] prompting us to develop CPV vignettes. The CPV vignette, compared with other vignettes, uses open-ended questions and flexible multistage evaluations to simulate actual practice and actual patient visits to validate their accuracy.[27,28]

Clinical Performance and Value (CPV) vignettes, which are simulations of client scenarios, have been shown to outperform both chart abstraction and direct observation as a tool to measure quality of care.

As a tool, CPV vignettes have been shown to outperform both chart abstraction (medical record review), a common measurement method in some settings,[27,29,30] and direct observation, which is often used in developing countries.[25,31] Chart abstraction can be more costly than CPVs because it requires records to be found and secured, and abstractors to review and record details from each clinical visit.[28] Clinical charting is also highly variable in different countries, obviating the possibility of using abstraction in cross-national studies.[32] By contrast, CPVs with explicit criteria can be scored very rapidly, and no adjustment for case-mix variation is needed. Direct observation, unlike CPVs, is influenced by the Hawthorne effect, wherein a provider's actions change due to the observation. Interestingly, recent research suggests that this observational

In 2011, the World Bank undertook a cross-national analysis of quality of care in 6 Eastern European and Central Asian countries.

bias may disappear over time.[33] CPVs have been shown to correlate well with actual physician practice and have been deployed at an affordable cost in a variety of clinical practice settings around the world.[6,8,30] In our other work, we have shown program costs for administering CPVs at US$2.25 per program beneficiary.[34] Even when abstraction, direct observation, or standardized patients can be implemented, the data need to be case-mix adjusted. CPV vignettes thus allow for direct comparison of provider performance within and between countries, both individually and in the aggregate, and were therefore used to measure clinical practice in this study.

METHODS

Setting

Between March 2011 and April 2013, the World Bank conducted a large, comprehensive cross-national and intra-country analysis of the quality of care among 6 ECA countries where it was working on quality of care projects (Albania, Armenia, Georgia, Kazakhstan, Kirov Province in Russia, and Tajikistan).[1] While these 6 countries are diverse, they may not capture the full diversity of the region. Notwithstanding, the health care systems of these countries have a wide variety of organizational structures, financial and human resources, and health priorities and outcomes.[35] Population and health characteristics of the 6 countries are listed in Table 1.

Field Operations

For this study, we assembled a cross-national research team, consisting of academicians, country programmatic experts, survey firms, and a private firm with expertise in the measurement of quality using CPV vignettes (QURE). The World Bank facilitated country-level buy-in and support for the study via local representatives and the Ministry of Health (MOH). Local MOH personnel constructed the sample frame rosters of hospitals, clinics, and providers. We secured signed letters of support from the MOH to facilitate access to the study sites and review of the data collection instruments. Local firms in each of the countries carried out the fieldwork and primary data collection.

We randomly selected hospitals and primary health care clinics for inclusion in the study.

Two regional training sessions for the data collection teams were conducted. In November 2011, a 3-day training session was held in Tbilisi, Georgia, with data collection firms from Armenia, Georgia, and Tajikistan. Trainees were schooled in standardizing data collection and were given an orientation to the CPV methodology and procedures. In addition, all the instruments were piloted at a local hospital with the trainers present. Fieldwork for these countries took place from January to March of 2012.

The second training session was held in Tirana, Albania, in May 2012, before the launch of the study in Albania, Kazakhstan, and Russia. Data collection for Albania and Russia was carried out from June to September 2012, and for Kazakhstan between January and April 2013.

All field teams consisted of 1 supervisor and 2 or 3 enumerators. With the exception of Kazakhstan, which had real-time data entry through laptops, data collection was conducted on paper instruments and completed by the enumerators that were then sent to the central office of each country for data entry. Providers' responses to the CPV vignettes were translated from the local language to English. Electronic files with each of the completed CPV responses were sent to QURE for scoring.

Supervision during the entire data collection process was carried out by QURE and supported by the World Bank through weekly teleconference meetings to monitor progress, address issues that arose in the field, and review data quality.

Sampling Methods

Facilities. PHC centers and secondary referral hospitals provide the majority of NCD, neonatal, and obstetric care—the focus of our study—in each country. Local survey firms compiled rosters of every hospital in each country, including number of beds, rural/urban designation, whether the hospital attended births, and whether it was a single-specialty hospital. Hospitals with fewer than 10 beds or that did not provide internal medicine care were excluded.

We used a probability proportional-to-size sampling technique, based on number of hospital beds, and randomly selected 42 hospitals per country. A census sample was conducted in Albania and Kirov Province, Russia, because they had fewer than 42 hospitals overall. Eight selected hospitals in Armenia and 7 in Tajikistan did not have maternity services, so the geographically closest maternity hospital was also included in the study. Surveyors visited every randomly selected hospital to confirm the inclusion criteria and willingness to participate. In Armenia, 2 private hospitals refused to participate, but no other hospital refusals occurred.

TABLE 1. Population and Health Characteristics of the ECA Countries Included in the Quality of Care Study, 2013[a]

	Albania	Armenia	Georgia	Kazakhstan	Kirov Province, Russia[b]	Tajikistan
Population	3,173,000	2,977,000	4,341,000	16,441,000	1,315,003	8,208,000
World Bank income group	Upper middle	Lower middle	Lower middle	Upper middle	High (Russia)	Low
% of population living in urban areas	53%	63%	53%	53%	74% (Russia)	27%
Life expectancy at birth	73 male 76 female	67 male 75 female	71 male 78 female	63 male 73 female	64 male 76 female	68 male 70 female
Total expenditure on health as % of GDP (2012)	6.0%	4.5%	9.2%	4.2%	6.3% (Russia)	5.8%
No. of physicians per 1,000 population	1.2	3.8	4.8	4.1	4.7	2.1
Neonatal mortality (deaths per 1,000 live births)	7	8	8	8	5	21
Maternal mortality (deaths per 100,000 live births) (2013)	21	29	41	26	24 (Russia)	44
Adult risk factors						
Tobacco smoking (2011)	26%	22%	27%	24%	40% (Russia)	N/A
High blood pressure (2008)	37%	42%	43%	35%	38% (Russia)	31%
Obesity (2008)	21%	24%	22%	24%	27% (Russia)	9%
% of total deaths due to NCDs, all ages, both sexes (2013)	89%	92%	93%	84%	86% (Russia)	62%
% of total deaths due to cardiovascular disease, all ages, both sexes (2013)	59%	54%	69%	54%	60% (Russia)	38%

Abbreviations: ECA, Eastern Europe and Central Asia; GDP, Gross Domestic Product; NCDs, noncommunicable diseases; UNICEF, United Nations Children's Fund; WHO, World Health Organization.
Sources: Albania, WHO (http://www.who.int/countries/alb/en/); Armenia, WHO (http://www.who.int/countries/arm/en/); Georgia, WHO (http://www.who.int/countries/geo/en/); Kazakhstan, WHO (http://www.who.int/countries/kaz/en/); Russia, Knoema World Data Atlas (http://knoema.com/atlas/Russian-Federation/Kirov-Region/Population); Tajikistan, WHO (http://www.who.int/countries/tjk/en/); and neonatal mortality for all countries, UNICEF (http://data.unicef.org).
[a] 2013 data unless otherwise specified.
[b] Data for Kirov Province only, unless otherwise specified.

From the study hospitals, a comprehensive list of associated PHC clinics was generated. PHC clinics included polyclinics, general medicine clinics, and health care outposts. For each hospital, we randomly selected 3 associated PHC clinics for participation.

Providers. Physician and midwife providers were selected from the final hospital and PHC rosters for each country. Physicians were classified by service line—internal medicine/general practice, pediatrics, obstetrics, or specialty care. We know that the minimum clinically meaningful difference is 3% to 4% in CPV scores.[8,36] At this effect size, a total sample of 3,830 observations was required to distinguish differences between countries, and within each country by rural vs. urban setting, provider specialties, and among facility types for each of the three disease areas. We, therefore, randomly selected 4 physicians at the service line level in each hospital, along with 3 midwives at the hospital level and 3 primary care providers in the clinics, to

generate a representative sample for each provider group.

Epidemiology and Disease Selection

The study focused on quality of care in 3 clinical areas: noncommunicable diseases, neonatal care, and obstetric care.

The study focused on the quality of care in 3 clinical areas: care of the noncommunicable (chronic) disease (NCD) patient, care of the newborn, and care of the mother. These clinical areas encompass both ambulatory and nonambulatory settings.

Chronic disease is a well-documented contributor to the ECA region's disease burden.[37,38] Mortality from major chronic NCDs in Central and Eastern Europe is almost twice that of European Union countries and afflicts a younger age group.[39] High rates of chronic disease also have an increasingly negative impact on the labor supply, including workforce participation, hours worked, wages, and earnings.[40]

Neonatal mortality comprises 38% of all under-5 mortality worldwide,[41] and is high in the ECA region, particularly in Central Asia where perinatal and neonatal mortality rates are 5 times higher than in Western Europe.[42] An estimated 90% of neonatal deaths worldwide are caused by birth asphyxia, infections, or complications of prematurity.[43] Although it is widely believed improving neonatal health requires access to sophisticated technology, the majority of neonatal deaths can be avoided with low-cost, evidence-based care.[41] As a result, very basic quality interventions have a major impact on neonatal outcomes.[42]

Maternal health remains at the forefront of global health efforts, and postpartum hemorrhage is a leading cause of maternal mortality during childbirth. Maternal mortality is particularly high in Tajikistan and Georgia (Table 1), with little prior research focused on provider quality of maternal health care in the ECA region. Most studies found in this area have focused more on systemic quality of care rather than provider quality of care. This emphasis on systemic care is underscored by a recent systematic review on the barriers to accessing adequate maternal care in Central and Eastern Europe, which found a total of 21 articles that looked at improvements in maternal care.[44] Of these 21 articles, only 7 examined the appropriateness of maternal care, all of which agree that there was a lack of needed skills in delivering care.

Using the CPV vignettes, providers indicated how they would normally gather information in their own settings to solve the case, from taking the patient's history to prescribing treatment.

Quality Measurement

Framework

This study used the structure-process-outcome framework to measure quality.[45] Health *outcomes*, such as disability or mortality, are the ultimate impact of health policy but some of these outcomes are challenging to measure accurately and hard to causally distinguish between disease severity and the quality of the health care services.[46] Care *processes*, or care services that patients receive from health care providers, are proximate to outcomes, occur *every* time there is a patient visit, and thus are potentially an ideal measure of quality.[41] *Structural* factors, such as provider training and facility characteristics, are perhaps the most readily measured but have much less direct impact on health outcomes, being mediated by the process of care delivered by the provider.

This study collected data on the quality of care using CPV vignettes to measure clinical practice, or care processes, for the 3 disease areas of interest. Additionally, data were collected in each country on the structural measures of quality in health care facilities where the providers practiced.

Measurement of Care Processes Through CPV Vignettes

A CPV vignette is a proprietary quality measurement tool designed to test a provider's ability to provide the proper care and treatment of simulated patients. In this study, each CPV vignette is a paper-based simulated case that starts with a typical patient presenting with symptoms and signs of an undisclosed clinical condition. By the nature of the case simulation, variation introduced by case-mix is removed, thereby allowing for direct comparison of provider performance within and between countries, both individually and in the aggregate. In addition, CPVs are designed to simulate a complete clinical encounter, making it possible to assess a provider's clinical decisions from when a patient enters to when a patient leaves.

For this study, physicians and midwives were required to respond in writing to open-ended questions indicating how they would normally gather information in their own settings to solve the case, replicating what they would do in a real-life scenario. The respondents had to answer questions on 5 aspects of the care process:

1. Taking the patient's history
2. Doing the physical examination
3. Requesting (and receiving) radiological or laboratory tests
4. Making a diagnosis
5. Prescribing disease-specific treatment

BOX. Sample Clinical Performance and Value Vignette

In a typical Clinical Performance and Value (CPV) vignette, providers are given a presenting problem for a simulated patient. For example:

Presentation: Selim, a 12-day-old newborn boy, is brought to your clinic by his mother because he is feeding poorly, won't sleep, and is irritable.

The providers are then asked what questions they would ask the patient (or in this case, his mother) about his history. The following is Selim's history, given to the providers once they have asked all their questions:

Full History: According to Selim's mother, he had fair suck, good cry, and good activity when he was brought home from the hospital 9 days ago. Yesterday, he became irritable, started crying all the time, and began coughing and refusing his feedings. This morning, he had a moderate- to high-grade undocumented fever. The mother reports Selim has not had any seizures, a rash, or excess sleepiness. His stools were of normal consistency although the frequency has decreased from 2 to 3 times each day to once daily. He had 5 diaper changes yesterday, all of which were fully soaked, according to the mother. There were no episodes of vomiting, seizures, jaundice, lethargy, or increased sleeping time. He is exclusively breastfed.

Selim was born via primary low-segment cesarean delivery to a 22-year-old primigravida. The length of gestation was 36 weeks by dates, confirmed with an earlier ultrasound. The obstetrician ruptured the bag of water artificially at the 5th hour of labor and the meconium was clear. The decision to perform a cesarean delivery was made after 7 hours of labor due to some decelerations noted on intrapartum fetal monitoring. At birth, his Apgar score was 7, improving to 9, and he was a term baby by pediatric aging (37 weeks). He weighed 3.2 kg at birth.

His mother had 3 prenatal consults obtained in the polyclinic in her oblast [administrative division]. There were no blood pressure elevations during the pregnancy, except during labor. She did not undergo testing for gestational diabetes. She did not report any recent cough/colds, fever, dysuria, vaginal discharge, or vaginal bleeding. The mother admits she had smoked cigarettes intermittently during the pregnancy, but there was no alcohol or illicit drug use.

She denies any history of sexually transmitted infections. She is up-to-date with her tetanus shot but received only 1 dose of the hepatitis B vaccine. She has never been hospitalized and is on no medications. She has no known drug allergies.

Next, the providers are asked which physical examinations they would perform. In Selim's case, the following information would be given to the providers after their response.

Physical Examination: On examination of the infant, he appears acutely ill and obviously irritable. There are no rigors or tremors noted. The respiratory rate is 90/min and the heart rate is 160/min. The rectal temperature is 38.8° C. Weight is 3 kg (down from 3.2 kg at birth). Breathing is shallow. There are no retractions, grunting, or cyanosis. On auscultation, the breath sounds were vesicular with no rales, wheezing, or crackles. There were no cardiac murmurs heard. The abdomen was not distended, and bowel sounds were present. The anterior fontanel was intact and slightly bulging, particularly when the infant cries. Capillary refill time was 2 seconds. Oxygen saturation was 87% on room air.

Then, the providers are asked which imaging or laboratory tests they would order to aid their diagnosis. Depending on what they ordered, they would get the following test results for Selim:

- *Complete blood count: normal hemoglobin of 12.8 g/dL and hematocrit (0.42); white blood cell (WBC) count is 13.8 x 10^9/L with a predominance of segmented PMNs (polymorphonuclear leukocytes) (84%) and 12% bands; platelets are 107.*
- *Glucose: 4.1 mmol/L.*
- *Blood culture: drawn and are pending.*
- *Chest x-ray: showed patchy infiltrates over both lung fields.*
- *Lumbar tap: yielded a turbid cerebrospinal fluid with a:*
  - *Low glucose level (1.9 mmol/L)*
  - *Elevated protein content (160 mg/dL)*
  - *Pleiocytosis (WBC count 265 cells/mm^3 with predominance of polymorphonuclear cells).*

(*continued on next page*)

Box. Continued

- *Gram stain of the cerebrospinal fluid (CSF) revealed the presence of gram-negative coccobacilli.*
- *CSF culture: result pending*

- *Serum electrolytes and creatinine: normal.*

At this stage, the providers are asked what their diagnosis is.

Selim's diagnosis: Neonatal sepsis with pneumonia and meningitis, moderate to severe.

Finally, providers are asked to delineate the next steps in the patient's treatment plan.

Selim's treatment plan:

- *Admit to hospital.*
- *Supplemental oxygen by face mask, monitor oxygen saturation.*
- *Intravenous glucose 10% in 0.18 normal saline.*
- *Intravenous antibiotics: ampicillin plus aminoglycoside OR intravenous aminoglycoside plus expanded spectrum penicillin antibiotic (or equivalent).*
- *Monitor vital signs including oxygenation.*
- *Monitor occipitofrontal circumference (to detect hydrocephalus).*
- *Repeat blood cultures after 24–48 hours.*
- *Repeat lumbar puncture after 24–48 hours of initiating antibiotics to document sterilization of CSF.*

Through the CPV vignette, we can assess the process of care practitioners would provide and how that process might lead to different outcomes for the simulated patient. For example, if Selim would have seen Physician A from our study, he would have seen a doctor who thoroughly explored his history, asking not only about the current episode prompting his mother to bring him to the clinic but also about his birth history details, and taken a detailed physical examination. These actions led Physician A to order a CBC, blood culture, glucose, and spinal tap; the spinal tap led to the discovery of gram-negative coccobacilli and Physician A's diagnosis of neonatal sepsis with pneumonia and meningitis. With this diagnosis, Physician A indicated she would immediately admit Selim to the hospital and recommended a full treatment plan.

On the other hand, if Selim would have seen Physician B from our study, he would have encountered a doctor who explored only the current presentation of the newborn without asking about any prior history. Physician B ordered only a CBC, blood culture, and chest x-ray; the x-ray showed patchy infiltrates in both lungs, leading the physician to diagnose Selim with community-acquired pneumonia. Fortunately, Physician B felt the pneumonia was serious enough to require immediate IV antibiotics and hospitalization, but without the proper workup to make the right diagnosis, Selim would not have received the follow-up blood culture, lumbar puncture, and adequate monitoring warranted in a newborn this sick.

For details on how this sample CPV vignette was scored for Physician A and Physician B, see the Supplement.

The CPV vignettes took into account particular capacity limitations in each country. For example, availability of chest CTs is limited throughout Kazakhstan, so this test is not an option in the CPV vignettes for these providers.

The study investigators created 5 CPV vignettes, initially in English, for the 3 disease areas of interest: NCD (including a multiple NCD risk factor case and an acute myocardial infarction [AMI] case), neonatal care (pneumonia and birth asphyxia cases), and obstetrics (postpartum hemorrhage case). The midwives were assessed only for the postpartum hemorrhage case. In developing these cases, WHO guidelines were used as the criteria for measuring quality of care for all cases within each health system.[47,48] Guidelines from relevant European medical societies were also added to increase local relevancy and buy-in from the MOHs.[49]

Every case required the clinician to perform a thorough history and physical examination of

the patient. The information gleaned from these 2 domains then informed the next steps (ordering laboratory tests and images, or doing a procedure) that the clinicians felt they needed to take to reach the correct diagnosis. Once a diagnosis (correct or incorrect) was reached, the clinician then formulated a treatment plan (e.g., counseling, medications, a procedure) as well as the follow-up for the patient (Box).

Each of the developed cases in this study had at least 1 essential element for the clinician to identify and treat. The birth asphyxia cases required the provider to anticipate and provide the necessary care for these newborn patients (e.g., gasping respirations requiring bag-and-mask ventilation). The neonatal pneumonia cases required proper workup (recognition of tachypnea and decreased alertness that should lead to blood cultures, chest x-ray, and lumbar puncture) to not only identify the pneumonia but also exclude the possibility of sepsis and meningitis. The maternal postpartum hemorrhage cases looked at whether the clinicians recognized tachycardia and hypotension in a multigravida patient, requiring an evaluation of uterine blood loss and surgical curettage. The AMI cases required recognition of the acuity, confirmation of this with either troponin or creatine kinase (CK)-MB levels, and provision of comprehensive pharmacologic ischemic interventions.

To ensure that the CPV vignettes were appropriate for each local setting while retaining comparability across countries, the patient narrative was adjusted to the specific country or region, for example, by changing pseudonyms for patients and adapting social characteristics for each country. All study instruments, including the CPVs, were translated into the local language as well as Russian and then piloted to ensure clarity. They were then back-translated into English to check for fidelity with the original instruments. All study instruments were also reviewed in detail by MOH representatives to ensure that the questions and the CPV cases presented were relevant to their particular setting.

The data collection in Albania and Russia was conducted in the main language of the country (Albanian and Russian, respectively). For the remaining countries, providers had the option to complete the questionnaire and CPV either in the national language (Georgian, Tajik, Armenian, or Kazak) or in Russian.

Structural Measures of Quality

A facility survey was completed by an administrator at each hospital and primary care site. The facility survey collected structural quality data about personnel, material and financial resources, and clinical services provided. Other collected structural measures included management approaches, available equipment (54 items), laboratory tests (35 items), and pharmacy (43 medications).

Data Analysis

The CPV vignettes for each provider were scored on a scale of 0% to 100%, where 100% indicated perfect conformity to the recommended clinical practice. To ensure that items of lesser importance were not equally weighted with items of greater importance, lesser items were grouped together into a single item. Providers receiving a "standard practice" rating were those who scored within 1 standard deviation of the mean of all providers, while above average was anything above the mean and substandard was anything below the mean. Previous studies have shown that a 3% increase or difference in absolute scores is clinically meaningful, and any score above 80% indicates delivery of high-quality care for the specific clinical scenarios tested.[6]

We used descriptive statistics and *t* tests to identify significant differences in CPV scores between hospitals and polyclinics and rural vs. urban facilities, and ANOVA to identify significant differences in scores across countries. For structural measures of quality, we performed descriptive statistics. All statistical analyses used STATA version 12.1 (StataCorp, College Station, Texas, USA).

Ethical Review

Ethical approval for this study was acquired in accordance with each participating country's MOH, who determined that since this was a survey on the quality of clinical care provided, an Institutional Review Board (IRB) review within each country was unnecessary. Informed consent was obtained in writing from all physician and midwife participants; there were no patient-level data involved; and the analysis was done anonymously. The names of the providers and hospitals were changed to numerical identifiers on the completed vignettes before they were scored. The study protocol was formally reviewed by the Chesapeake IRB, which determined that the protocol was exempt from review under the United States Code of Federal Regulation, 45 CFR 46.

Providers in Kirov Province, Russia, had the highest overall performance on the CPV vignettes, while those in Albania and Tajikistan had the lowest.

RESULTS

Background Characteristics

In total, 3,584 randomly sampled physicians and 384 randomly sampled midwives completed the surveys and CPVs across the 6 countries. The average age of the physicians was 46.2 years, with country averages ranging from 41.8 years in Kazakhstan to 50.1 years in Georgia. Midwives were, on average, 43.9 years of age, with a high of 48.2 years in Georgia and a low of 39.2 years in Kazakhstan. Over two-thirds (71.2%) of the physicians and nearly all (98%) of the midwives were women.

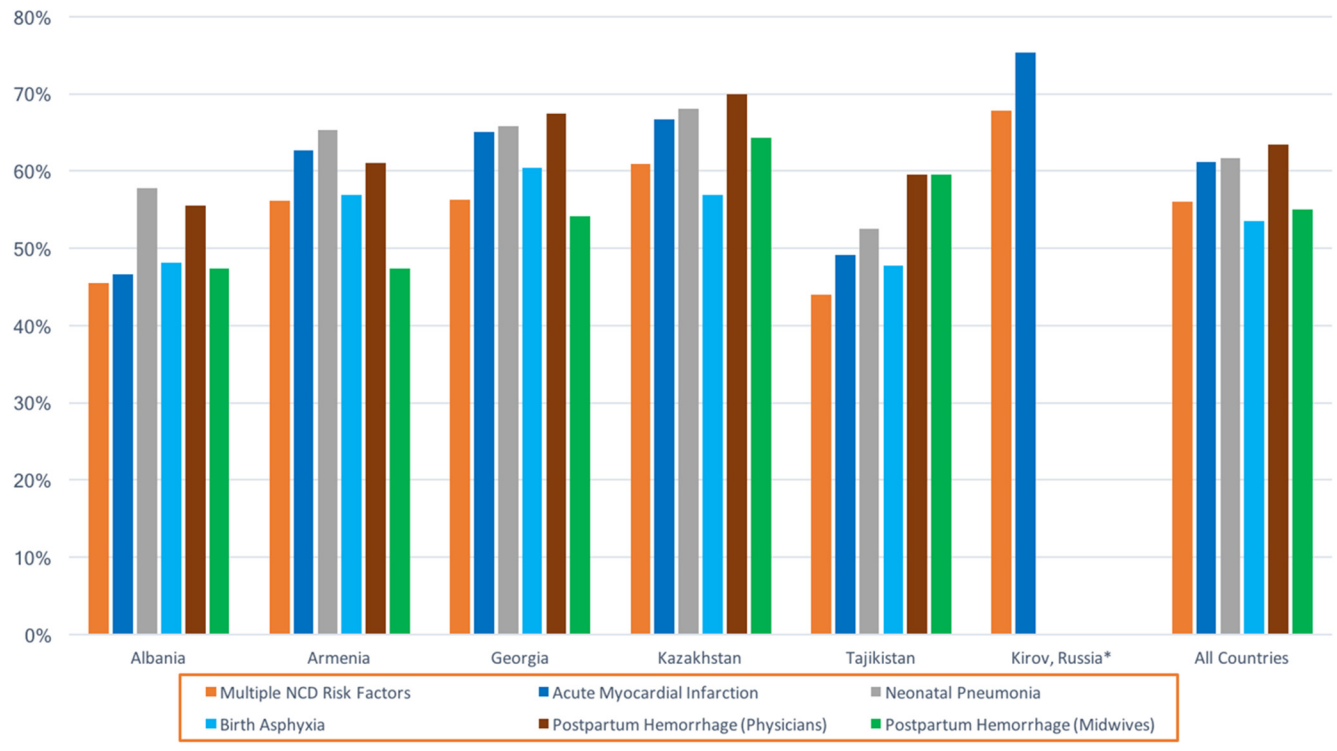
CPV-Measured Quality: Cross-Country Comparisons

The average CPV vignette score varied between the highest-performing and lowest-performing country by 20 percentage points. Providers in Kirov Province, Russia, had the highest overall performance with an average vignette score of 70.8%, followed by providers in Kazakhstan, Georgia, and Armenia, with country-level scores of 64.1%, 63.2%, and 61.0%, respectively. At the lowest end, providers in Albania and Tajikistan each had an average score of 50.8%. This country-level variation persisted across clinical areas (Figure).

Physicians in Russia (Kirov Province) and Kazakhstan typically provided the highest quality of care overall as measured by the CPV vignettes. Tajikistan performed lower on the CPV vignettes than any of the other countries ($P<.01$).

For neonatal care, with scores ranging between 60% and 68%, providers in Kazakhstan, Georgia, and Armenia performed significantly better than those in Tajikistan ($P<.05$). (Russia measured

FIGURE. Mean CPV Vignette Scores by Country and Condition



Abbreviations: CPV, Clinical Performance and Value; NCD, noncommunicable disease.

*Russia measured quality of care only for NCDs.

TABLE 2. Variation of Mean CPV Vignette Scores (%) for Neonatal Care Conditions, By Country

	Neonatal Pneumonia				Birth Asphyxia			
	Mean	25th Percentile	75th Percentile	Difference Between 25th and 75th Percentiles	Mean	25th Percentile	75th Percentile	Difference Between 25th and 75th Percentiles
All Countries	**61.7**	**51.7**	**75.0**	**23.3**	**53.6**	**42.3**	**65.1**	**22.8**
Albania	57.8	47.5	72.5	25.0	48.1	38.0	57.5	19.5
Armenia	65.3	55.8	77.5	21.7	57.0	47.5	70.0	22.5
Georgia	65.9	57.5	77.5	20.0	60.4	47.5	72.5	25.0
Kazakhstan	68.0	60.0	77.5	17.5	56.9	44.6	70.5	25.9
Kirov, Russia	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tajikistan	52.6	42.5	65.0	22.5	47.7	37.5	59.9	22.4

Abbreviation: CPV, Clinical Performance and Value.

TABLE 3. Variation of Mean CPV Vignette Scores (%) for Postpartum Hemorrhage, By Country and Type of Clinician

	Physicians				Midwives			
	Mean	25th Percentile	75th Percentile	Difference Between 25th and 75th Percentiles	Mean	25th Percentile	75th Percentile	Difference Between 25th and 75th Percentiles
All Countries	**63.5**	**52.9**	**75.2**	**22.3**	**55.1**	**43.6**	**67.1**	**23.5**
Albania	55.6	47.5	63.1	15.6	47.4	35.0	59.4	24.4
Armenia	61.1	52.3	70.6	18.3	47.4	34.9	59.5	24.6
Georgia	67.4	56.3	77.5	21.2	54.2	44.5	63.8	19.3
Kazakhstan	69.9	61.5	79.4	17.9	64.3	56.1	74.8	18.7
Kirov, Russia	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tajikistan	59.5	48.7	72.6	23.9	59.6	48.9	71.4	22.5

Abbreviation: CPV, Clinical Performance and Value.

quality only for NCDs.) Providers overall struggled more with the birth asphyxia case (53.6% average score across all countries) than the neonatal pneumonia case (61.7% average score) (Table 2) ($P<.01$).

Among physicians, the best performers with the postpartum hemorrhage CPV vignette were from Kazakhstan (69.9% average score) and Georgia (67.4%), while for midwives, those from Kazakhstan (64.3%) and Tajikistan

TABLE 4. Variation of Mean CPV Vignette Scores (%) for Noncommunicable Disease Conditions, By Country

	CPV Vignette Condition							
	Acute Myocardial Infarction				Multiple NCD Risk Factors			
	Mean	25th Percentile	75th Percentile	Difference Between 25th and 75th Percentiles	Mean	25th Percentile	75th Percentile	Difference Between 25th and 75th Percentiles
All Countries	**61.1**	**48.8**	**74.7**	**25.9**	**56.0**	**44.9**	**67.1**	**22.2**
Albania	46.7	36.2	57.3	21.1	45.5	37.0	53.1	16.1
Armenia	62.7	53.3	73.9	20.6	56.1	44.3	67.1	22.8
Georgia	65.0	54.0	76.6	22.6	56.3	47.1	67.0	19.9
Kazakhstan	66.7	55.8	78.7	22.9	61.0	53.0	69.6	16.6
Kirov, Russia	75.3	65.1	84.5	19.4	67.8	62.3	72.5	10.2
Tajikistan	49.2	38.3	58.1	19.8	44.0	35.6	54.3	18.7

Abbreviations: CPV, Clinical Performance and Value; NCD, noncommunicable disease.

TABLE 5. Average CPV Vignette Scores (%), by Clinician Specialty and CPV Vignette Condition

	CPV Vignette Condition				
	Multiple NCD Risk Factors (n=1,034) Mean (SD)	Acute Myocardial Infarction (n=1,027) Mean (SD)	Neonatal Pneumonia (n=733) Mean (SD)	Birth Asphyxia (n=641) Mean (SD)	Postpartum Hemorrhage (n=628) Mean (SD)
All physicians					
General practice (n=633)	53.9 (15.7)	57.3 (17.4)	59.0 (18.2)	48.5 (16.9)	54.9 (14.8)
Pediatricians (n=1,005)	–	–	63.2 (16.9)	56.2 (16.7)	–
Internal medicine (n=910)	58.7 (15.7)	66.2 (15.8)	56.5 (15.2)	45.4 (13.5)	60.3 (18.5)
Cardiologists (n=270)	55.9 (15.0)	69.2 (14.5)	–	–	–
OB/GYN (n=637)	–	–	51.7 (16.2)	54.1 (16.0)	64.0 (15.4)
Other physicians (n=45)	53.7 (16.2)	53.4 (17.9)	52.7 (12.4)	41.9 (17.3)	49.5 (6.9)
Midwives (n=353)	–	–	–	–	55.1 (17.0)

Abbreviations: CPV, Clinical Performance and Value; NCD, noncommunicable disease; OB/GYN, obstetricians/gynecologists; SD, standard deviation.

(59.6%) provided the highest quality of care as measured by the CPV vignettes (Table 3). In general, obstetrician-gynecologists scored higher than general practice physicians (about 64% vs. 58%, respectively) on postpartum hemorrhage. In Tajikistan, midwives performed similarly to physicians (about 60% average score), in contrast to the other countries where the physicians provided higher CPV-measured quality of care.

Across all regions in this study, NCD and neonatal care performance was higher at hospitals than at primary care facilities, although this difference was not significant ($P>.05$).

CPV-Measured Quality: Within-Country Comparisons

While between-country CPV score averages varied by 20 percentage points, variation in quality of care *within* countries, as measured by the CPV vignettes, was much greater. But in each country—regardless of the clinical setting studied, local resource constraints, and other challenges facing providers—many individual practitioners performed well. Using a threshold CPV score of 80%, 11% of the providers demonstrated this high level of care or higher. Among these high performers, 87% were specialists and 13% were general practice or internal medicine physicians. In Table 4, the 25th percentile of performance for treatment of an AMI episode overall was only 48.8%, meaning 1 in 4 physicians performed at or below this level. Kirov, Russia, had the least variability of care on both the AMI and multiple NCD risk factor vignettes, with one-half of its physicians performing between 65% and 85% on the AMI vignette and between 62% and 73% on the multiple NCD risk factor vignette. Similarly alarming findings can be found in Table 2 and Table 3, where looking at poor performance, we found one-quarter of all providers scored below 50%.

CPV-Measured Quality by Provider Characteristics

Bivariate analysis showed female clinicians had significantly higher CPV scores than male clinicians (60.9% vs. 52.9%, respectively; $P<.01$). At the physician level, specialists (62.5%) performed significantly better than general practice physicians (62.5% vs. 55.3%, respectively; $P<.01$). This finding held within individual CPV case types (Table 5). For example, general practitioners scored 12.1 percentage points lower than cardiologists for AMI cases. In general, within a specific disease area, those with training in the specialty of the case scored higher (with scores by case type ranging from 56.2% to 69.2%) than their general practice colleagues (48.5% to 59.0%) ($P<.01$). One exception was the multiple NCD risk factor case where internal medicine physicians scored slightly ahead of cardiologists (58.7% vs. 55.9%, respectively).

Gaps in Clinical Care

This study identified specific issues of clinical concern that urgently suggest the need for remediation and follow-up measurement. In some countries, diagnosis of AMI was missed more than half (67%) the time. While aspirin is affordable and widely available in the countries studied, it was prescribed less than 40% of the time when indicated for AMI. The one exception was Russia, where aspirin was used appropriately 80% of the time. Similarly, cholesterol- and blood pressure-lowering drugs were used correctly less than 40% of the time when indicated.

In the case of a newborn with birth asphyxia, only 32% of providers reported they would check for an open airway—universally poor across all countries in the study. Oxytocin, used for controlling postpartum hemorrhage, was prescribed only 64% of the time, although this figure masks cross-country differences. Georgia and Kazakhstan had oxytocin prescription rates above 70%, but for Albania, Armenia, and Tajikistan, this rate was below 60%.

Important gaps in care existed in the workup of patients, although not all providers performed poorly in all areas and not all areas of care were poor. For example, across all countries, 84% of providers, on average, identified the need to counsel patients with diabetes on proper diet and 75% of all providers, on average, ordered a chest x-ray in their neonatal cases to evaluate them for pneumonia. But there were important differences between countries; for example, neonatal x-rays to evaluate pneumonia were ordered by 91% of providers in Armenia but only by 64% of providers in Tajikistan. However, with few exceptions, providers did not use the tools (such as laboratory testing and imaging studies) available to appropriately work up the patient or monitor progress. Monitoring urine output for neonatal pneumonia cases was virtually nonexistent at 3%, with monitoring vital signs for these patients somewhat better at 17%. Fewer than half of the providers mentioned ultrasound—needed to evaluate postpartum hemorrhage—or vital signs for monitoring birth asphyxia.

Disaggregating quality of care scores by clinical domains—history taking, physical examination, laboratory and imaging workup, diagnosis, and treatment—unmasked a decay in quality of care across the patient interaction. The data showed that as providers progressed from history taking and physical examination (with CPV vignette averages above 60%), which center on collecting data, to later domains of testing and diagnosis, which involve making judgments about the data collected, scores declined. Treatment scores, the last domain in the CPV vignette

11% of providers across all 6 ECA countries performed at a high level on the CPV vignettes.

Only 32% of providers reported they would check for an open airway in the case of birth asphyxia, and oxytocin was prescribed only 64% of the time to control postpartum hemorrhage.

There was a decay in quality of care across the patient interaction, with scores declining as providers progressed from history taking and physical examination to testing and diagnosis.

Diagnosis of acute myocardial infarction was missed 67% of the time.

TABLE 6. Health Care Structural Quality Factors by Country and Facility Type

	Country and Facility Type											
	Albania		Armenia		Georgia		Kazakhstan		Kirov, Russia		Tajikistan	
	Total	Hospital	Total	Hospital	Total	Hospital	Total	Hospital	Total	Hospital	Total	Hospital
Average catchment	29,555	78,204	15,649	38,300	13,225	39,569	N/A	N/A	14,105	17,565	50,693	119,048
Average no. of full-time physicians	24	60	22	52	32	76	N/A	N/A	35	48	36	61
Average no. of full-time nurses	38	104	50	132	30	83	N/A	N/A	119	174	84	207
Infrastructure items												
Controls/operates pharmacy (%)	45%	92%	95%	100%	49%	100%	N/A	N/A	30%	42%	17%	37%
Owns transportation (%)	33%	100%	46%	83%	26%	69%	N/A	N/A	86%	96%	43%	72%
Medical equipment and supplies in working condition (% out of 54 items)	35%	60%	48%	75%	40%	72%	N/A	N/A	43%	56%	34%	53%
Laboratory tests available (% out of 35 items)	45%	58%	59%	73%	70%	72%	N/A	N/A	75%	77%	54%	60%
Medications in stock (% out of 43 items)	35%	52%	42%	54%	18%	45%	N/A	N/A	10%	15%	28%	44%
No. of ambulances with defibrillators	20.8	27.2	1.1	1.5	1.4	1.8	N/A	N/A	1.2	1.3	0.4	0.6
No. of computers in working condition	5.8	18.2	5.6	14.6	9.4	23.8	N/A	N/A	27.3	37.6	2.6	6.7
Operational items												
Committees/bodies at the facility												
Quality assurance/review committee	15%	31%	59%	94%	27%	63%	N/A	N/A	44%	60%	27%	46%
Morbidity and mortality conference or committee	12%	33%	30%	67%	18%	57%	N/A	N/A	48%	65%	52%	93%
Infection control committee	11%	36%	33%	60%	22%	59%	N/A	N/A	40%	53%	56%	76%
Pharmacy or therapeutics committee	16%	81%	56%	81%	16%	47%	N/A	N/A	9%	11%	10%	17%
Written guidelines for treatment and management of various conditions (% out of 18)	58%	60%	66%	60%	55%	44%	N/A	N/A	79%	81%	34%	36%
Able to pull patient chart based on name (%)	77%	72%	98%	98%	55%	65%	N/A	N/A	34%	40%	48%	52%
Have system to track patients who require chronic care but miss follow-up (%)	39%	21%	58%	29%	46%	45%	N/A	N/A	86%	83%	68%	46%

encounter, were below 50% in all cases, with the exception of multiple NCD risk factors (average 66%).

Structural Quality Measures

Facilities participating in this study typically had quality structure scores less than 50% for most measures, with large hospitals having significantly better infrastructure and operational scores than PHC clinics (Table 6) ($P<.01$). Urban facilities typically had higher structural scores than rural facilities ($P<.01$), with differences ranging from 2% to 5%.

DISCUSSION

The findings from this study suggest that the 6 ECA countries studied are challenged by poor quality clinical care, regardless of practice setting, specialty, or facility type. Like other settings worldwide, we found high quality of care is the exception and not the norm.[5,17,20,36,50] Intra-country quality, as measured by performance on CPV vignettes, varied by as much as 20 percentage points, but within-country quality varied by as much as 65 percentage points. Still, within each country, many individual practitioners performed well. These results provide a comparative basis describing what *can* be achieved (i.e., the highest performers), even under difficult conditions.

The wide variation in CPV scores across all countries indicates that as many as 1 in 6 providers may deliver worrisomely low-quality levels of care. Even the typical score, which for all 5 conditions evaluated in the CPV vignettes was midrange (45% to 55%), indicates that on CPV cases providers carried out just over half of the patient care criteria recommended by guidelines and practice standards.

By contrast, in every country, a considerable proportion of practitioners *delivered high-quality care*. Among physicians, 11% of the sample scored greater than 80%, suggesting that good care quality is possible even within the constraints of a region's health systems. The presence of high performers is notable among both physicians and midwives.

The lower quality of care scores, as measured by CPV vignettes, observed in primary health care clinics and rural areas compared with hospitals demonstrates a need to target quality improvement efforts geographically, particularly toward primary care diagnosis and treatment.[51–53] This appears to be especially important for reaching the poor who are likelier to live in rural areas and access care through primary care providers.[54]

Performance by midwives on CPV vignettes was significantly higher in Kazakhstan and Tajikistan, where the regulatory environment enables independent practice by this profession. Improved training and structural support for midwives in other countries would potentially help promote care quality improvements in their countries.

The notable decay in quality across the care encounter (from history taking to diagnosis) raises important questions about providers' ability to accurately diagnose and treat conditions.[55] Furthermore, the conditions with the lowest scores—multiple NCD risk factors, birth asphyxia, and postpartum hemorrhage—are conditions for which low-cost, widely available treatments can significantly reduce mortality. The low CPV vignette scores identify specific deficiencies that, if remedied, would rapidly improve quality of care and outcomes.

The conditions with the lowest scores were multiple NCD risk factors, birth asphyxia, and postpartum hemorrhage, conditions for which low-cost, widely available treatments can significantly reduce mortality.

Policy Implications of CPV Vignettes

A number of policy levers, such as the Balanced Score Card,[56] accreditation,[57] and Pay for Results,[6,34] are generally available to improve quality of care. Effective serial monitoring has become a prerequisite for demonstrating the success (or failure) of these or other policies over time.[58] Adding public reporting of quality measures would help to improve quality by increasing accountability,[58] promoting improvement in the health status of the populations in the 6 ECA countries,[59] and lowering costs.[60] In addition to supporting public reporting, serial CPV vignette measurement can be used to monitor the effectiveness of any initiative introduced to improve the process quality of care, as well as potential links to performance incentives.

Good quality of care is possible even within the constraints of a region's health systems.

Benefits of the CPV Vignette Methodology

Few large-scale quality of care assessments have been undertaken, in part, due to the absence of effective measurement tools that provide robust, reliable, and case-mix adjusted results across diverse economic, cultural, and social settings. While all process of care measures have limitations, this study shows that quality can be measured widely and affordably using CPV vignettes.

There have been other evaluations of a similar scale and at both inter- and intra-country levels, such as the Service Provision Assessment (SPA).[24,31] However, the process of care evaluation used in the SPA is limited compared with this study, as CPVs measure the entire clinical process of care without requiring a clinical evaluator or

This study shows that quality can be measured widely and affordably using CPV vignettes.

introducing the bias that occurs with direct observation.

Implementation of this study demonstrates that large-scale inter- and intra-country process of care quality evaluations are only possible with active local participation, a multidisciplinary team, and attention to data collection training. This study enlisted community members for training staff, piloting data collection, and conducting ongoing quality assurance checks, paying particular attention to supervision and data consistency.

The study, conducted in 6 ECA countries, measured quality of care among 3,584 physicians and 384 midwives in 1,039 facilities, making it the largest cross-national comparison of quality undertaken in this region. The process of measuring the quality of clinical services at cross-national scale and providing benchmarks was done relatively quickly, making quality of care measurement a powerful policy opportunity for improving health.

Limitations

This study was conducted in 5 countries and 1 large province of the Russian Federation and thus cannot be considered representative of the entire ECA region.

A potential concern is that CPVs do not reflect actual provider *practice* and are instead only measuring *knowledge*,[61] which is important but potentially different than practice. CPV vignettes, unlike other vignettes, have been validated in the United States against actual practice. They proved to correlate closely with provider behavior and are therefore a useful measure of quality of care.[6,29,27,62–65] In some cases, where procedural intervention is required (e.g., a surgical technique, psychotherapy, or pediatric care), CPVs cannot be validated with standardized patients. These exceptions notwithstanding, the published validation studies have shown that CPVs correlate well with measures using standardized patients, the gold standard for measurement of clinical performance in some of the clinical cases we studied (e.g., pneumonia, NCD risk factors, AMI),[6,29,27,63,66–68] with the notable exception of postpartum hemorrhage and neonatal asphyxia.[69] However, validation can be viewed as whether the measurement is responsive and able to explain better outcomes. Chief among these studies is the experimental evidence that when CPV scores improve, not only does actual practice change but so do health outcomes of patients cared for by those providers.[34] This evidence, summarized in a literature review of the best measures of clinical practice, concluded that CPV vignettes can be an effective way to assess the quality of care across facilities and large numbers of providers.[62] CPVs have been deployed at an affordable cost in a variety of clinical practice settings around the world.[6,8,30] The authors note that similar validation against standardized patients in low- and middle-income countries would enhance earlier validation work, although performing such studies could prove difficult, if not impossible.

While not done in this study, serial CPV measurement with feedback of results to providers has been demonstrated in a number of settings to improve care quality and health outcomes in the population.[70] This study, with its 1 round of measurement, could not demonstrate the impact of measurement on practice. Ultimately, quality measurement must be done serially and go beyond benchmarking to motivating changes in practice. Every country needs to link changes in knowledge and practice to changes in practice and health status. This has already been done using CPV vignettes in some countries.[58]

While CPVs are comprehensive measures of the specific clinical care processes, they do not measure structural or other elements of care. For example, this article does not address patient satisfaction as a critical indicator of quality nor the adequacy of drug supplies or of medical supervision. Interestingly, given the central nature of clinical care practice to all dimensions of quality, a review conducted by Doyle and colleagues showed a consistent link between technical quality and patient satisfaction.[71] In our own experimental studies, using the CPV methodology, we have found that as CPV scores improve, so does patient satisfaction.[72]

Finally, this was a descriptive study. It did not determine how much of the gaps in measured performance could be attributed to modifiable vs. non-modifiable factors. Ideally, this would be done experimentally or prospectively in a follow-on to this large-scale study.

CONCLUSIONS

This study provides a comprehensive and detailed baseline picture of health care quality across 3 clinical conditions in 6 ECA countries. While the data show that excellent quality of care is possible in all of these countries and in all types of facilities, it also provides an alarming picture of poor and variable quality, as measured by

CPV vignettes. National and cross-national measuring and benchmarking the process of care among peers—if done serially—could spur quality improvement efforts that raise overall quality of care and decrease clinical variability.[73,74]

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ORIGINAL ARTICLE

Geographic Access Modeling of Emergency Obstetric and Neonatal Care in Kigoma Region, Tanzania: Transportation Schemes and Programmatic Implications

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32% of estimated live births in the region may not be able to reach emergency obstetric and neonatal care (EmONC) services within 2 hours in dry season, regardless of the type of transportation available. However, bicycles, motorcycles, and cars provide a significant increase in geographic accessibility in some areas. Achieving good access may require upgrading non-EmONC facilities to EmONC facilities in some districts while incorporating bicycles and motorcycles into the health transportation strategy in others.

ABSTRACT

Background: Access to transportation is vital to reducing the travel time to emergency obstetric and neonatal care (EmONC) for managing complications and preventing adverse maternal and neonatal outcomes. This study examines the distribution of travel times to EmONC in Kigoma Region, Tanzania, using various transportation schemes, to estimate the proportion of live births (a proxy indicator of women needing delivery care) with poor geographic access to EmONC services.

Methods: The 2014 Reproductive Health Survey of Kigoma Region identified 4 primary means of transportation used to travel to health facilities: walking, cycling, motorcycle, and 4-wheeled motor vehicle. A raster-based travel time model was used to map the 2-hour travel time catchment for each mode of transportation. Live birth density distributions were aggregated by travel time catchments, and by administrative council, to estimate the proportion of births with poor access.

Results: Of all live births in Kigoma Region, 13% occurred in areas where women can reach EmONC facilities within 2 hours on foot, 33% in areas that can be reached within 2 hours only by motorized vehicles, and 32% where it is impossible to reach EmONC facilities within 2 hours. Over 50% of births in 3 of the 8 administrative councils had poor estimated access. In half the councils, births with poor access could be reduced to no higher than 12% if all female residents had access to motorized vehicles.

Conclusion: Significant differences in geographic access to EmONC in Kigoma Region, Tanzania, were observed both by location and by primary transportation type. As most of the population may only have good EmONC access when using mechanized or motorized vehicles, bicycles and motorcycles should be incorporated into the health transportation strategy. Collaboration between private transportation sectors and obstetric service providers could improve access to EmONC services among most populations. In areas where residents may not access EmONC facilities within 2 hours regardless of the type of transportation used, upgrading EmONC capacity among nearby non-EmONC facilities may be required to improve accessibility.

INTRODUCTION

Poor geographic access to emergency obstetric and neonatal care (EmONC) often contributes to delays in women with obstetric complications receiving care.[1] Such delays can result in adverse maternal and neonatal outcomes.[2] The greatest risk of adverse health outcomes for pregnant women, unborn babies, and neonates occurs between 37 weeks of gestation (i.e., full-term

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pregnancies) and 7 days after delivery. While medical urgency varies with the type of obstetric complication, optimal access to EmONC facilities is usually considered to be within 2 hours of travel time, to provide lifesaving interventions for complications due to obstetric hemorrhage that require the most urgent care.[3]

Therefore, programs should strive to improve EmONC access by limiting the time required for a pregnant woman to reach an EmONC facility to within 2 hours of the onset of an obstetric complication, so that patients with the most urgent complications receive timely medical attention.[3] Since access to adequate transportation is essential to reaching appropriate obstetric care in time, understanding both the local transportation context and how it affects EmONC service coverage may provide programs with insights on how the existing EmONC service network is being used, and how it could be used more effectively.

The Bloomberg Philanthropies-funded project, Reducing Maternal Deaths in Tanzania, has worked to improve access to basic EmONC (BEmONC) and comprehensive EmONC (CEmONC) services in the Kigoma Region of Tanzania among all hospitals, health centers, and large dispensaries providing delivery services. Due to limited road networks, poor road quality, and diverse terrain, Kigoma's population uses various forms of transportation (including 4-wheeled motor vehicles, motorcycles, boats, bicycles, and walking) to reach medical care.

In the existing body of literature, only a few studies analyzing geographic accessibility to care explored instances whereby motorcycles could be used as a primary transportation method. Similarly, very few studies have addressed the use of boat transportation in the context of health care-seeking travel, a mode of travel sometimes used for referrals of complicated cases. Transportation via boat has been well-reported in rural areas in Africa that are away from major road networks and near large bodies of water.[4–7]

In this article, we used a raster-based travel time cost surface model to examine the spatial distribution of travel time to EmONC (i.e., both BEmONC and CEmONC facilities) and the proportion of births (a surrogate measure for women needing delivery care) with good geographic access to EmONC services (i.e., within 2 hours' travel) at regional and subregional levels in Kigoma Region, Tanzania, using various transportation schemes. Because of the diverse terrain and transportation methods used, this accessibility analysis in this region may serve as a case study to explore how various means of transportation may be used to maximize access to EmONC services using an existing road network, by modeling travel time.

METHODS

Study Site

Kigoma Region, which covers 45,066 square kilometers, is situated in the northwest corner of Tanzania and borders the Democratic Republic of the Congo, Burundi, and Lake Tanganyika (Figure 1). The region's land cover consists of grassland (34%), cropland (8%), forest (34%), and water (14%), while the remaining area consists of human settlements and other terrains. Topographically, there is a wide range of altitudes in Kigoma Region; the lowest area is 800–1,000 meters above sea level, along Lake Tanganyika, while the highest areas are in the northern and southern highlands (1,500–2,400 meters above sea level).[8] The Luiche, Malagarasi, and Ruchuigi rivers originate from the northern and northeastern highlands and move southward before draining west into Lake Tanganyika.

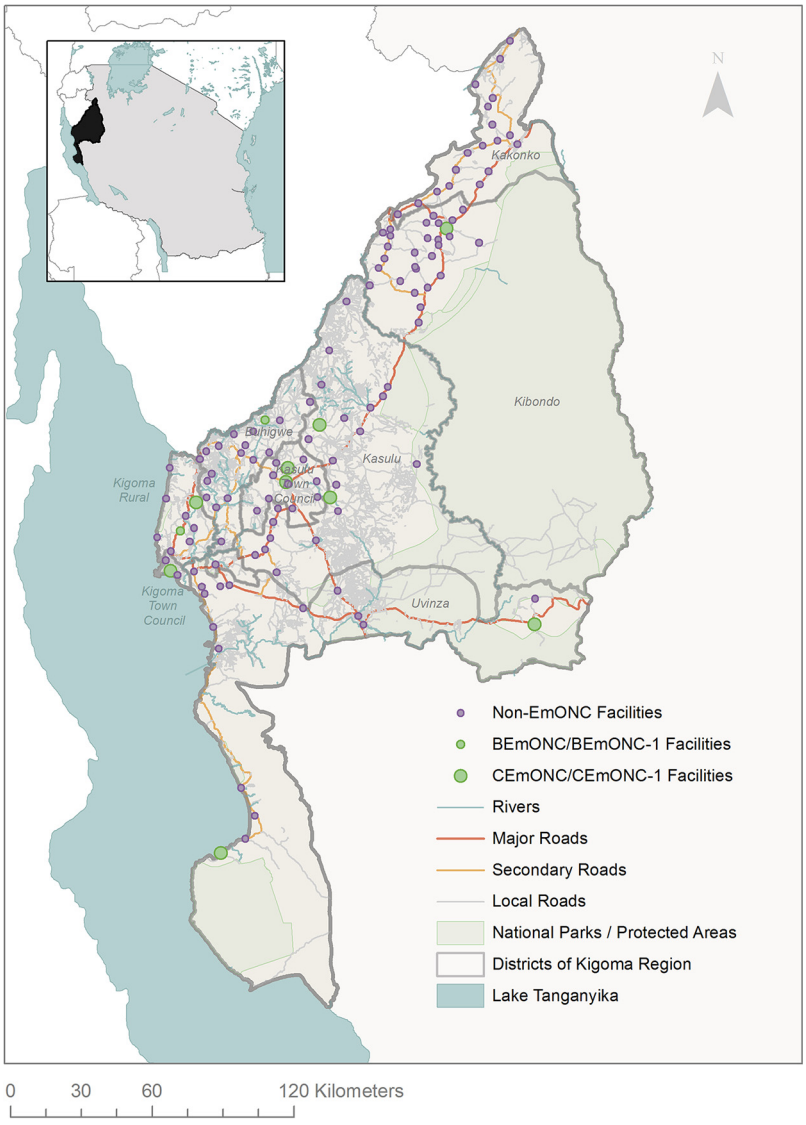
In 2012, the region had a reported population of 2,127,930, of which an estimated 470,000 (22%) were women of reproductive age (i.e., 15–49 years).[9] Kigoma Region consists of 8 administrative councils (Buhigwe, Kakonko, Kasulu, Kasulu Township Authority, Kibondo, Kigoma Rural, Kigoma Municipal-Ujiji, and Uvinza).[10] It is characterized by its rurality (83% of surveyed households[11]), high birth rates (210 births per 1,000 women aged 15–44 years[12]), and relatively high maternal mortality (222 maternal deaths per 100,000 facility-based live births in 2013[13]). In 2014, only 47% of the deliveries in Kigoma Region were attended by a skilled birth attendant.[12]

Accessibility Analysis Software

This analysis aims to estimate the amount of time required for populations to travel to the nearest EmONC facility in Kigoma Region.

This analysis aims to estimate the minimum amount of time required for populations to travel to the nearest EmONC facility in Kigoma Region when seeking care, by using AccessMod version 4.0 (World Health Organization [WHO], Geneva, Switzerland), an add-on analytic extension to ArcGIS 9.3.1.[14] This travel time modeling program uses a least-cost path (friction surface) approach to produce a raster layer across the target area, where each gridded cell represents the minimum travel time from the cell's location to the target destination. Spatial raster data models are representations of continuously varying attributes in which the surface of the earth is divided into uniformly spaced pixels of cells, and each pixel carries one

FIGURE 1. Delivery Health Facilities, by Emergency Obstetric and Neonatal Care Status, Included in the Study, Kigoma Region, Tanzania, 2013



Abbreviations: BEmONC, basic emergency obstetric and neonatal care; BEmONC-1, partially functional BeMONC facility (i.e., BEmONC without assisted vaginal delivery); CEmONC, comprehensive emergency obstetric and neonatal care; CEmONC-1, partially functional CEmONC facility (i.e., CEmONC without assisted vaginal delivery); EmONC, emergency obstetric and neonatal care.

or more attributes of a value for that location. Raster data differ from vector data models (e.g., points, lines, and polygons) when representing spatially continuous processes and interactions such as distance, terrain, and travel time.

The travel time model requires the following data inputs: (1) geographic coordinates of the health facilities providing EmONC services; (2) combined land cover raster dataset; (3) digital elevation model (DEM) raster dataset; and (4) travel speed

specification, based on land cover classification and transportation modes. Tobler's function, which corrects walking speed based on the direction of slopes on the terrain, was used to adjust the anisotropic (directional) walking speed.[15] Motorized transportation did not require directional speed adjustments. Unfortunately, due to the limitations of our software installation, we were unable to adjust for anisotropic changes in bicycling speed due to a reported bug in AccessMod version 4.0.

Input Data

Table 1 summarizes the data source, the spatial resolution, and other specification details of the input geospatial data used for modeling the travel time and estimating accessibility to existing EmONC services in the region. All input geospatial datasets were cropped to the administrative boundaries of Kigoma Region, as derived from the ward boundaries of the 2012 Tanzania census.[10] All rasters used in the travel time analysis were specifically at 30-meters resolution, while the live birth raster data used in the live births analysis were kept at 100-meters resolution, as it was recommended not to resample that dataset. All data layers were projected into the spatial reference frame, WGS84/UTM Zone 35S.

Health Facility Dataset

The health facility dataset was derived from a 2013 region-wide health facility assessment led by the U.S. Centers for Disease Control and Prevention (CDC) staff in selected Kigoma Region health facilities to document the functionality of EmONC infrastructure and EmONC-related human resources.[16] During the same time frame, the CDC and project partners used the Pregnancy Outcomes Mortality Surveillance (POMS) system to document changes in facility-based deliveries in the region and to assess corresponding pregnancy outcomes in the region.[13] Together, these 2 surveys documented evidence for the observed practice of the 9 essential medical services necessary for treating and managing maternal and neonatal complications (referred to as signal

TABLE 1. Characteristics of the Input Geospatial Datasets, by Data Layer, for Modeling Travel Time and Estimating Accessibility Coverage Among Women Needing Delivery Care in Kigoma Region, Tanzania

	Data Layer					
	Land Cover[a]	**River Network**	**Road Network[b]**	**Digital Elevation Model**	**Birth Density Map[c]**	**Health Facility Coordinates**
Data format	Raster	Shapefile	Shapefile	Raster	Raster	Shapefile
Year	2010	2015	2015	2000	2012	2016
Source	Regional Centre for Mapping of Resources for Development, NASA SERVIR Global[21]	OpenStreetMap	OpenStreetMap	Shuttle Radar Topography Mission[22]	WorldPop[29]	CDC Kigoma Health Facility Assessment[16]
Spatial resolution	30 meter	N/A	N/A	30 meter	100 meter	N/A
Purpose	Provide non-road land feature class (i.e., forestland, grassland, cropland, settlement, wetland)	Provide a layer of physical barrier in addition to wetland	Provide road land feature class (i.e., major roads, major roads crossing residential areas, secondary roads, local roads)	Provide elevation/slope landscape used for travel speed adjustment for walking	Provide estimated distribution count of live births for a specified travel time catchment	Provide locations of assessed coordinates in the analysis

[a] The 2010 Tanzania land cover scheme I was used to specify non-road land classes.
[b] Roads are reclassified to reflect the classification scheme used by John Snow, Inc. and Medical Supply Department in the cross-country medical supply route analysis in 2014.[18]
[c] The layer was created using the mapping methodology described by Tatem et al. (2014).[46]

functions[17]), both at the facility level (through the health facility assessment) and at the individual delivery level (through POMS).

Included in this study were 127 health facilities in the region (Figure 1), composed of hospitals, health centers, and large dispensaries providing delivery services (i.e., dispensaries experiencing more than 90 births per year), accounting for 97% of all facility deliveries in 2012 in Kigoma Region. A total of 11 facilities were found to be providing EmONC levels of care. Eight facilities (4 hospitals and 4 health centers) were identified as fully functional CEmONC facilities, performing 9 signal functions for EmONC within the 3 months before the assessment; 1 facility was identified as a partially functional CEmONC facility (CEmONC-1), performing 8 signal functions excluding the provision of assisted vaginal delivery (AVD).[16] Two additional health centers were found to be partially functional BEmONC facilities (BEmONC-1), defined as performing 6 BEmONC signal functions, excluding AVD. Despite being unable to provide AVD, the 3 partially functional BEmONC or CEmONC facilities were found to have strong enough transportation referral networks to ensure their inclusion in the roster of EmONC facilities. The geographic coordinates used to locate the facilities in this study were recorded in the health facility assessment, using Garmin eTrex 30 devices with an accuracy of 3–5 meters.

We specified 4 different travel scenarios according to whether the primary transportation mode was by walking, bicycle, motorcycle, or car.

Combined Land Cover Dataset

A road network dataset, obtained from OpenStreetMap, was reclassified to reflect the classification scheme used by John Snow, Inc. (JSI) and the Medical Supply Department (MSD) of Tanzania for their 2014 cross-country medical supply route analysis.[18] The road classes included: (1) major roads; (2) major roads crossing residential areas; (3) secondary roads; and (4) local roads[18] (road network visualized in Figure 1). Local roads were further divided into categories, based on road width and OpenStreetMap classifications, including the following: (1) car-passable roads; (2) motorcycle- and bicycle-passable roads (i.e., tracks that are passable to motorcycle and bicycle, but not cars); and (3) walking-only roads.[19,20] Boating routes were digitized to allow for travel approximately 60 meters away from the shore of Lake Tanganyika. Docks were identified using Bing satellite imagery and were digitized to connect to boat travel routes.

Both river and road network vector datasets, obtained from OpenStreetMap, were transformed to raster datasets consisting of 30-meter gridded cells, and were then overlaid on the land cover raster dataset.[21] This created a combined land cover raster dataset with 13 unique land feature classes. The 6 non-road land cover classes included forest land, grassland, cropland, settlements, wetlands, and other land. For the purposes of analysis, wetlands and rivers were considered to be impassable to any form of transportation.

Digital Elevation Model

To provide a mapped model of land elevation, we obtained Shuttle Radar Topography Mission (SRTM) digital elevation model data, at a spatial resolution of 30 meters (1 arc-second), from the U.S. Geological Survey.[22]

Travel Scenarios

To simulate the use of various primary transportation modes in real life, we specified 4 different travel scenarios according to the primary transportation modes (i.e., walking, bicycle, motorcycle, or car) described in the 2014 Kigoma Reproductive Survey (RHS) conducted by the CDC:

1. Walking Scenario (Scenario 1): walking and boat
2. Cycling Scenario (Scenario 2): walking, bicycling, and boat
3. Motorcycle Scenario (Scenario 3): walking, motorcycle taxi, and boat
4. Car Scenario (Scenario 4): walking, 4-wheeled motor vehicle, and boat

Boats were included for every scenario, as there are many villages around the lake that may use boats for at least part of the trip. A boat route was included as part of a journey if its inclusion resulted in an overall shorter travel time. Walking was also included in every scenario, because all residents would need to walk at some point during their trip to an EmONC facility, as they travel through land areas with low road coverage.

To simulate real-life travel experiences in which travel time may vary by terrains, road types, and transportation used, our travel time computation module specified a transportation mode with a corresponding travel speed for every combined land cover class, under each travel scenario. Various sources were used to ascertain the transportation-specific travel speed for each land cover type in the dry season, as summarized in Table 2; the sources consisted of the Global Accessibility Map,[23] AccessMod version 3.0 publication literature,[24] a cost-surface analysis

TABLE 2. Source and Rationale for Travel Speed Specification per Land Cover Type in Kigoma Region, Tanzania

Land Cover Type	Walking	Bicycling	Motorcycle	4-Wheeled Motor Vehicle	Boat
Forestland	Global Accessibility Map ("tree cover/broadleaved and tree cover/mixed leaf type")	N/A	N/A	N/A	N/A
Grassland	Global Accessibility Map ("shrub cover, close-open, evergreen/deciduous, mosaic: cropland/shrub/grass cover, and cultivated and managed area")	AccessMod version 3.0 publication literature[24] (cycling on "low-density vegetation")	AccessMod version 3.0 publication literature[24] (cycling on "low dense vegetation") for simulating reduced motorcycling speed on non-road land features	N/A	N/A
Cropland	Same as in the cell above	N/A	N/A	N/A	N/A
Settlement	Half of the urban walking speed (5 km/hr) specified in AccessMod version 4.0 user manual to approximate the reduced speed of a pregnant woman walking or being carried on a stretcher	AccessMod version 3.0 publication literature[24] (cycling on "built areas")	AccessMod version 3.0 publication literature[24] (cycling on "built areas") for simulating reduced motorcycle speed on non-road land features	N/A	N/A
Other land classification	Global Accessibility Map ("bare area")	AccessMod version 3.0 publication literature[24] (cycling on "low-density vegetation")	AccessMod version 3.0 publication literature[24] (cycling on "low-density vegetation") for simulating reduced motorcycling speed on non-road land features	N/A	N/A
Boat route	N/A	N/A	N/A	N/A	Local knowledge
Major roads	Global Accessibility Map ("bare area")	AccessMod version 3.0 publication literature[24] (cycling on "main road")	The average motorcycling speed per road class recorded from studies done in Vietnam and the Philippines.	Average speed data taken either from WHO's United Republic of Tanzania Road Safety Brief or from a time-distance study done in Dar es Salaam.	N/A
Major roads crossing residential areas					N/A
Secondary roads					N/A
Local roads: passable to all transportation			Set to be equal to 4-wheeled motor vehicles, under the local assumption that motorcycles usually cannot travel faster than these vehicles on roads		N/A
Local roads: passable to motorcycle/bicycle				N/A	N/A
Local roads: walking only		N/A	N/A	N/A	N/A

Summary of the original speed data sources and rationales from which the traveling speeds were derived per transportation and landcover type, for constructing a traveling scenario table required by AccessMod version 4.0 analysis modules to estimate the travel time and accessibility to existing emergency obstetric and neonatal care services in Kigoma Region.

TABLE 3. Travel Speeds, per Land Cover Type, to the Nearest Emergency Obstetric and Neonatal Care Facilities in Kigoma Region, Tanzania, by Travel Scenario

	Travel Speeds (km/hr)										
	Walking Scenario (Scenario 1)		Cycling Scenario (Scenario 2)			Motorcycle Scenario (Scenario 3)			Car Scenario (Scenario 4)		
Land Cover Type	*Walking*[a]	*Boat*	*Walking*	*Bicycling*[b]	*Boat*	*Walking*	*Motorcycle Taxi*	*Boat*	*Walking*	*Car*	*Boat*
Forestland	1.0	–	1.0	–	–	1.0	–	–	1.0	–	–
Grassland	1.7	–	–	7.0	–	–	7.0	–	1.7	–	–
Cropland	1.7	–	1.7	–	–	1.7	–	–	1.7	–	–
Settlement	2.5	–	–	7.0	–	–	7.0	–	2.5	–	–
Other land cover	2.5	–	–	7.0	–	–	7.0	–	2.5	–	–
Boat route	–	15.0	–	–	15.0	–	–	15.0	–	–	15.0
Major roads	2.5	–	–	10.0	–	–	40.2	–	–	50.0	–
Major roads crossing residential areas	2.5	–	–	10.0	–	–	26.2	–	–	30.0	–
Secondary roads	2.5	–	–	10.0	–	–	35.2	–	–	40.0	–
Local roads: passable to all transportation	2.5	–	–	10.0	–	–	15.0	–	–	15.0	–
Local roads: passable to motorcycle/bicycle	2.5	–	–	10.0	–	–	15.0	–	2.5	–	–
Local roads: walking only	2.5	–	2.5	–	–	2.5	–	–	2.5	–	–

[a] Tobler's function was used for correcting anisotropic movement.
Wetlands and rivers were considered to be impassable for the purposes of this analysis (i.e., walking speed of 0), and were not included in this table.

conducted in Dar es Salaam,[25] WHO's Tanzania road safety brief,[26] a motorcycle analysis conducted in Hanoi, Vietnam,[27] and a cost-distance analysis conducted in the Biliran Island, Philippines.[28] Table 3 describes the travel speed for each land cover class for all 4 travel scenarios employed in this analysis.

Live Birth Density Dataset

Live birth count was used as a proxy measurement for women needing delivery care, which is the target population of EmONC services. A 2012 projected live birth raster dataset for Tanzania was obtained from the WorldPop Project.[29] The value of each 100-meter gridded cell represented the estimated number of live births that would have occurred in an area of 100 square meters in 2012.

Analysis

A raster layer that describes the minimum travel time required to reach the nearest EmONC facility was created using the AccessMod version 4.0 extension's modules for each of the 4 travel scenarios. For this accessibility analysis, the upper limit of the estimated travel time was set at 2 hours, a conservative time frame consistent with the WHO recommendations for access to EmONC facilities.[30] Therefore, "good geographic access to EmONC care" was operationally defined as a woman's travel time to EmONC care being at, or under, 2 hours, while "poor geographic access to EmONC care" was defined as a woman's travel time to EmONC care exceeding 2 hours.

Each scenario-specific travel time raster layer was reclassified and converted into 4 incremental

30-minute travel time zones (up to 2 hours) as polygon vectors in ArcGIS 10.3. All 2-hour service catchment areas for each corresponding travel scenario were merged to show the distribution of areas with good EmONC service access (i.e., areas within which one can reach EmONC services in less than 2 hours) based on each of the primary transportation modes.

To compute the region-wide proportion of live births in a travel time zone or service catchment, we divided the total number of live births within a travel time zone or service catchment by the total number of live births in Kigoma Region. In addition, the proportion of live births with poor access to EmONC under each travel scenario was calculated per administrative council for each travel scenario (i.e., Scenarios 1–4 and the "all-modes" scenario, where women may use any of the 4 travel scenarios to reach the nearest EmONC facility as necessary), by dividing the total number of live births located outside the 2-hour service catchment in an administrative council by the total number of live births in the entire council. The live birth figures involved in these calculations were aggregated from the 2012 live birth raster dataset in ArcGIS 10.3, collected to a 100-meter resolution by various travel time or 2-hour catchment polygon vectors using zonal statistics.

The estimate for the number of all births per catchment presented in this analysis was the product of the total population of women aged 15–49 years in Kigoma Region in 2012,[9] the annual population growth coefficient (for projecting the population of 2013),[9] the age-specific fertility rate in the 2014 Kigoma RHS,[12] and the proportion of births occurring in that catchment.

Ethical Considerations

This study was reviewed and approved by the CDC's Center for Global Health Human Subject Review Board and was determined not to comprise human subjects research.

RESULTS

Geographic Access to the Nearest EmONC Facility by Transportation Mode

Compared with the walking scenario (Scenario 1), in which the travel distance covered within 2 hours was confined to the immediate surroundings of each EmONC facility, the travel distance greatly increased once people could access bicycles (Scenario 2), motorcycles (Scenario 3), or cars (Scenario 4) (Figure 2). The greatly improved accessibility along the road network was not visually evident until people traveled by motor vehicles (Scenarios 3 and 4) (Figure 2). The travel time distributions by motorcycle (Scenario 3) and by bicycle (Scenario 2) was less linked to the road network than was traveling by car, as bicycle and motorcycle taxis were assumed to be capable of traveling through the grassland and other land cover surrounding many roads.

Many towns located near the shore of Lake Tanganyika—particularly those in the southwest—were connected to some levels of a road network (Figure 1) and were mostly within the 2-hour travel time catchment from an EmONC facility if motorized vehicles were used (Figure 2). A few areas on the northern shore were not connected to any EmONC facilities by the road network but were able to gain marginal EmONC access (e.g., travel time of 91–120 minutes) in scenarios in which motorized vehicles were used, since boat routes provided connections to the closest road network.

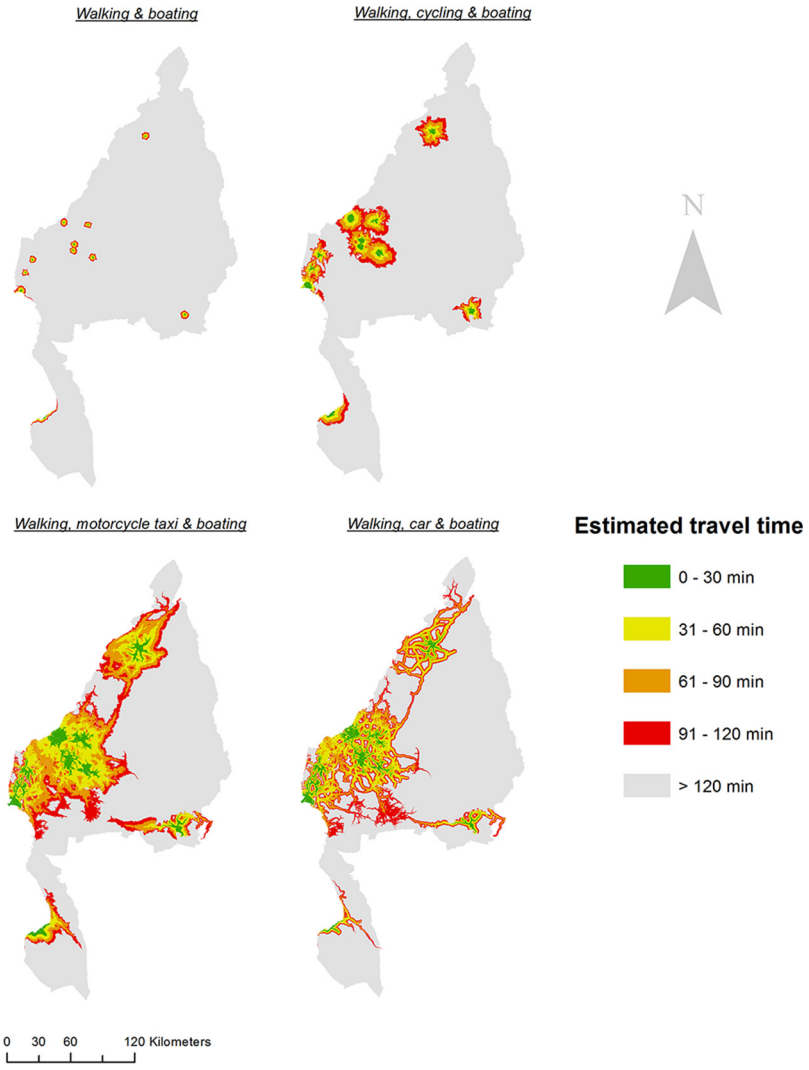
The region-wide percentage of live births with poor access to EmONC decreased with faster methods of transportation, with the walking scenario (Scenario 1) having the highest percentage of poor access (87%), followed by mechanized transportation (i.e., Scenario 2: 65%), and finally motorized transportation (i.e., Scenario 4: 39%; Scenario 3: 33%) (Table 4). Figure 3 displays the areal distribution of Kigoma Region by primary transportation modes (travel scenarios) that women could use to reach EmONC within 2 hours. In other words, each colored catchment area displays all the primary transportation modes, or travel scenarios (of the 4 in this analysis), that women in that area may use to reach the nearest EmONC facility within 2 hours. Even in the ideal scenario where people may use any of the 4 primary transportation modes, about one-third (32%) of the estimated live births would not reach EmONC facilities within 2 hours in Kigoma Region. One-third of live births (i.e., 24% [Car, Motorcycle Taxi] + 2% [Car] + 7% [Motorcycle Taxi] = 33%) occurred in areas where the population could reach an EmONC facility only if motorized vehicles (i.e., motorcycle [Scenario 3] or car [Scenario 4]) were available. Seven percent of the live births occurred in areas where the population may only reach EmONC services if a motorcycle taxi (Scenario 3) were available.

About one-third of estimated live births would not reach an EmONC facility within 2 hours in Kigoma Region in the ideal travel scenario.

Distribution of Live Births With Poor Access to EmONC per District by Transportation Mode

Among the 8 administrative councils, Kakonko, Kibondo, and Uvinza consistently were estimated

FIGURE 2. Distribution of Estimated Travel Time to the Nearest Emergency Obstetric and Neonatal Care Facility by Travel Scenario, Kigoma Region, Tanzania



to have more than half of their live births experiencing poor access to EmONC service regardless of the travel scenario used (Figure 4). Kigoma Muncipal-Ujiji was the only council where the percentage of live births with poor EmONC access remained below 30% across all travel scenarios. It was also the only council where no meaningful difference in accessibility was observed among the 3 types of vehicles (i.e., bicycle, motorcycle taxi, and cars; Scenarios 2, 3, and 4, respectively).

In the scenario where bicycles alone were used, for 3 councils (Kakonko, Kibondo, and Uvinza), more than half of the women could not get to care within 2 hours, even if they used any of the 4 primary transportation modes (all-mode scenario). Kigoma Municipal-Ujiji and Kasulu Township Authority had fewer than 20% of live births experiencing poor EmONC access when bicycles were used (Figure 4). In scenarios in which motorized vehicles were fully utilized (Scenarios 3 and 4), only half of the councils in

TABLE 4. Distribution of Estimated Proportion of Live Births Occurring in Each Travel Time Catchment by Travel Scenario,[a] Kigoma Region, Tanzania, 2013

Travel Time (min)	Walking Scenario (Scenario 1) No. (%)	Cycling Scenario (Scenario 2) No. (%)	Motorcycle Scenario (Scenario 3) No. (%)	Car Scenario (Scenario 4) No. (%)
0–30	1,263 (2)	9,044 (11)	17,418 (21)	16,572 (20)
31–60	3,172 (4)	7,542 (9)	16,487 (20)	13,565 (16)
61–90	3,451 (4)	6,044 (7)	13,320 (16)	11,768 (14)
91–120	3,123 (4)	6,522 (8)	8,001 (10)	8,631 (10)
>120	71,980 (87)	53,837 (65)	27,763 (33)	32,453 (39)

[a] Walking scenario (Scenario 1) includes both walking and boat access. Cycling scenario (Scenario 2) includes walking, boat access, and bicycle access. Motorcycle scenario (Scenario 3) includes walking, boat access, and motorcycle access. Car scenario (Scenario 4) includes walking, boat access, and car access.

Kigoma Region (Buhigwe, Kasulu Township Authority, Kigoma Municipal-Ujiji, and Kigoma Rural) had fewer than 20% of live births experiencing poor EmONC access.

DISCUSSION

Our study provides a lens for public health stakeholders to focus on the disparity in geographic access to EmONC services across Kigoma Region in Tanzania. By using spatial health care accessibility modeling, stakeholders can identify locations where various interventions, such as increasing transportation access or health resources, could be implemented to effectively improve access. The fact that 32% of estimated live births in Kigoma Region may not be able to reach EmONC services within 2 hours in dry season, regardless of the type of transportation used, suggests that a transportation-based intervention alone may not be enough to achieve a high level of accessibility to EmONC services. Our results in Kakonko, Kibondo, and Uvinza suggest it may be necessary to upgrade non-EmONC facilities, especially health centers, to have EmONC capabilities.

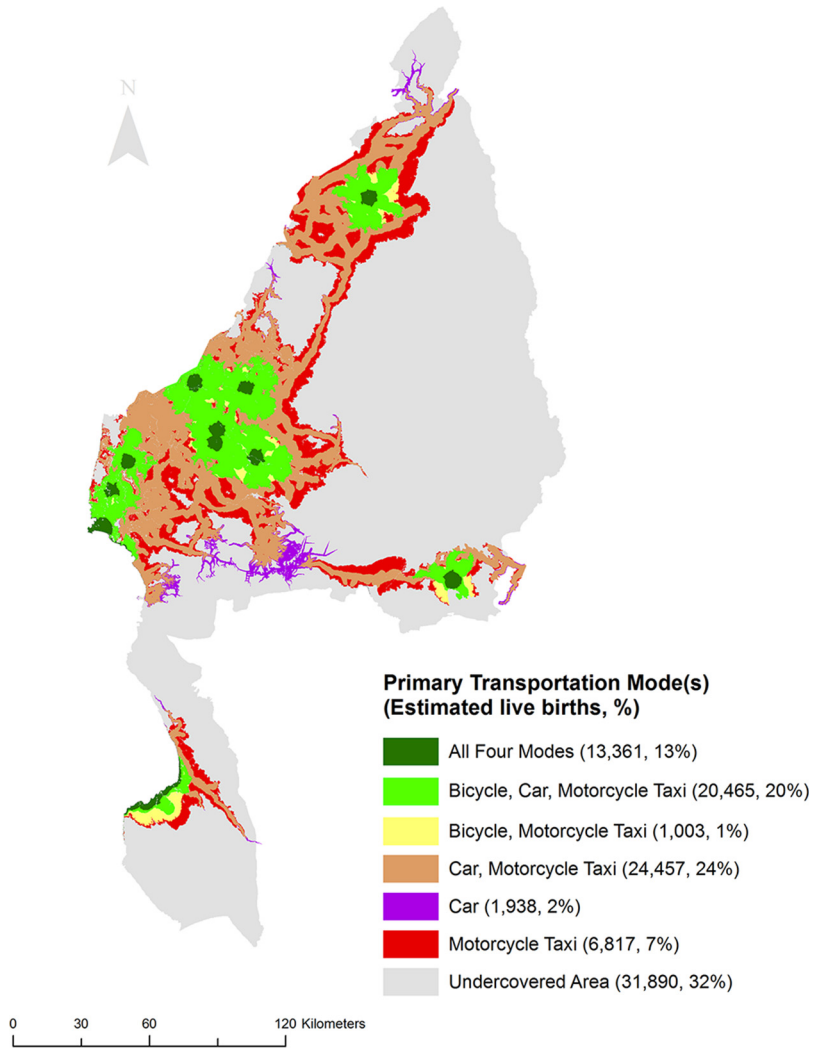
We therefore recommend to implementing partners that to address coverage gaps, the priority for upgrades should be given to facilities located in areas with suboptimal estimated travel time but with a higher density of births, where the demand for delivery care is likely to be greater. Another possible programmatic intervention may include establishing affordable maternity waiting homes in the geographic proximity of CEmONC facilities such that women living farther than 2 hours away from any EmONC facilities may stay during the last weeks of their pregnancy. However, to ensure the effectiveness of such an intervention, connection to appropriate transportation from the maternity homes and promotion of using the homes via social network and community support should be established.[31] As several hospitals and health centers in Kigoma are associated with local maternity waiting homes, future research may be required to assess the usage of the homes and their impact to EmONC access by analyzing travel time.

A transportation-based intervention alone may not be enough to achieve a high level of accessibility to EmONC services in Kigoma Region, Tanzania.

Our findings also suggest that there are areas where geographic access to EmONC might be enhanced by improving women's access to mechanized or motorized vehicles. Similar trends were also observed in a study that used travel time cost surface modeling to assess accessibility by various transportation scenarios in the Western Province of Rwanda.[32] Since access to a transportation mode may depend on both affordability and availability, it is crucial to consider the advantages and disadvantages of each of the primary methods of transportation when considering health transportation strategies. Although 4-wheeled motor vehicles have the advantages of greater geographic reach, increased long-distance travel capabilities, and potential space for medical equipment, they may be a less practical option for ambulance transportation given the relatively low availability of functional vehicles, insufficient

There are areas where geographic access to EmONC might be enhanced by improving women's access to mechanized or motorized vehicles.

FIGURE 3. Primary Transportation Modes Allowing Access to the Nearest Emergency Obstetric and Neonatal Care Facility Within 2 Hours, Kigoma Region, Tanzania

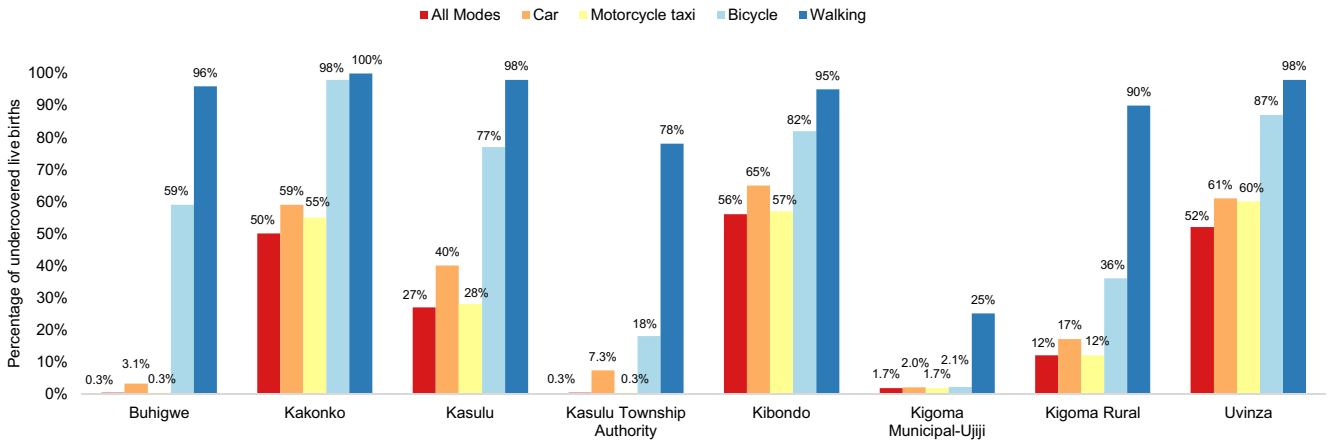


fuel, monetary cost, and lack of available drivers,[16] especially in rural communities.

In sub-Saharan Africa, 4-wheeled motor ambulance services are rarely available for the general population due to the high costs associated with maintaining such vehicles.[33] Furthermore, ambulances are frequently used for other duties unrelated to patient transportation in clinical emergencies, making them even less accessible.[1] Another limitation of 4-wheeled public transportation vehicles is that they are mostly operated around urban areas or town centers, particularly on major interurban roads.[34,35] Therefore, unless women living in rural areas reside in villages close to major roads, it is unlikely they will be able to access 4-wheeled vehicle transportation in a timely fashion.

Many studies have stressed the importance of motorcycles and bicycles as intermediate means of transportation to improve access to health services, taking advantage of their high availability and mobility.[33,36–38] Although these transportation methods may not be optimal for traveling over very long distances due to their susceptibility to wear and tear in rough terrain or extreme weather and higher overall taxi fares for longer distances,[34,39] it has been

FIGURE 4. Percentage Distribution of Live Births With Poor Access to Emergency Obstetric and Neonatal Care Facilities, by District, for Each Travel Scenario in Kigoma Region, Tanzania



suggested that they may be useful for bridging the accessibility gap in rural communities by transporting women from isolated villages to nearby traffic hubs, where women can access public transportation to reach EmONC facilities.

Our estimates of the proportion of live births with poor access by transportation method (Figure 4) suggest that the areas around Kigoma Town—Kigoma Municipal-Ujiji, Kigoma Rural, and Kasulu Township Authority—would be the most suitable districts for using bicycles for health transportation. Residents in Buhigwe, Kasulu, and Kigoma Rural districts could benefit greatly if motorcycles were successfully integrated to the local health transportation, given the large proportion of live births that would have sufficient geographic access under the motorcycle scenario. Using motorcycles in isolated areas may be especially important in Kasulu district, where there could be an expected 12% decrease in the live births with poor EmONC access if motorcycles were used, compared with the scenario in which 4-wheeled motor vehicles were used.

One major challenge to systematically incorporating motorcycles into health transportation is that the number of motorcycles in rural Tanzania is relatively low, compared with rural regions of some other African countries where motorcycles compose the majority of their transportation fleets.[35] This may explain the relatively low use (14%) of motorcycles for traveling to advanced health facilities (e.g., hospitals and health centers) in Kigoma Region, as shown in the 2014 RHS (Supplement). Another potential factor is the cultural and social stigma against women riding on motorcycles in many sub-Saharan African regions.[40–42] Although there has been an increasing trend in motorcycle imports in Tanzania in recent years,[34,43] effectively incorporating motorcycles as part of routine health transportation would require continued collaboration between private and public transportation sectors and EmONC facilities, as well as promoting the use of motorcycle-based transportation intervention to rural populations.

The areas around Kigoma Town seem to be the most suitable districts for using bicycles for health transportation, while residents in Buhigwe, Kasulu, and Kigoma Rural districts could benefit from access to motorcycles.

Bicycles are one of the most common modes of transportation in rural Tanzania.[34] However, only 6% of delivery trips to advanced health facilities involve bicycles, according to the weighted distribution of transportation type among the most recent delivery trips to health centers and hospitals in Kigoma obtained from 2014 RHS (Supplement). Furthermore, the overall utility of the bicycle as effective health transportation for women in labor may still be vastly limited by its susceptibility to wear and tear by rough road and weather conditions, which may downplay its traveling speed, as well as limited seating space and physical discomfort experienced by pregnant women during the bike ride. Consequently, bicycles may only be used in very limited travel situations, such as traveling from areas where women may not reach EmONC by stretcher (i.e., being carried on a stretcher by walking men) within 2 hours and where discomfort and tear

associated with traveling distance is acceptable. A possible solution for resolving limited seating space could involve modifying bicycles to include lightweight trailers for carrying pregnant women. In-depth multidisciplinary assessments that consider transportation management, cost-effectiveness, and sociocultural factors will be required to effectively strategize the integration of bicycles and motorcycles into local health transportation systems in Kigoma Region.

Boat rides may provide women in geographically secluded villages along the northeastern shore with indispensable access to nearby transportation hubs.

Finally, our findings suggest that boat rides may provide women living in geographically secluded villages along the northeastern shore of Lake Tanganyika with indispensable access to nearby transportation hubs, where they may subsequently reach EmONC facilities via local road networks. Therefore, it may be crucial to develop multistakeholder partnerships among local community financing programs, EmONC facilities, boat ferries operators, and public transportation to facilitate affordability and a smooth transportation network transition. However, boat ferries have the disadvantage of being subject to adverse weather and poor safety regulations.[44] Therefore, a long-term solution to enhancing EmONC access in these remote areas may still involve expanding local obstetric health resources, including upgrading the nearest health centers.

Limitations

A major caveat for this analysis, as well as for other studies using travel time cost surface models, is that a single idealized traveling situation was assumed for each primary transportation scheme. Our schema assumed that people will access (and only use) the prespecified primary transportation on the nearest road until they reach the closest road to the nearest EmONC facility. Furthermore, all of the accessibility maps were modeled based on the road network distribution and vehicular traveling speeds for the dry season, which may not account for the potential barriers caused by flooding or poor road conditions during the rainy season. Therefore, caution should be applied when attempting to generalize such accessibility maps to real-life scenarios in which motor vehicle access may be limited based on one's residence, financial capacity, current road conditions, and local climate. In addition, the technical limitation observed when modeling anisotropic cycling speed may lead to overestimation of travel time in areas where women are traveling downhill, or underestimation of travel time in areas where women are traveling uphill.

Many of our input data layers, while collected around similar time periods (as shown in Figure 1), are not from exactly the same time period. The digital elevation model (collected in 2000) and land cover (collected in 2010) stayed relatively static in the study area throughout the time period. Meanwhile, the data layers more subject to change were aligned to match with the approximate time period of our study (i.e., the road and river networks collected in 2015, birth density map collected in 2012). While it is very unlikely that these layers are meaningfully different from their distribution in 2013, we recognize the minor impact that this data collection time discrepancy may potentially have on the accuracy of our accessibility simulation.

With regard to the underlying data used, crowdsourced road data such as OpenStreetMap are inevitably subject to inconsistent data quality, as quality depends on mappers' experience, despite numerous quality assurance efforts.[45] The number of digitized roads saved in the database for a specified area may depend on the availability of active OpenStreetMap projects in that area, as online contributors are more likely to digitize features requested by active OpenStreetMap projects. This can potentially lead to us underestimating road access in certain areas in Kigoma Region. In addition, there is little evidence on the walking speed for people carrying a woman on a stretcher (a common method of travel for pregnant women in labor in sub-Saharan Africa), or the travel speed of motorcycle by road type in rural sub-Saharan Africa. Lack of this evidence may limit the accuracy of the travel time catchment area and the proportion of covered live births reflected in this study. Furthermore, the speeds used in the analysis may not account for geographic differences or traffic flows between originating locations and Kigoma Region. There may be overestimation of travel time in scenarios where 4-wheeled motor vehicles were used, as Dar es Salaam, the source location for the 4-wheeled motor vehicle travel speeds, may have heavier traffic than Kigoma. Conversely, there may be underestimation in scenarios where motorcycles were used, as motorcycles tend to travel much faster on paved roads, which may be more prevalent in Hanoi, one of the source locations for the motorcycle speeds, than in Kigoma.

In this analysis, geographic considerations have to be made to the underlying spatial resolution of the raster datasets used and in the aggregation of the proportion of live births with poor access to EmONC care. Any output travel time

raster is affected by the quality of the spatial resolution of the input datasets. As road network is rasterized from vector data, the travel speed for a specific road class is applied to the whole 30-meter square cell, even though many roads are below a width of 30 meters. This can lead to overestimation of access in areas around the roads. In addition, there are inherently greater uncertainties about subnational data within WorldPop's birth density map.[46] This can affect the accuracy of the estimated proportion of live births with poor EmONC access reported in areas where local population densities are significantly lower (e.g., Kibondo administrative council) than the overall average. The travel time zone and 2-hour catchment raster were both converted to polygon vectors before aggregating birth estimates via zonal statistics. Despite the high resolution (i.e., 30 meters) of the travel time friction surface, such conversion may affect the accuracy of the birth estimates around the travel time zone or 2-hour catchment border. Similarly, our inability to resample birth grids to finer resolution, due to a lack of complete and accurate high-resolution spatial data on housing distribution, may also affect the accuracy of our birth estimates, especially for smaller-sized travel time zones or 2-hour catchment areas.

CONCLUSION

Bicycles, motorcycles, and cars provide a significant increase in geographic accessibility to EmONC services in Kigoma Region, Tanzania, but the utility of each primary transportation method may vary locally. Therefore, in order to develop an effective yet feasible health transportation intervention, stakeholders should carefully consider the capacity of their current resources while collaborating with health facilities and public transportation sectors to incorporate bicycles and motorcycles as part of the local health transportation routine. In areas where motorized transportation did not achieve satisfactory improvement to geographic accessibility, upgrading EmONC capacity among local dispensaries and non-EmONC health centers while improving health transportation should maximize local geographic access to EmONC services. Future directions of research, pending availability of other forms of data, could include rainy/dry season-specific analyses, as well as travel-time analyses to maternity homes.

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ORIGINAL ARTICLE

Increasing Contraceptive Access for Hard-to-Reach Populations With Vouchers and Social Franchising in Uganda

Benjamin Bellows,[a] Anna Mackay,[b] Antonia Dingle,[c] Richard Tuyiragize,[d] William Nnyombi,[d] Aisha Dasgupta[b,e]

Between 2011 and 2014, the program provided more than 330,000 family planning services, mostly to rural women in the informal sector with little or no education. 70% of the voucher clients chose an implant and 25% an intrauterine device.

ABSTRACT

From 2001 to 2011, modern contraceptive prevalence in Uganda increased from 18% to 26%. However, modern method use, in particular use of long-acting reversible contraceptives (LARCs) and permanent methods (PMs), remained low. In the 2011 Uganda Demographic and Health Survey, only 1 of 5 married women used a LARC or PM even though 34% indicated an unmet need for contraception. Between 2011 and 2014, a social franchise and family planning voucher program, supporting 400 private facilities to provide family planning counseling and broaden contraceptive choice by adding LARCs and PMs to the service mix, offered a voucher to enable poor women to access family planning services at franchised facilities. This study analyzes service trends and voucher client demographics and estimates the contribution of the program to increasing contraceptive prevalence in Uganda, using the Impact 2 model developed by Marie Stopes International. Between March 2011 and December 2014, 330,826 women received a family planning service using the voucher, of which 70% of voucher clients chose an implant and 25% chose an intrauterine device. The median age of voucher users was 28 years; 79% had no education or only a primary education; and 48% reported they were unemployed or a housewife. We estimated that by 2014, 280,000 of the approximately 8,600,000 women of reproductive age in Uganda were using a contraceptive method provided by the program and that 120,000 of the clients were "additional users" of contraception, contributing 1.4 percentage points to the national modern contraceptive prevalence rate. The combination of family planning vouchers and a franchise-based quality improvement initiative can leverage existing private health infrastructure to substantially expand family planning access and choice for disadvantaged populations and potentially improve contraceptive prevalence when scaled nationally.

BACKGROUND

From 2001 to 2011, modern contraceptive prevalence in Uganda increased from 18% to 26% among married women of reproductive age.[1] Despite these gains, the use of modern methods, in particular long-acting reversible contraceptives (LARCs) and permanent methods (PMs), remained quite low. In the 2011 Uganda Demographic and Health Survey (DHS), short-acting injections were the most common method used, and only 1 of 5 married contraceptive users reported using a LARC or PM.[1] The 2011 Uganda DHS also reported that intrauterine devices (IUDs) were used by less than 1% of married women even though 34% of married women indicated an unmet need for family planning services.[1] High modern contraceptive prevalence is associated with improved maternal health outcomes and a range of positive social outcomes.[2,3]

Access to a broad method mix is associated with higher contraceptive continuation rates, and higher levels of contraceptive use are associated with reductions in maternal and neonatal mortality and morbidity, a key development goal in low- and middle-income countries (LMICs).[4,5] While the method mix has improved in many LMICs it remains skewed with short-acting modern contraceptives representing most of the observed increases in uptake in response to family planning program initiatives.[6,7] Significant inequities and disparities

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remain in women's access to long-acting methods.[8,9] LARCs remain effective over months and years, allowing women to delay, space, or limit births as they choose.[10,11] For populations using LARCs, short-duration supply chain disruptions are less likely to increase risk of unintended pregnancies. Although initial costs for these methods are higher, the average cost over the period of use is often lower than less effective short-acting methods.[12] LARC methods are often out of reach of the most vulnerable and marginalized women due to cost; fewer trained providers, in some settings; and lack of consumer awareness, among other barriers.[13–15]

As in many LMICs, the barriers to family planning in Uganda exist at the patient, facility, health systems, and policy levels.[16,17] Although policy and health system-level barriers can present significant challenges to LARC uptake, it is often high client out-of-pocket costs, lack of trained providers, and weak supply chains that present the most significant challenges in increasing access to and use of LARCs.[10,18] Targeting provider subsidies and information to beneficiaries who would likely be unable to use the service in the absence of the intervention is essential to addressing these challenges. According to the 2011 Uganda DHS, over half of Ugandan contraceptive users access their method through the private sector. However, most private providers are not trained or equipped to provide a range of family planning services and, where LARCs are offered, financial barriers can prevent uptake.

As described elsewhere, reproductive health voucher programs are designed around 3 key actors[19]:

1. A management agency and its community distribution agents
2. Beneficiaries voluntarily seeking family planning services
3. The family planning service provider

The management agency recruits and monitors community-based distributors who provide vouchers, which represent both a financial subsidy and community-based health education intervention, to disadvantaged or vulnerable clients. The management agency also establishes and maintains reimbursement to family planning facilities that provide contraceptive services at a predefined quality standard. In addition, programs can deploy independent agents to conduct verification and recurrent quality assurance checks. Voucher programs have been of increasing interest to policy makers and reproductive health care consumers in LMICs.[20–24] A recent systematic review found that family planning voucher programs were associated with improved contraceptive uptake, reduced fertility, and increased family planning coverage among low-income populations. However, research gaps were noted, including a lack of study outcomes on family planning quality, unintended outcomes, client qualitative experiences, family planning voucher integration with health systems, and issues related to scale-up of the voucher approach.[25]

Between 2011 and 2014, Marie Stopes Uganda (MSU), a family planning NGO, used donor funds to increase access to LARCs and PMs through a combined social franchise and family planning voucher scheme (Figure 1). MSU trained and supported 400 private facilities across Uganda to provide high-quality family planning counseling and to increase family planning choice by adding LARCS and, in some cases, PMs to the available service mix through a partial franchise model. Through the model, MSU regulates and supports the franchisees' reproductive health and family planning services, allowing the franchisee to offer additional services.[10] Before the initiative, few facilities provided LARC services due to perceived low consumer demand, limited supplies, and lack of provider skills. When they joined the MSU franchise network, facilities were introduced to standard quality assurance measures, provider training on LARC insertion and removal, regular supervision, intermittent quality checks, and service delivery area monitoring.[10,26]

To reduce financial barriers to access, a voucher, with a consumer cost of approximately US$1, was introduced with a focus on poor women of reproductive age. A poverty grading tool—a short questionnaire that scores household assets and consumables to identify disadvantaged individuals—was used to determine eligibility for the voucher program and was administered during voucher distribution in Uganda.[27,28] Adherence to the poverty grading tool criteria was verified during client follow-up surveys. MSU marketed the vouchers through different radio formats, community meetings and dramas, and direct-to-consumer activities. Clients accessed services using their vouchers during regular hours at social franchise outlets/partial franchisees. The voucher entitled consumers to family planning counseling, a method of their choice, and follow-up services, such as IUD removal, as needed. Although the voucher was intended to increase access to LARCs and PMs, as short-acting

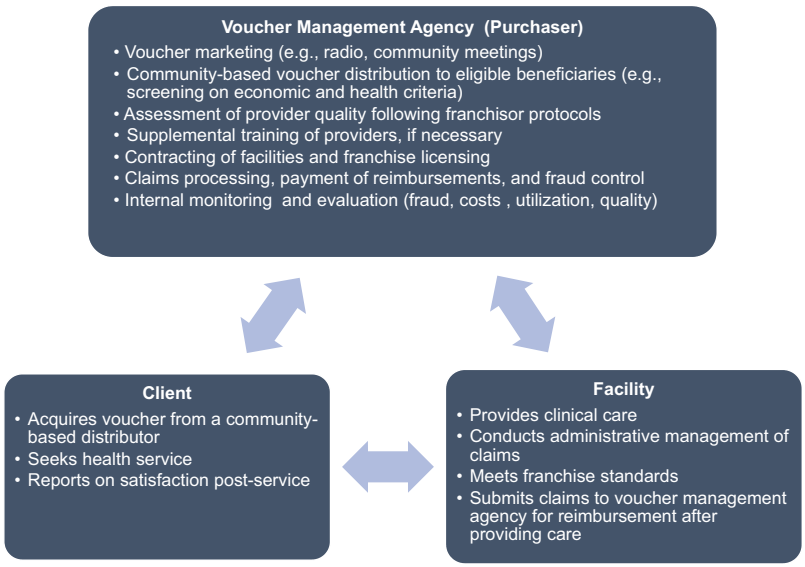
For populations using LARCs, short-duration supply chain disruptions are less likely to increase risk of unintended pregnancies.

High client out-of-pocket costs, lack of trained providers, and weak supply chains often present the most significant challenges in increasing access to and use of LARCs.

Marie Stopes Uganda increased access to LARCs and PMs through a combined social franchise and family planning voucher scheme.

The voucher entitled consumers to family planning counseling, a method of their choice, and follow-up services as needed.

FIGURE 1. Marie Stopes Uganda Family Planning Social Franchise and Voucher Program Design and Functions



methods are usually available in the public sector, it was also redeemable for short-acting methods, to ensure family planning choice. Providers were reimbursed by MSU for voucher services provided after voucher claim vetting and validation.

METHODS

This study presents service trends and voucher client demographics from the family planning voucher program in Uganda. Routine service delivery and client data were collected on every voucher client through a voucher management information system, with client demographic data recorded at the point of voucher distribution and cross-checked by the service provider. To reduce error and fraud, MSU conducted a medical plausibility review of all claims, data verification audits of sampled claims, and intermittent client follow-up checks. All data collection and analysis were conducted according to international principles of maintaining privacy and confidentiality of personal information.

Using the Impact 2 model developed by Marie Stopes International (MSI), the study estimated the health impact of the contraceptive services, such as pregnancies and maternal deaths averted, as well as contributions to contraceptive prevalence rate (CPR) growth and the contribution to national-level additional users of contraception in Uganda.

Impact 2 is a publicly available Excel-based model designed to use service provision data (http://mariestopes.org/impact-2).[29] Impact 2 converts service data to the estimated number of contraceptive method users in a year, rather than the total number of clients who received services each year. Because LARCs and PMs offer multiple years of contraceptive coverage, the women who use these methods may not receive services annually. For example, some women who receive a LARC in 2012 could still be using the method in 2013, without receiving another service in 2013. The model factors in discontinuation of LARCs. For short-acting methods, the model estimates the number of services required for one year's worth of use. From the number of users of contraceptive methods, the model estimates the number of pregnancies averted and the resulting adverse health and economic outcomes averted, using best-available data on probabilities of these outcomes.

The model also takes into account data on who the program is reaching—for example, some women who are "new" to a provider may not be new to contraception—and estimates how these

distinctions contribute to national-level additional users of contraception, in line with goals established by the global Family Planning 2020 (FP2020) initiative.[30] While it is important that the social franchise and voucher program offers quality services and a fuller choice of methods, providing clients who were already using contraception from another provider with contraception services will not result in national-level increases in contraceptive use. Impact 2 addresses this by setting a "client profile," which categorizes clients as:

- Adopters, who were not using a modern contraceptive method before receiving their service
- Continuing clients, who were already using a modern contraceptive method that they had received from the provider
- Provider-changers, who were already using modern contraception but previously received their method from a different provider

Impact 2 does not allow provider-changers to contribute to national-level growth in contraceptive use. Continuing clients are important to maintain the baseline of users, while adopters offset declines in user-numbers and contribute to national additional users. However, reliable data on the proportion of voucher clients who were adopters, continuers, and provider-changers were not available from the voucher client data set. Instead, the client profile used to generate Impact 2 additional user and CPR change data was estimated from client exit interviews carried out on a random sample of family planning clients using services from MSI's Social Franchise channel in Uganda in 2012 and 2013. The short, interviewer-administrated standardized questionnaire gathered information about the client's demographics and recent use of contraception. In the absence of a client exit interview survey for 2014, the 2013 client profile estimate was used. Because the family planning clients surveyed included both voucher and non-voucher users, and the exit interviews were not carried out in 2011 and 2014, the exit interview client profiles were proxies for the proportion of voucher clients who were adopters, continuers, and provider-changers. Exit interview data were used for the CPR change and additional user estimates only; all other findings were based on the routine voucher client data collected as part of the voucher management process.

After service data and the client profile were entered into the model, Impact 2 was run in "service life-span" mode to estimate the impact of services provided in a given year over the full life span of the methods—given that LARC and PM services will continue to provide contraceptive protection in future years. The service life-span concept applies to LARC and PM services only; for short-acting methods, there is no carry forward into future years. Using the service life-span mode ensures that the contribution of LARCs and PMs made in the first year is carried forward into subsequent years by including a modelled reduction in LARC use over time to reflect estimated discontinuation of methods use by current users.

RESULTS

Between March 2011 and December 2014, 330,826 services were provided to women under the family planning voucher scheme in Uganda.

The median age for the family planning voucher users was 28 years (interquartile range [IQR], 23–32 years). Although gender was not recorded, gender-specific methods indicate that the vast majority of family planning voucher clients were women with a median of 3 living children. A majority (79.4%) of voucher clients had no education or only a primary education, and nearly half (47.6%) reported they were unemployed or self-described as a housewife. Almost a quarter (22.5%) of the clients were laborers or smallholder agriculturalists (Table 1).

Most family planning voucher clients had no education or only a primary education, and nearly half reported they were unemployed or a housewife.

Although data on fertility preferences were limited, clients were asked about the number of currently living children they have and the number of children they desired to have in their lifetime. Approximately 6% reported having more children than they ideally wanted, 34% wanted no additional children, and 60% wanted to have 1 or more children in the future (data not shown).

Over half (58.6%) of clients heard about the voucher from either a community-based distributor (46.6%) or a health care worker (12.0%). A minority of clients heard about the voucher through a social contact, such as friends, family, or another satisfied user (15.4%); heard about the voucher through marketing and mobilization channels, such as behavior change communication, radio, banners, branding, and community mobilization (14.0%); or reported no information source (10.7%) (Table 2).

A majority (69.8%) of voucher clients used their voucher to receive an implant and 25.1% received an IUD (Table 3). Contraceptive

TABLE 1. Family Planning Voucher Client Characteristics, 2011–2014 (N=330,826)

Characteristic	Value
Age,[a] years, median (IQR)	28 (23–32)
No. of surviving children, median (IQR)	3 (2–5)
Education, No. (%)	
None	101,052 (30.6)
Some or completed primary	161,424 (48.8)
Some or completed secondary	61,449 (18.6)
Post-secondary	3,857 (1.2)
Missing	2,937 (0.8)
Occupation, No. (%)	
Unemployed/housewife	157,395 (47.6)
Agriculture/laborer	74,532 (22.5)
Professional	9,537 (2.9)
Other	13,702 (4.1)
Missing	75,660 (22.9)

Abbreviation: IQR, interquartile range.
[a] Data on age were missing for 2,064 clients.

TABLE 2. Source of Information About the Voucher Program and Benefits (N=330,826)

Source	No. (%)
Community-based distributor	154,162 (46.6)
Health care worker	39,704 (12.0)
Missing/none	35,536 (10.7)
Friend/relative	30,750 (9.3)
Radio	29,156 (8.8)
Satisfied user	20,078 (6.1)
Behavior change communication promotions	12,365 (3.7)
Other	4,153 (1.3)
Branding	3,946 (1.2)
Community mobilization	976 (0.3)

Of the 8.6 million women of reproductive age in Uganda in 2014, we estimated that 280,000 were using a contraceptive method delivered through the Marie Stopes Uganda franchise and voucher program.

Over nearly 4 years, the social franchise and voucher program provided more than 330,000 family planning services.

uptake and client volume increased significantly over time. There appears to be a seasonal increase in October and November of each year, with a slight decrease in volume in late December and early January (Figure 2). This decrease may be attributed to facilities closing for the holidays and clients being preoccupied with other business.

The estimated impacts of the program, as a result of the services provided in a given year, are presented in Table 4. Since LARCs and PMs provide multiple years of protection, some of these impacts will happen over multiple future years. For example, we estimated that the services provided in 2014 averted or will avert 218,000 unintended pregnancies and 520 maternal deaths, and save nearly US$14 million in direct health care costs.

Of the approximately 8,600,000 women of reproductive age in Uganda in 2014, we estimated that 280,000 were using a contraceptive method delivered through the franchise and voucher program. This estimate is derived from Impact 2, and includes those women who took up a contraceptive method in 2014, and the estimated portion of women who took up a LARC or PM in 2011–2013 and are estimated to be continuing to use that method in 2014. Applying the percentages of client profiles from the MSI exit interview results of 2012 and 2013, respectively (adopters 33%, 40%; continuers 32%, 22%; and provider-changers 36%, 37%), we estimate that 120,000 of the clients were "additional users" of contraception, which takes into account estimated adopters, discontinuation from previous years, and other dynamic factors in contraceptive use at the population level. We further estimate that this social franchise and voucher program added 1.4 percentage points to national mCPR between 2011 and 2014.

Figure 3 presents estimates of the number of family planning users from the voucher program by year, and puts this in the context of national LARC and PM user numbers derived from the DHS and the Performance, Management, and Accountability 2020 (PMA2020) surveys and population estimates.

DISCUSSION

Over the nearly 4-year project period, the number of clients participating in the family

TABLE 3. Family Planning Methods Selected by Voucher Clients, 2011–2014

	2011	2012	2013	2014	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Implants	5,617 (89.4)	40,900 (85.8)	80,743 (70.8)	103,769 (63.7)	231,029 (69.8)
IUDs	660 (10.5)	5,741 (12.0)	27,720 (24.3)	48,822 (29.9)	82,943 (25.1)
Bi-tubal ligation	4 (0.1)	778 (1.6)	5,093 (4.5)	9,726 (5.9)	15,601 (4.7)
Vasectomy	1 (<0.1)	58 (0.1)	236 (0.2)	425 (0.3)	720 (0.2)
No method given	0 (0.0)	78 (0.2)	160 (0.1)	65 (<0.1)	303 (0.1)
Injectables	0 (0.0)	98 (0.2)	60 (0.1)	25 (<0.1)	183 (0.1)
Oral contraceptive pills	0 (0.0)	22 (0.1)	9 (<0.1)	6 (<0.1)	37 (<0.1)
Condoms	0 (0.0)	1 (<0.1)	3 (<0.1)	1 (<0.1)	5 (<0.1)
Emergency contraception	0 (0.0)	1 (<0.1)	3 (<0.1)	1 (<0.1)	5 (<0.1)
Total	**6,282 (100.0)**	**47,677 (100.0)**	**114,027 (100.0)**	**162,840 (100.0)**	**330,826 (100.0)**

Abbreviation: IUD, intrauterine device.

planning social franchise and voucher program in Uganda increased substantially, with more than 330,000 services provided in total. The limited education level and high unemployment status of the voucher clients suggest that the voucher program was serving disadvantaged beneficiaries as intended. Nearly half of the clients heard about the family planning services from a community-based voucher distributor, which emphasizes the importance of mobilizing demand in the community to realize improvement in contraceptive access, particularly in rural areas. Successful rural mobilization via community-based agents was demonstrated in early voucher programs and, more recently, in generalized family planning initiatives.[31,32]

The program's emphasis on reducing financial barriers to accessing LARCs was an important prerequisite to realizing World Health Organization tier-effectiveness counseling.[33] If clients are aware that LARCs cost more than other methods, they are less likely to seek or request them. These findings are consistent with the literature that vouchers help to reduce the price barrier and likely empower clients to demand the most effective contraceptive method.[34,35] Supply-side factors also contribute to improved LARC uptake, and the increase in uptake of implants in our analysis is consistent with other recent reports from social franchises in sub-Saharan Africa.[10]

By 2014, there were an estimated 280,000 women using contraception from the franchising and voucher program. To put this in context, there were an estimated 500,000 LARC and PM users nationally by 2014–2015.[36] Based on preliminary findings from the 2016 Demographic and Health Survey, the modern method CPR among married women increased by 9 percentage points between 2011 and 2016, from 26% to 35%, and the LARC proportion of the method mix doubled during the same time period, from 12% to 22%.[37] Furthermore, IUD use among married women increased threefold, from 0.5% to 1.5%.[37] By reducing financial barriers to LARCs and PMs, the voucher and franchising program may have helped contribute to national-level increases in contraceptive prevalence: the estimated CPR increase from the voucher program of 1.4 percentage points represents 15% of Uganda's CPR increase between the 2011 and 2016 DHS surveys for modern methods among married women. Attribution from these program data is based on several assumptions. First, it is assumed that all other providers generally maintained their 2010 CPR contributions. Second, the extent to which any providers did not maintain their 2010 CPR contributions, the voucher

Vouchers help reduce the price barrier to accessing LARCs and likely empower clients to demand the most effective contraceptive method.

FIGURE 2. Date of Family Planning Voucher Clients' First Visit to a Marie Stopes Uganda Social Franchise Facility, January 2011 to January 2015

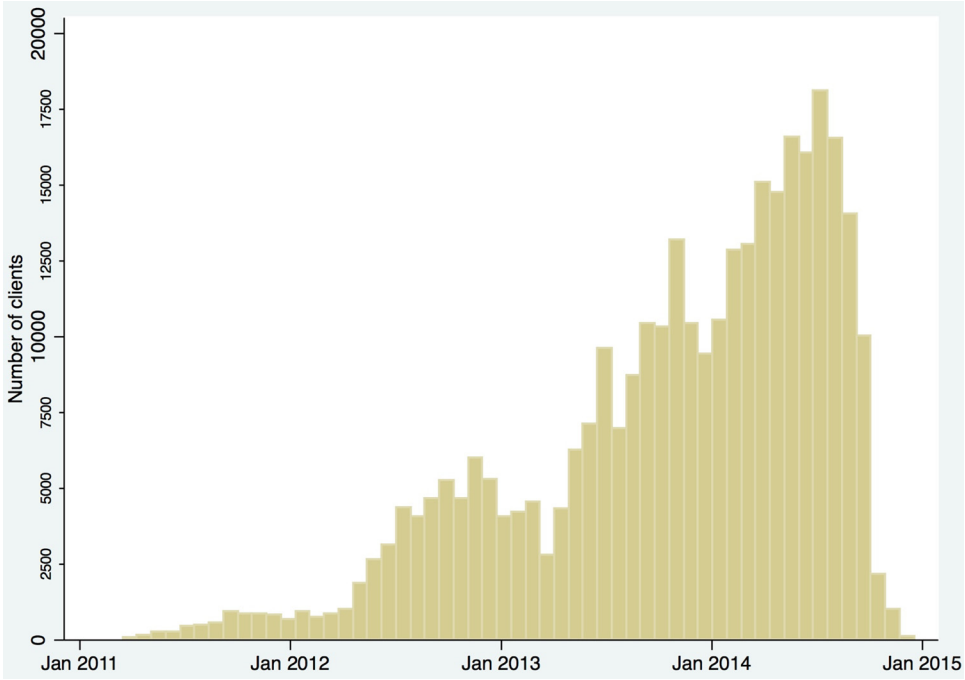


TABLE 4. Estimated Impact of the Marie Stopes Uganda Social Franchise and Voucher Program, 2011–2014

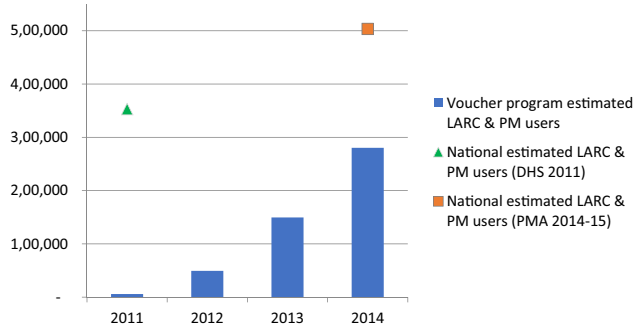
	2011	2012	2013	2014
Unintended pregnancies averted	6,000	55,000	145,000	218,000
Maternal deaths averted	10	150	360	520
Direct health care costs saved (2014 USD)	429,000	3,400,000	9,100,000	13,800,000

program would have to offset that decline. Third, our analysis assumed a baseline of zero LARC users in 2010 at affiliated facilities; however, if the affiliated facilities were already providing LARCs
and PMs prior to the start of the 2011 program, then at least part of the LARC and PM take-up seen in the voucher program might have taken place even in the absence of the program. The franchised facilities, however, were all newly trained on LARCs and PMs and thus the assumption that they did not provide LARCs and PMs before the voucher program is considered reasonable.

Operating the voucher scheme within a social franchise offers opportunities to undertake quality improvement interventions on the basis of voucher monitoring data. Voucher clients are engaged first at the community-based distribution point and again at the clinic visit. Because their contact details are available, they can be contacted later to gauge their satisfaction with and the

quality of the services and methods they used. As can be seen from Table 3, while implants remained the most popular method throughout the project period, the proportion of women choosing IUDs increased significantly from 11% in 2012 to 30% in 2014. This likely can be attributed to a quality improvement intervention undertaken in 2013 that aimed to reduce supply-side barriers to method access and maximize client choice of method. Results from a 2013 voucher client follow-up survey indicated that many clients had not been fully counseled on IUDs. Follow-up interviews with providers revealed that franchisees lacked confidence on IUD counseling and provision. After retraining and mentoring of providers from mid-2013 onwards, increasing numbers of women chose IUDs, suggesting that franchisees were providing higher-quality counseling on IUDs as part of a comprehensive method mix, and women were better able to exercise method choice.

FIGURE 3. Marie Stopes Uganda Voucher Program Users Compared With National Estimates of LARC and PM Users, 2011–2014



Abbreviations: DHS, Demographic and Health Survey; LARC, long-acting reversible contraceptive; PM, permanent methods; PMA, Performance, Monitoring, and Accountability.

Limitations

Because of the nature of the study, no comparison group was available. It is also possible that a secular increase in family planning utilization—in which a high number of disadvantaged individuals began to seek long-acting reversible contraception without relying on the voucher—could have occurred in Uganda during the program period. Additionally, the routine voucher data presented here may include recording errors by voucher distributors and providers. Finally, using social franchising client exit interview results as a proxy for voucher user client profiles may underestimate the proportion of voucher users who are family planning adopters, as non-voucher social franchise clients are more likely to return to using short-acting methods. However, the majority of social franchise clients between 2011 and 2014 were voucher users, so we consider the client exit interview results to be a reasonable proxy.

CONCLUSION

The combination of family planning vouchers and a franchise-based quality improvement initiative can leverage existing private health infrastructure to substantially expand family planning access and choice for disadvantaged populations and potentially improve contraceptive prevalence when scaled nationally. Linking a voucher scheme with a social franchise also offers opportunities to undertake quality improvement interventions with providers and improve choice for women. Policy makers considering options to expand contraceptive coverage should consider testing a voucher initiative among private-sector franchises. For the public sector, the voucher system provides a mechanism by which to validate strategic purchasing of services for marginalized populations from franchised facilities.

After retraining and mentoring providers, increasing numbers of women chose IUDs, suggesting that franchisees were providing higher-quality counseling on IUDs as part of a comprehensive method mix.

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ORIGINAL ARTICLE

Overcoming Operational Challenges to Ebola Case Investigation in Sierra Leone

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Deficiencies in transportation and communication, low frontline staff morale, and mistrust among communities, among other operational challenges, greatly limited Ebola case investigation in Sierra Leone. Recommendations for future outbreaks: (1) timely compensation for frontline staff, (2) context-appropriate transportation and communication resources, (3) systematic data collection, storage, and retrieval systems, (4) sound linkages between frontline staff and communities, (5) daily meetings between frontline staff and epidemiologists, (6) clear and appropriate operational chain of command, and (7) political and funding support to operational agencies.

ABSTRACT

The Ebola virus disease (EVD) epidemic that hit West Africa in 2013 was the worst outbreak of EVD in recorded history. While much has been published regarding the international and national-level EVD responses, there is a dearth of literature on district-level coordination and operational structures, successes, and failures. This article seeks to understand how the EVD response unfolded at the district level, namely the challenges to operationalizing EVD surveillance over the course of the outbreak in Port Loko and Kambia districts of Sierra Leone. We present here GOAL Global's understanding of the fundamental challenges to case investigation operations during the EVD response, including environmental and infrastructural, sociocultural, and political and organizational challenges, with insight complemented by a survey of 42 case investigators. Major challenges included deficiencies in transportation and communication resources, low morale and fatigue among case investigators, mismanagement of data, mistrust among communities, and leadership challenges. Without addressing these operational challenges, technical surveillance solutions are difficult to implement and hold limited relevance, due to the poor quality and quantity of data being collected. The low prioritization of operational needs came at a high cost. To mediate this, GOAL addressed these operational challenges by acquiring critical transportation and communication resources to facilitate case investigation, including vehicles, boats, fuel, drivers, phones, and closed user groups; addressing fatigue and low morale by hiring more case investigators, making timely payments, arranging for time off, and providing meals and personal protective equipment; improving data tracking efforts through standard operating procedures, training, and mentorship to build higher-quality case histories and make it easier to access information; strengthening trust in communities by ensuring familiarity and consistency of case investigators; and improving operational leadership challenges through meetings and regular coordination, establishing an active surveillance strategy in Port Loko, and conducting an after-action review. Resolving or addressing these challenges was of primary importance, and requisite for the implementation of technical epidemiological complements to EVD case investigation.

INTRODUCTION

The West African Ebola virus disease (EVD) epidemic began in Meliandou, Guinea, in December 2013, before spreading to Liberia and Sierra Leone in March and May 2014, respectively. By July 2014, EVD had spread beyond containment, and on August 8, 2014, the World Health Organization (WHO) declared a "Public Health Emergency of International Concern."[1]

While there is new literature on the scale of the outbreak, international-level failures, and EVD clinical features and transmission chains to help inform and contextualize these numbers, there is a dearth of literature on the operational details of the EVD response at the district level in Sierra Leone.[2] These details include day-to-day activities and the difficulties faced when mounting a response to a large-scale outbreak in resource-limited

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settings. This article attempts to help fill this gap, drawing on the authors' collective 64 months of experience with the EVD response efforts in Sierra Leone. Specifically, we discuss case investigation operations in Port Loko and Kambia districts of Sierra Leone.

Emergency bylaws enacted in August 2014 required the investigation of all deaths and cases of sickness, among other exceptional legal demands.[3] Fulfilling this requirement and effectively managing the EVD outbreak required a well-trained and capacitated disease surveillance structure to conduct the following components:

- **Case investigation:** Conduct in-person assessments of all persons reported ill or deceased to determine if they met the case definition for suspected EVD, which is decided based on the confluence of 15 possible symptoms and history of EVD contact. Refer suspected cases to EVD treatment centers. Document all known contacts of the suspected EVD case and search for all missing contacts.
- **Dead body swabbing:** Using oral swab specimens, test all dead bodies for post-mortem EVD before burial. If specimen tests EVD-positive, conduct follow-up investigation and contact tracing.
- **Contact tracing:** Monitor anyone who has direct contact with an individual with EVD for signs and symptoms of the virus during the 21-day incubation period. Note that the term "contact tracing" in the Sierra Leonean context refers to the monitoring of known contacts, rather than elicitation and location of previously unknown contacts.

EVD surveillance requires all 3 of these complementary and co-dependent components; however, this manuscript focuses on the first component—case investigation and specifically its operational needs.

In October 2014, the National Ebola Response Centre (NERC) was created to provide a central, coordinated response to EVD at the national level.[4] Corresponding District Ebola Response Centres (DERCs), responsible for local EVD response operations, rolled out to the country's 13 districts shortly thereafter.[5] DERCs were staffed by the Republic of Sierra Leone Armed Forces, the British Armed Forces, the UK Department for International Development (DFID) and the UK Stabilisation Unit, the U.S. Centers for Disease Control and Prevention (CDC), the respective district medical officer (DMO) and members of their district health management team (DHMT), NGOs, and several United Nations agencies, including the Mission for Ebola Emergency Response and WHO.

However, even with this structure in place, conducting case investigation, dead body swabbing, and contact tracing was an enormous effort considering the scale of the outbreak. Sierra Leone has high levels of all-cause morbidity and mortality rates,[6] and EVD presents many clinical similarities to endemic diseases like Lassa fever and malaria, the latter alone accounting for 50% of health facility outpatient visits.[7] Indeed, by late 2014, Port Loko district experienced one of the highest EVD caseloads in the country, with nearly 100 laboratory-confirmed cases per week.[8]

Emergency bylaws enacted in August 2014 required the reporting and investigation of all deaths and cases of sickness, among other exceptional legal demands.

The high burden of cases, requiring daily investigation, demanded substantial logistical resources and an operational framework—both of which were lacking in the earliest stages of the outbreak—and DERCs remained unable to contain the rapid spread of EVD. Delays in scaling up an international public health emergency response—for which there was little precedence—and a heavy focus on providing technical epidemiological support rather than operational and logistical support, exacerbated these challenges.

Even with a robust national structure in place, conducting Ebola disease surveillance was an enormous effort considering the scale of the outbreak.

Rapid field epidemiology training by WHO and the CDC in late 2014 developed a much-needed cadre of Sierra Leonean case investigators (also referred to in-country as district surveillance officers), complemented by a cohort of expatriate WHO and CDC epidemiologists. However, operational support to facilitate their work during the height of the outbreak was still insufficient. EVD case investigation quality and efficiency thus remained insufficient through 2014. In Port Loko district during the month of December 2014, 22%

A safe burial cemetery in Kambia, Sierra Leone.

of confirmed EVD cases were found dead at the time of investigation, only 26% of confirmed EVD cases had a known source case, and the percentage of confirmed EVD cases previously identified as EVD contacts was a mere 15%.[9]

METHODS

In December 2014, the Port Loko DERC requested NGO support for EVD surveillance from the Ebola Response Consortium, an NGO consortium in Sierra Leone led by the International Rescue Committee. GOAL Global thus began supporting EVD surveillance in Port Loko in January 2015, with DFID funding. The same request was made in Kambia in March 2015, with GOAL support beginning in April 2015. What follows are the challenges encountered in conducting EVD case investigation in Port Loko and Kambia, and the work of GOAL in collaboration with various DERC and DHMT stakeholders to address and effectively operationalize EVD surveillance activities in these 2 districts. A summary of challenges and interventions is presented in the Table.

GOAL Global began supporting EVD surveillance in two districts—Port Loko and Kambia—in January 2015 and March 2015, respectively.

This insight draws from our experiences working in the EVD response, as well as a survey of 42 Port Loko and Kambia case investigators conducted by 2 of the authors in December 2015. The University of Chicago Social and Behavioral Sciences Institutional Review Board reviewed and approved the survey.

We acknowledge the following limitations of this analysis: All data presented here were official data, or data collected by the authors themselves during the response, with all efforts made to portray an accurate picture. However, data quality is admittedly limited due to the crisis conditions of the EVD response. Additionally, this article represents the viewpoints of a limited number of professionals working in Port Loko and Kambia districts of Sierra Leone during this time—only several among thousands of national staff and many tens of international responders who worked in these districts during the outbreak.

In Sierra Leone, case investigators had to navigate unpaved roads and riverine areas.

CHALLENGES TO CONDUCTING EVD CASE INVESTIGATION

Environmental and Infrastructural Challenges

Case investigator transportation presented a substantial challenge to EVD surveillance. In Port Loko and Kambia, only 7 and 3 vehicles, respectively, were available for case investigation as of December 2015 to cover an average of 43.3 daily alerts of sickness and death in Port Loko and 8.1 in Kambia,[10] among a total population of 900,000 people over a total area of 8,827 square kilometers.[11,12] This created major logistical challenges to response capacity.

In addition to the challenge presented by lack of vehicles, both Port Loko and Kambia have poor-quality unpaved roads and a complicated latticework of riverine areas. Accessibility difficulties are exacerbated during the rainy season from May to September, when the 2 districts each receive between 2 and 4 meters of rain.[13] Poorly maintained and poor-quality vehicles were inadequate for such harsh conditions and prevented timely and efficient case investigation when they broke down or could not navigate roads. A lack of reliable fuel supply further hampered case investigation efforts.

Severe communication challenges limited the flow of information necessary for EVD surveillance.

Severe communication challenges also impeded case investigation. Deficiencies in Sierra Leone's telecommunications infrastructure meant it was often difficult for communities to raise sickness and death alerts, particularly in rural areas. As such, the flow of information necessary for EVD surveillance was often limited at its point of origin.

However, if communities raised an alert, there was no guarantee that a case investigator would successfully locate the alert, as the reported locations were often unspecific and investigators often lacked phone credit or found themselves out of network coverage to call for clarification. Additionally, case investigators often failed to communicate important information back to the

TABLE. Challenges and Solutions to Conducting Ebola Virus Disease Case Investigation, Sierra Leone

Type	Challenges	Solutions
Environmental and Infrastructural		
Transportation	• Lack of vehicles, poorly maintained low-quality vehicles, and lack of fuel posed challenges for case investigators to cover daily alerts of sickness and death in the 2 districts. • Poor-quality unpaved roads, riverine areas, and the rainy season from May to September further complicated response efforts.	• GOAL collaborated with DFID, NERC, WHO, and other NGOs to provide high-quality off-road vehicles, along with fuel, drivers, and other logistical support. • GOAL rented 12 vehicles in Port Loko and Kambia, and advocated with WHO and NERC to provide additional vehicles. • GOAL requested authorization and funding from DFID for Catholic Relief Services in Port Loko and GOAL in Kambia to fuel the additional vehicles. • GOAL advocated and helped facilitate the acquisition of boats from the Republic of Sierra Leone Armed Forces to facilitate access to riverine areas in Kambia.
Communication	• Deficiencies in telecommunications infrastructure made it difficult for communities to raise sickness and death alerts, particularly in rural areas. • Case investigators could not reliably locate alerts and often failed to communicate important information due to unspecific reported locations, lack of phone credit, or unreliable network coverage.	• GOAL distributed cellular phones, phone credit, and satellite phones to case investigators and their coordinators in the DHMT and DERC. • GOAL provided closed user groups to all case investigation teams and selected individuals in the DERC, enabling free unlimited calling between case investigators, their supervisors, and epidemiology teams in WHO and CDC.
Data quality and management	• Mismanagement of investigation materials posed a challenge to locating specific information, tracking efforts, and building case histories. • Discrepancies occurred at the field and district levels, and no formal filing mechanism existed for completed case investigation forms. • Inconsistency in naming conventions, spelling, and characterization of residence made matching documents difficult.	• GOAL developed standard operating procedures in collaboration with all surveillance stakeholders. • Standard operating procedures ensured that case investigation forms were collected, stored, and organized in a retrievable manner. • GOAL hired data managers in both the Port Loko and Kambia DERC to file and immediately digitize this information in real time. • WHO established an after-action review in Port Loko in collaboration with GOAL, CDC, and the DHMT to review case investigation information and data at the end of each day.
Personal safety and fatigue	• Case investigators were unable to eat during their long work day due to dangers of purchasing food from high-risk communities, stigma from communities who feared them, a lack of personal funds, and insufficient time.	• GOAL immediately provided daily take-away breakfast and lunch to all case investigators. • Case investigators received hand sanitizer and personal protective equipment to help prevent EVD infection, and rain gear allowed for easier movement of personnel during the rainy season.
Sociocultural		
Community trust	• A lack of community trust in response staff and enormous stigma resulted in difficulties conducting case investigations, lack of truthful information, and sometimes violence. • Case investigators rarely returned to the same communities each day and generally did not work in their own communities.	• GOAL assigned a dedicated team for each of Port Loko's and Kambia's chiefdoms to ensure familiarity and consistency. • To the extent possible, case investigators were assigned to work in their chiefdom of origin.

Continued

TABLE. Continued

Type	Challenges	Solutions
Traditional healers	• A lack of trust in facility-based health care and fear of nosocomial infections drove many to seek health care from traditional healers. • Despite the fact that traditional healers were legally banned from practicing and required to report cases of illness, many people disregarded the bylaws despite fears of punitive measures. • Cases of sickness and death went unreported, and traditional healers fueled new EVD clusters when they contracted the disease from their patients.	• DERC stakeholders, including GOAL, attempted to formally involve traditional healers as public health agents in the EVD response. However, due to the illegality of their work under the national bylaws, there was strong political hesitation to permit activity that appeared to legitimize the trade. As such, further efforts to include traditional healers were not pursued.
Political and Organizational		
Management structures	• In Port Loko, GOAL became the lead operational agency and coordinator of the surveillance pillar. However, in Kambia, WHO continued leading surveillance, directing operational activities, and overseeing logistical needs despite not controlling operational resources. Crucial operational adjustments in Port Loko were therefore not easily implemented in Kambia. • No single organization was identified as the lead agency for case investigators, and therefore no single point of advocacy existed to resolve their needs, complicating the resolution of problems.	• Leadership challenges in Kambia were addressed to some degree through relationship building and regular coordination with technical leads and DERC management. • GOAL, WHO, and CDC developed an active surveillance strategy in Port Loko to address the high proportion of EVD cases identified post-mortem or with no known source case.
Human resources	• The lack of sufficient case investigators and the work fatigue that resulted were among the biggest challenges facing case investigators. • Funding constraints and a perceived lack of need at the NERC resulted in a national directive that prevented hiring new surveillance staff.	• GOAL advocated with DFID and NERC to bring in additional human resources. • The DHMT, GOAL, WHO, and CDC trained the new case investigators. • Mentorship in the field reinforced the training. • A rotation system was implemented to provide time off to address surveillance efficiency, quality, and case investigator work fatigue.
Compensation	• Case investigators averaged more than a month of missed pay per person and could sometimes not afford to buy food or pay rent. • At the national level, case investigators were sometimes incorrectly relegated to lower pay categories and clerical errors resulted in their removal from payroll. • Threats of strikes were frequent and morale was extremely low.	• Resolving case investigator salary issues was a protracted and complicated process. • Initially, NERC paid all case investigators, with funding from the World Bank. • Ultimately, GOAL secured DFID funding and NERC permission to pay all case investigators directly in both districts beginning in July 2015.
Inter-pillar coordination	• Many of the 11 vertical pillars of operation at DERCs performed complementary work. • Horizontal integration and cooperation between pillars was profoundly challenging, which often resulted in a lack of effective cooperation between them.	• Meetings were established to create horizontal linkages between the pillars in Port Loko in January 2015 and in Kambia in April 2015. • GOAL attempted to reinforce horizontal communication by developing an EVD response framework, which was not fully realized because it was developed late in the response.

Abbreviations: CDC, U.S. Centers for Disease Control and Prevention; DERC, District Ebola Response Centre; DFID, UK Department for International Development; DHMT, district health management team; EVD, Ebola virus disease; NERC, National Ebola Response Centre; WHO, World Health Organization.

DERC because of these same reasons. The delay in both accessing cases and reporting on them due to telecommunications challenges resulted in protracted and haphazard case investigations and follow-up.

Data management of investigation materials from the field and within the DERC also posed a challenge to effectively tracking and building case histories, with discrepancies occurring both in the field and at the DERC. No formal filing mechanism existed for completed case investigation forms, which were in hard copy only and were often scattered across multiple DERC offices. Locating specific information was therefore challenging and time-consuming; this was further complicated by Sierra Leonean naming conventions, variations in spelling, and characterization of residence, which made matching documents exceptionally difficult. The need for a systemized retrieval mechanism was crucial because an EVD case was generally not laboratory-confirmed on the day it was investigated, when the case investigation form was completed. As such, if a positive case result returned from the laboratory, locating the initial case investigation form from a previous day often proved difficult. A case investigation form duplicated from memory usually resulted in a lower-quality case report.

Lastly, case investigators were unable to eat during their long work day due to dangers of purchasing food from high-risk communities, stigma from communities who feared EVD responders, a lack of personal funds to do so, and insufficient time. Case investigators complained of fatigue due to insufficient nutrition, which resulted in limiting work efficiency and rigor.

Sociocultural Challenges

Sociocultural challenges further limited EVD surveillance efficacy. Enormous stigma against EVD response workers and a powerful lack of trust in EVD response staff resulted in difficulties generating high-quality case investigations and sometimes resulted in violence against case investigators.[14] Due to insufficient human resources and logistical capacity, case investigators rarely returned to the same communities each day, but instead responded to alerts ad hoc. Nor was it standard procedure for case investigators to operate within their own community. Thus, communities often regarded them with suspicion as outsiders. For instance, in April 2015, community members chased case investigators out of a remote village in Kambia and threatened them with machetes when they were dispatched to investigate an alert.

When case investigators in Port Loko and Kambia were asked to rank the challenges they considered most significant to their work, 77% included "community trust in surveillance" as 1 of their top 3 challenges (Figure 1). This lack of trust led to lower-quality investigations, as communities were reticent to provide truthful information to case investigators.

No formal filing mechanism existed for completed case investigation forms and locating information was challenging and time-consuming.

Additionally, a lack of trust in facility-based health care and fear of nosocomial infections drove many to seek health care from traditional healers. While traditional healers were legally banned from practicing under the emergency bylaws and required to report any cases of illness,[3] many disregarded the bylaws and continued treating patients without integration with EVD surveillance or response activities. As such, many instances of sickness and death remained unreported, and the high-risk population of traditional healers fueled new EVD clusters when they contracted EVD from their patients. Traditional healers and those with connections to them often were not transparent with case investigators for fear of punitive measures for violating the emergency bylaws.

Political and Organizational Challenges

Some of the greatest challenges that faced EVD surveillance in Port Loko and Kambia were political and organizational challenges. WHO district offices were intended to provide technical support and offer an advisory role to DERC operations. In the early days of the response and in the absence of widespread external support, WHO also provided operational and logistical support for many DERC activities. This engendered a reliance within the DERC on WHO as both an advisory and operational body, despite the WHO Assistant Director-General Dr. Bruce Aylward attesting that the "organization . . . was not designed to be an operational field-based organization . . . play[ing] such a role."[15]

Case investigators rarely returned to the same communities or operated within their own communities, which resulted in lack of trust and sometimes violence.

When GOAL began supporting Port Loko case investigation in January 2015, it was quickly identified as the lead operational agency and coordinated the surveillance pillar (1 of 11 organizational pillars of operation within DERCs), collaborating closely with WHO and CDC as technical leads. In Kambia, due to a different response trajectory and political climate, WHO maintained coordination leadership of the surveillance pillar, directed operational activities, and

The difference in operational management structures between the 2 districts meant that crucial operational adjustments in Port Loko were not easily implemented in Kambia.

The lack of sufficient case investigators and the work fatigue that resulted were among the biggest challenges facing EVD case investigation in both Port Loko and Kambia.

oversaw logistical needs despite not controlling operational resources. The difference in these 2 management structures meant that operational adjustments in Port Loko identified as crucial and effective (see Interventions) were not easily implemented in Kambia, a political challenge that frequently limited response efficacy and efficiency.

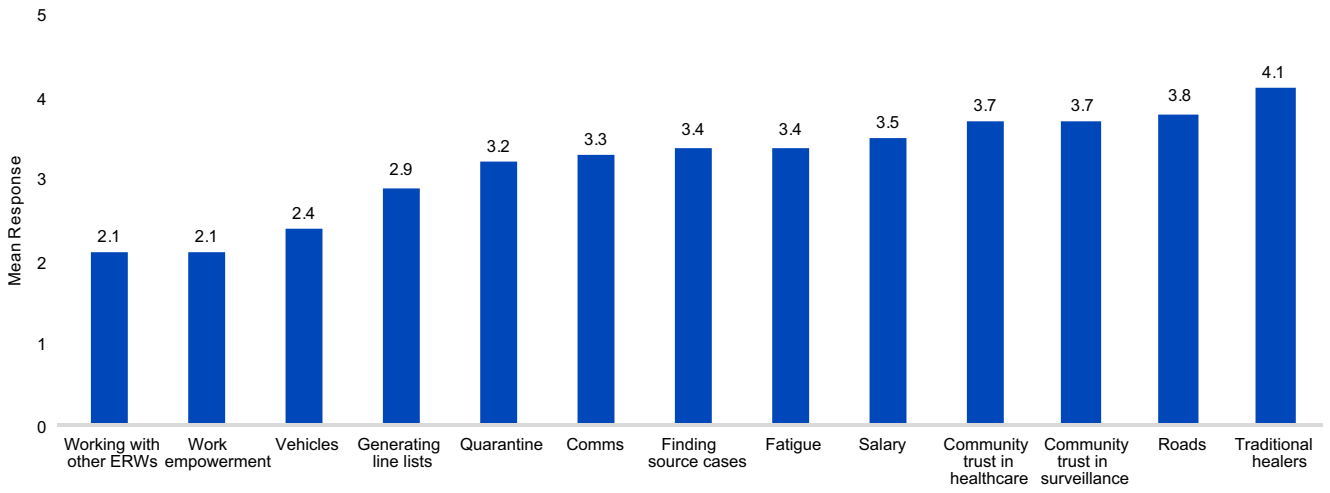
This management structure of the surveillance pillar in Kambia contributed to challenges with coordination. No single organization was identified as the lead agency for case investigators, and therefore no single point of advocacy existed to resolve their needs, limiting the resolution of various identified and serious problems. In contrast, these concerns were addressed more efficiently in Port Loko, where management and organizational responsibilities were more clearly delineated.

Human resources, particularly the lack of sufficient case investigators and the work fatigue that resulted, were among the biggest challenges facing EVD case investigation in both Port Loko and Kambia. Throughout much of the outbreak, case investigators worked 7 days a week, without scheduled time off or periods of rest. From an operational standpoint, this was necessary as human resources were badly lacking. However, 21% of case investigators surveyed considered work fatigue as 1 of the 3 biggest challenges to their work (Figure 1). Funding constraints and a perceived lack of need at the NERC resulted in a national directive that prevented the hiring of new surveillance staff after March 2015. This became problematic, particularly in Kambia when GOAL and the DERC leadership identified an immediate need to increase the number of investigators from 3 to 9 in April 2015 to effectively address the persistent EVD caseload in Kambia and the high risk of EVD importation from neighboring Guinea.[16]

Timely compensation was considered to be another major challenge by case investigators: 53% of case investigators included compensation as 1 of the 3 biggest challenges to their work (Figure 1). When asked "What are some things NERC could have done better?" 88% of case investigators listed late or non-compensation.

A letter dated February 16, 2015, from the Port Loko DMO to NERC listed a backlog of 92.4 million SLL (approximately US$18,500) among the district's 53 case investigators, averaging more than 1 month of missed pay per person, dating back to October 2014 (Alfred Kamara, written communication, February 16, 2015). These

FIGURE 1. Challenges Identified by Case Investigators as Most Significant[a] to EVD Case Investigation, Port Loko and Kambia Districts, Sierra Leone (N=42)



Abbreviations: ERW, Ebola response workers; EVD, Ebola virus disease.

[a] On a scale of 1 to 5 (1=not significant at all, 5=most significant).

payments were not distributed until May 2015. In a low-income country where personal savings are nominal, case investigators sometimes complained that they could not afford to buy food or pay rent due to lack of payment. Additional issues at the national level included erroneous relegation of case investigators to lower pay categories and clerical errors that removed personnel from payroll. Threats of strikes were frequent, and morale was extremely low.

Lastly, the organizational design of the DERC itself challenged collaborative work. DERCs were organized by 11 vertical pillars of operation, each with its own function and management. Many pillars performed complementary work; however, horizontal integration and cooperation was profoundly challenging, as doing so could appear to encroach on identified management responsibility. This often resulted in a lack of effective cooperation between pillars.

INTERVENTIONS TO ADDRESS OPERATIONAL EVD CASE INVESTIGATION CHALLENGES

Without addressing operational challenges, technical surveillance solutions are difficult to implement and hold limited relevance, due to the poor quality and quantity of data being collected to direct more technical and strategic solutions. In the early months of the Port Loko and Kambia DERC-led responses, epidemiological analysis was prioritized over operational needs. This lower prioritization came at a high opportunity cost, leading to a decrease in operational capacity and efficacy of interventions intended to resolve challenges detrimental to case investigation. To mediate this, GOAL addressed these operational challenges as outlined below, corresponding to the aforementioned categories of challenges.

Environmental and Infrastructural Interventions

First, an intervention was necessary to provide case investigators with the basic resources they required to continue working. GOAL immediately provided daily take-away breakfast and lunch to all case investigators to prevent hunger, fatigue, and EVD exposure from purchasing food in high-risk communities and to avoid stigma faced in communities during investigations. Case investigators received hand sanitizer and appropriate personal protective equipment to help prevent EVD infection, and rain gear allowed for easier movement of personnel in flooded areas. Case investigator morale improved rapidly as a result.

To address transportation issues, GOAL collaborated with DFID, NERC, WHO, and other NGOs to provide high-quality off-road vehicles to case investigation teams in both Port Loko and Kambia, along with the requisite fuel, drivers, and other logistical support. GOAL rented 12 vehicles in Port Loko and Kambia, and advocated with WHO and NERC to provide additional vehicles for case investigation. GOAL asked DFID for authorization and funding for Catholic Relief Services as the district fleet management agency in Port Loko and GOAL in Kambia to source and provide fuel for the additional vehicles. This allowed the assignment of at least 1 case investigation team to each of the 2 district's chiefdoms. Boats were needed to facilitate access to riverine areas, which were successfully acquired from the Republic of Sierra Leone Armed Forces. These measures improved the timeliness, quality, and efficiency of case investigation activities in areas that were previously difficult or impossible to access.

GOAL collaborated with other agencies to provide high-quality off-road vehicles, fuel, drivers, and logistical support, as well as boats for riverine areas.

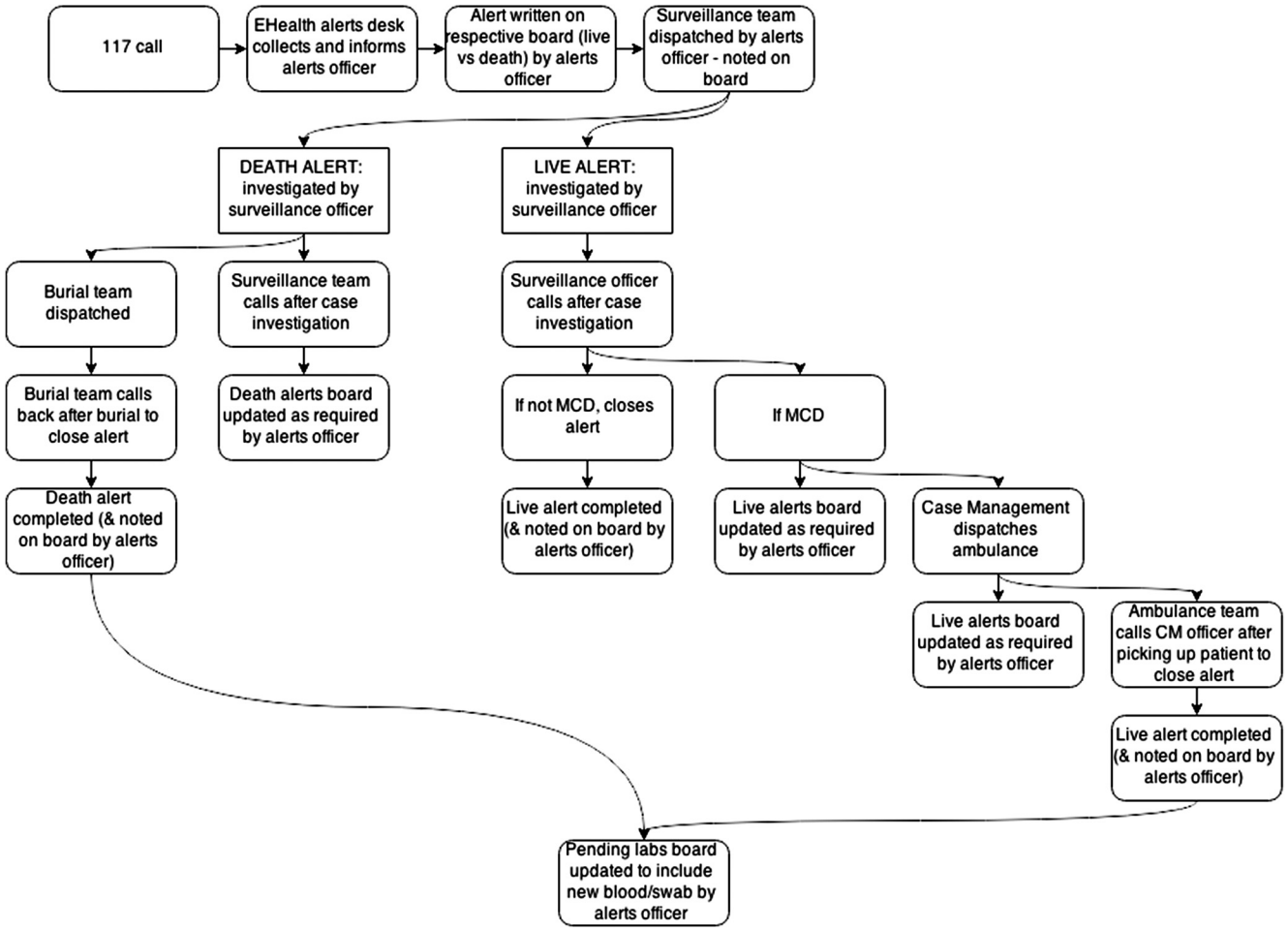
Late payments, non-compensation, and clerical errors related to pay resulted in threats of strike and extremely low morale among case investigators.

GOAL distributed cellular phones, phone credit, and satellite phones, where necessary, to case investigators and their coordinators in the DHMT and DERC, to ensure the timely communication of information between the DERC and the field. Closed user groups were provided to all case investigation teams and selected individuals in the DERC, enabling free unlimited calling between case investigators, their supervisors, and epidemiology teams in WHO and CDC. These measures also facilitated more timely requests, and ultimately, responsiveness from case investigators to the DERC for resources such as the dispatch of ambulance or burial teams.

Case investigators and coordinators in the DHMT and DERC received phones, phone credit, satellite phones, and closed user groups to ensure timely communication.

WHO established an after-action review in Port Loko in collaboration with GOAL, CDC, and the DHMT in January 2015, to review case investigation information and data at the end of each day. The after-action review provided an opportunity for ongoing training as epidemiologists reviewed cases with case investigators and provided guidance on how to improve subsequent investigations. The after-action review also ensured all surveillance information and case investigation forms from the field were systematically returned to the DERC each day, as well as provided a daily forum to raise operational concerns. This effective measure was immediately implemented by GOAL and other surveillance

FIGURE 2. Flow Chart of Ebola Disease Alert Response, Sierra Leone



Abbreviations: CM, case management; EVD, Ebola virus disease; MCD, meets case definition.

Notes: A "117 call" is the national EVD alert hotline, the mechanism by which most occurrences of sickness and death were reported to the District Ebola Response Centres (DERCs). "EHealth" is an NGO that supported the DERC. This flow chart is part of the standard operating procedures developed by Samuel Boland on behalf of GOAL.

pillar partners in Kambia when their support began in April 2015.

Challenges surrounding data quality and coordination were also addressed by developing various standard operating procedures in collaboration with all surveillance stakeholders, including the basic structure of alert response by case investigators (Figure 2). Standard operating procedures were also put in place to ensure case investigation forms were collected, stored, and organized in a retrievable manner. All information was consolidated in an organized filing cabinet. GOAL hired data managers in both the Port Loko and Kambia DERCs to file and immediately digitize this information in real time. This allowed for timely retrieval and communication of surveillance data to relevant stakeholders and EVD response workers, including case investigators.

Sociocultural Interventions

Assigning 1 dedicated team for each of Port Loko's and Kambia's chiefdoms enabled familiarity and

consistency between communities and the case investigators working within them. To the extent possible, case investigators were assigned to work in their chiefdom of origin. As a result, community trust in case investigators improved in both districts, and case investigators could thus be in regular conversation with local leaders such as paramount and village chiefs, teachers, health facility staff, and traditional healers. Additionally, data quality increased as case investigators became experts in specific EVD cases and transmission chains. This occurred because of the geographic consistency of case investigator deployment and the increased understanding of local cultural contexts surrounding a particular transmission chain.

Several DERC stakeholders, including GOAL in Port Loko in June 2015, attempted to formally involve traditional healers as public health agents in the EVD response. However, despite the potential efficacy of their inclusion, due to the illegality of traditional healers' work under the national bylaws, there was strong political hesitation to permit activity that appeared to legitimize the trade.[17] As such, further efforts to include traditional healers in the EVD response were not pursued.

Political and Organizational Interventions

Additional human resources were brought in to address the issue of work fatigue in both Port Loko and Kambia. GOAL advocated for these additional case investigators with DFID and NERC, who agreed to increase case investigators in both districts. In July 2015, case investigators increased from 25 to 65 in Port Loko, and from 3 to 9 in April 2015 in Kambia— with a further increase from 9 to 21 in July 2015.[11,12] The number of case investigators is relative to the size of the districts—Port Loko has an estimated population of 550,000 and an area of 2,208 square miles split among eleven chiefdoms, whereas Kambia has a population of 350,000 and an area of 1,200 square miles split among 7 chiefdoms. The DHMT, GOAL, WHO, and CDC trained these new case investigators, and mentorship in the field reinforced the formal training, resulting in improved data collection quality. As new case investigators became operational, a rotation system was implemented to provide time off. This helped address surveillance efficiency, quality, and case investigator work fatigue.

Resolving compensation issues for case investigators was a protracted and complicated process. Initially, NERC paid all case investigators, with funding from the World Bank. GOAL advocated with NERC on behalf of case investigators, the visibility of which provided some comfort to case investigators. Ultimately, to alleviate ongoing challenges surrounding payments, GOAL secured DFID funding and NERC permission to pay all case investigators directly in both districts beginning in July 2015. Direct and timely payment considerably improved case investigator morale.

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Community members in Kambia, Sierra Leone, welcome case investigators and their release from quarantine.

Case investigators worked in dedicated chiefdoms to ensure familiarity and consistency, which strengthened trust among communities.

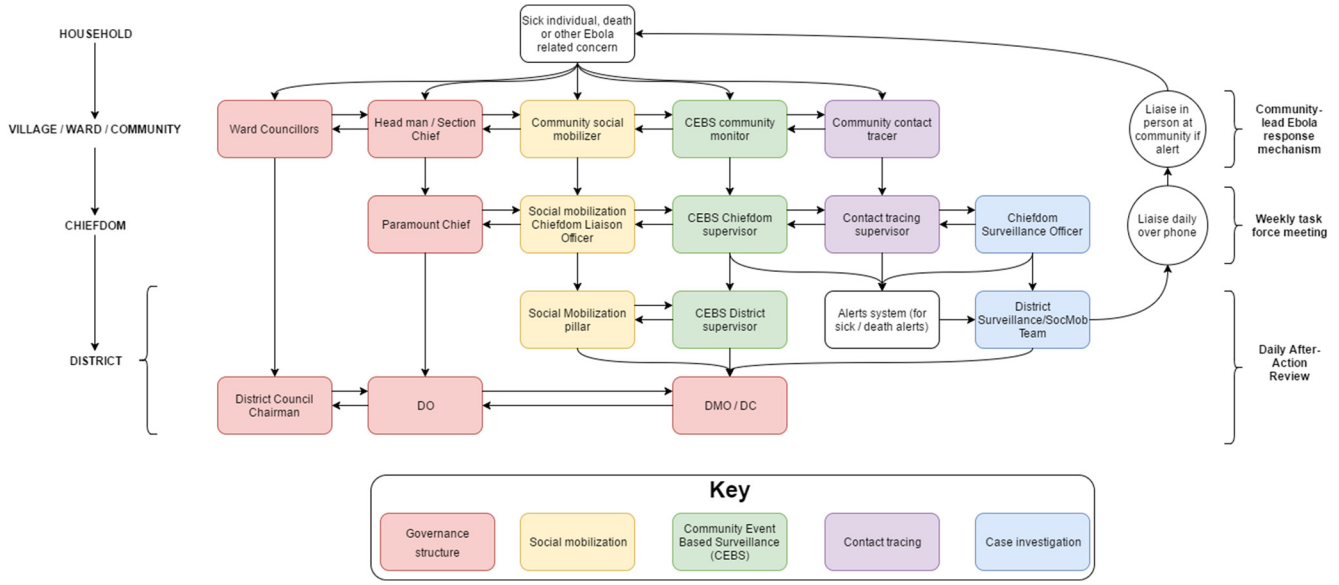
Case investigators received training and mentorship to improve data collection quality.

An EVD response framework was established to create linkages between pillars, but it was not fully realized as it was developed late in the response.

Inter-pillar coordination meetings were established to create horizontal linkages between the pillars in Port Loko in January 2015, and in Kambia in April 2015. GOAL attempted to reinforce horizontal communication by developing an EVD response framework (Figure 3). Unfortunately, this structure was not fully realized in either district as it was developed late in the response. However, responses to future emergencies should consider similar coordination mechanisms that encourage both horizontal and vertical communication.

Leadership challenges in Kambia were mitigated to some degree through relationship building and regular coordination with technical leads and DERC management; however, case investigation management remained fragmented. To address the high proportion of EVD cases identified post-mortem or with no known source case, GOAL, WHO, and CDC developed an active surveillance strategy in Port Loko, which began in April 2015. This strategy targeted operational resources based on epidemiologic analysis of areas that were underreporting—an ideal convergence of operational and technical expertise. DERC leadership in Kambia decided not to employ this strategy as they considered it too difficult to operationalize. Although similar interventions

FIGURE 3. GOAL Ebola Virus Disease Response Structure, Sierra Leone



Abbreviations: CEBS, community event-based surveillance; DC, District Coordinator; DMO, District Medical Officer; DO, District Officer.

Note: Developed by Samuel Boland on behalf of GOAL.

occurred in the 2 districts, analysis of alert data from June 2015 to September 2015 (during Operation Northern Push, an effort by the NERC and DFID to eliminate EVD transmission from Port Loko and Kambia), showed statistically significant lower percentage increases in alerts in Kambia.[18]

RECOMMENDATIONS

EVD case investigation in Port Loko and Kambia districts of Sierra Leone faced numerous environmental, infrastructural, sociocultural, political, and organizational obstacles and difficulties. GOAL's intervention, beginning in January 2015 in Port Loko and April 2015 in Kambia, addressed these issues to varying degrees of success in each district.

Technical support is indispensable in any outbreak but is limited unless operational needs are addressed and structures established to ensure the quality and systematic collection of surveillance data.

While the focus on technical support is indispensable in any outbreak, operational needs must be addressed and structures established to ensure the quality and systematic collection of surveillance data, as well as its storage, organization, retrievability, and communication. Without comprehensive and reliable data, effective technical support is limited. In future outbreaks, all of the following operational components must also be addressed within a politically and organizationally enabling environment:

- Ensure frontline staff receive timely compensation for and sufficient rest from their work, to boost staff morale, efficiency, and safety.
- Provide sufficient and context-appropriate transportation and communication resources, to ensure effective communication between field staff, their coordinators, and community members.
- Establish systematic data collection, storage, and retrieval systems, to ensure that any record can be effectively and efficiently accessed.
- Create formal linkages between frontline staff and the communities they work in to develop trust between them, thus increasing staff safety and investigation quality.
- Establish daily meetings between frontline staff and epidemiologists to ensure information and data quality and to provide opportunities for daily mentorship and training.

- Identify clear and appropriate leadership for operational chain of command.
- Give credence at all political and funding levels to operational foundations.

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ORIGINAL ARTICLE

From Albania to Zimbabwe: Surveying 10 Years of Summer Field Experiences at the Rollins School of Public Health

Evelyn L Howatt Donahoe,[a] Roger W Rochat,[a] Deborah McFarland,[a] Carlos del Rio[a]

Since 1985, students from the Rollins School of Public Health have worked for more than 300 organizations in 84 countries. The students indicated key benefits of applying public health course work in real-world settings and gaining skills, including cultural competency, leadership, teamwork, communication, and program implementation. They also experienced challenges related to health, safety, and support.

ABSTRACT

The objective of this article is to describe summer field experiences at the Rollins School of Public Health. An online survey was conducted among Master of Public Health students returning from summer field experiences. We used printed reports from 2004–2012 and original survey data from 2010–2013 to perform a trend analysis using correlation analysis and linear regression. We found that our students have worked for more than 300 organizations in 84 countries. The average cost of a summer field experience fluctuated around US$3,500, with students receiving an average of US$2,180 in funding. About 50% of students conducted human subjects research. This survey was used to improve student practical experiences through information sessions for students and feedback to key constituents, including the Emory Institutional Review Board and the Emory Travel Clinic.

INTRODUCTION

All Master of Public Health (MPH) students attending an accredited school are required to complete a practicum of at least 200 hours before graduating. Increasing numbers of these students have sought opportunities abroad to fulfill this requirement.[1] International field experiences are often expensive and can require additional effort on the part of students to find and gain access to these opportunities. This has been the case for many MPH students, both those in global and non-global programs, at the Rollins School of Public Health (RSPH) of Emory University. Although RSPH has never had a formal program that links students to international practicum opportunities, as early as 1985, students used the summer between the first and second years of the MPH program to engage in applied public health work across the globe.

By 2004, anecdotal feedback from students indicated that they did not feel prepared for the public health work they were engaging in over the summer.[2] In response, the Hubert Department of Global Health created an annual survey to evaluate their summer field experiences (SFE), which became known as the SFE survey (Figure 1). Initially, the survey asked questions related to perceptions of student preparedness and how to improve the quality of these global public health work experiences. It later expanded to ask additional questions related to Institutional Review Board (IRB) processing times, health and safety issues, and finances. The survey results continue to be used to describe how students find international summer opportunities. We use it to align our educational program with the needs of students by enhancing the curriculum; advising students; deciding how to allocate funds; improving IRB training, consultation, and turnaround time; and improving Emory Travel Clinic policy and training, among others.[2] The school currently asks all public health students planning international practicums, regardless of funding, to attend 5 hours of pre-departure safety and security training, 1 hour per day during a dedicated week in the spring semester. The agenda includes preparation, travel policies, physical and emotional health, personal safety, and sexual harassment/assault.

METHODS

Since 2004, the Hubert Department of Global Health at RSPH has been conducting an annual SFE survey of

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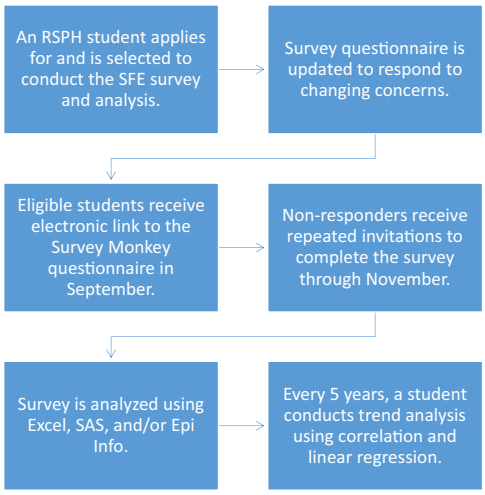
students. Specifically, at the beginning of the second semester each year, the Director of Graduate Studies in the Hubert Department of Global Health and a selected student use Survey Monkey to design and conduct the annual survey of second-year students to evaluate their activity during the summer between the second and third semesters. Respondents include all public health students in global health academic programs; all public health students receiving Global Field Experience funds, regardless of academic department; and all students funded by the Emory Global Health Institute for international, multidisciplinary public health team projects (often used by graduate students in public health for their obligatory public health practicum).

The content of the questionnaire varies from year to year, but we consistently seek to evaluate what makes a satisfactory, successful, healthy summer field experience; how students obtain these field experiences; and the expenses and sources of funding support. We seek to make the final evaluation reports each year readily accessible to all students.

In 2004, the Emory IRB reviewed the survey and determined that it is program evaluation, not human subjects research. The survey is confidential, but not anonymous.

For the purpose of this article, we reviewed the printed survey evaluation reports from 2004 to 2012, along with the raw survey data from 2010 to 2013. We describe trends and patterns based on correlation analysis and linear regression.

FIGURE 1. Annual RSPH Summer Field Experience Survey Process



Abbreviations: RSPH, Rollins School of Public Health; SFE, summer field experience.

FIGURE 2. Locations of RSPH Summer Field Experiences, 1985–2014

Note: Partial data were used for years prior to 2009. Data were not available for 2010.

RESULTS AND DISCUSSION

Between 2004 and 2013, a total of 1,048 students completed the survey, with an overall response rate of 89%.[2–11] The number of students responding increased from 68 in 2004 to 147 in 2013. The students have worked in very diverse locations on a range of health-related issues with a number of host organizations (Figure 2). An estimated 84 countries and 370 different organizations have hosted RSPH students since 1985.

Practicum Opportunities and Selection

Of key importance to this evaluation is recognizing the ways in which students identified and accessed SFE opportunities. Most students identified a viable practicum opportunity during the first or second semester through faculty advisors, networking with second-year students, or during an annual practicum fair in late October. First-year students were able to learn about SFEs during their first semester from the presentations of second-year students. In 2013, half of the students who went abroad said they identified their summer practicum through their own personal and work contacts or other students. The timing of applications depended on the size and scope of

An estimated 84 countries and 370 different organizations have hosted RSPH students since 1985.

the project. For students choosing to develop multidisciplinary projects that involved students from at least 3 Emory schools, proposals were due by the end of January. Students applying for Global Field Experience (GFE) funding had to submit their individual proposals by the end of February.

75% of the students were the only students to ever work with their summer-experience organization.

While this autonomy likely contributed to the great diversity in experiences, it may also have drawbacks. Each year, a few students have their experiences cut short because they discover upon arrival that the host organization is not prepared or the student has not communicated sufficiently with the organization. In many cases, the student is able to find a second opportunity; however, this is not always the case. For those using the SFE as a public health practicum, the field supervisor must approve the project in advance and assess progress midway and at the end of the project. This process helps reduce the number of student–host miscommunication issues.

Funding of Practicums

No matter how students identify their practicum opportunity, several mechanisms to assist with funding for SFEs outside the United States are available through the university. Based on survey responses, each year about 60% of students who had SFEs outside the United States received financial support from the GFE, which provides small grants from Emory-endowed funds. GFE grants require a proposal submission, and the amount of funds allocated depends on proposal quality and time of submission. Students who receive GFE funds are required to present their work at the end of the summer.

The second most common source of funding is the Emory Global Health Institute (EGHI), which sponsors about 25% of students with SFEs outside the United States. EGHI-sponsored students are required to work in multidisciplinary teams that include people outside of the school of public health. In addition, the Global Elimination of Maternal Mortality from Abortion (GEMMA) fund supports about 10 students each year in practicums related to reproductive health and abortion.

Despite these funding options, most students pay for at least part of their experience out of pocket: the average cost of an SFE outside the United States is about US$3,500, while the average amount of funding received per student is about US$2,180.[13–17] About a fifth of students have fully funded summer experiences, and most pay less than US$2,000 out of their own pockets. The combination of the financial assistance available and the autonomy with which students identify and set up their summer experiences are likely to contribute to the great diversity in experiences: not only have students worked on every continent, except Antarctica, and worked with 370 organizations, but most were the only students to ever work with their organization. In fact, this was the case for 75% of the students.

This diversity is both a strength and a weakness. Students are able to pursue practicum opportunities that are most in line with their interests and career goals. Subject areas have included nutrition, infectious disease, refugee health, homelessness, faith and health, communications, technology in public health, addiction, geriatric care, one health, health systems, and water, sanitation, and hygiene (Box). However, since most organizations have only hosted an RSPH student once, few hosts have provided continuity in sequential years. Notably, a few organizations consistently provide practicums: each year about 7% of students worked with the U.S. Centers for Disease Control and Prevention (CDC), 3% with CARE, 2% with the Rwanda-Zambia HIV Research Group, and 2% with the Center for Global Safe Water.

Benefits and Challenges of the Practicum Experience

For students, perhaps the greatest benefit of the SFE is the opportunity to apply their public health course work in a real-world setting. Survey respondents frequently cited the opportunity to practice both qualitative and quantitative methods as beneficial for future careers:

> *Finally putting my qualitative research skills to work . . . I gained many skills from tool development to conducting actual qualitative research and fieldwork.* –RSPH student completing an SFE in Paraguay, 2013

In addition, students commonly reported that their field experience increased their cultural competency, leadership, coordination, language, teamwork, communication, interpersonal, and program implementation skills, which are often more difficult to teach in a classroom setting.

> *I gained many cross-cultural skills including communication, increased flexibility . . . the professional and personal development from the experience is invaluable.* –RSPH student completing an SFE in Armenia, 2013

BOX. Four Case Studies of Rollins School of Public Health International Practicums

Kyu Han Lee: Antimicrobial Resistance in Abu Dhabi, United Arab Emirates

Rollins School of Public Health student Kyu Han Lee in Abu Dhabi.

Through retrospective data analysis, Kyu Han Lee identified several potential multidrug resistant outbreaks previously undetected by infection control personnel. Organization: Health Authority, Abu Dhabi.

Anna Fulton: An Oral Cholera Vaccine Intervention in Mae La Refugee Camp, Thailand

Rollins School of Public Health student Anna Fulton conducted several cholera-related surveys in Thailand.

Anna Fulton conducted a Knowledge, Attitudes, and Practice survey after a cholera vaccine intervention; conducted microbial testing on household drinking water samples; and conducted a census verification in a camp of 46,000 refugees leading to more accurate follow up of vaccinated individuals. Organization: U.S. Centers for Disease Control and Prevention (CDC).

(*continued on next page*)

Students have also shared their struggles, including difficulties related to health, safety, and support. By 2006, enough students had written that they felt unsupported by RSPH during their practicum that the Likert-scale question "How supported did you feel?" in relation to school support was added to the survey. In response, 60% of students said they felt academically supported, while only 45% said they felt psychologically supported during their SFE.

Grayson Privette: Emergency Preparedness and Response: Mapping Guatemala's Health Infrastructure

© Grayson Privette

A surgical health post in Guatemala.

Grayson Privette created a surge capacity tool, which was used to assess the characteristics, capabilities, and spatial distribution of health care infrastructure for emergency preparedness and response. Organization: CDC.

Lisa Sthreshley: Cultural, Social, and Economic Factors That Influence Household Adoption of Fuel Efficient Stoves in Kinshasa, Democratic Republic of the Congo

© Mano Ntayingi

Rollins School of Public Health student Lisa Sthreshley (center, top row) with fellow interviewers and focus group participants in the Democratic Republic of the Congo.

Lisa Sthreshley conducted an evaluation of Top-Lit Up Draft stoves designed to reduce indoor air pollution in the Democratic Republic of the Congo. Results of the analysis led to improvements in the design of the stove. Organization: IMA World Health.

The issues of support, health, and safety continue to be important to both the students and the school.

Between 2006 and 2014, 10 students reported being sexually or physically assaulted during their international practicum. Subsequent data collection showed that in 2015 more students reported sexual assault than ever before (although that data are not represented in this paper). Lack of disclosure or reporting by students, faculty, and others to protect the privacy of students may lead to an undercount of these events.

About half of the students reported experiencing at least one 1 health problem during the summer, with several students each year reporting serious events requiring hospitalization or evacuation from the host country. In these cases, Emory's student insurance has been able to assist with organizing and paying for the evacuation services.

Survey questions that ask about assault, harassment, and illnesses, such as diarrhea, respiratory infections, and mental health problems, have helped the Emory Travel Clinic and Emory University design a health and safety training for students before their departure. The school currently asks all public health students planning international practicums, regardless of funding, to attend 5 hours of pre-departure safety and security training, 1 hour per day during a dedicated week in the spring semester. The agenda includes sessions on preparation, travel policies, physical and emotional health, personal safety, and sexual harassment/assault. Student comments on the 2013 survey prompted the Travel Clinic to provide more private spaces for travel consultations.

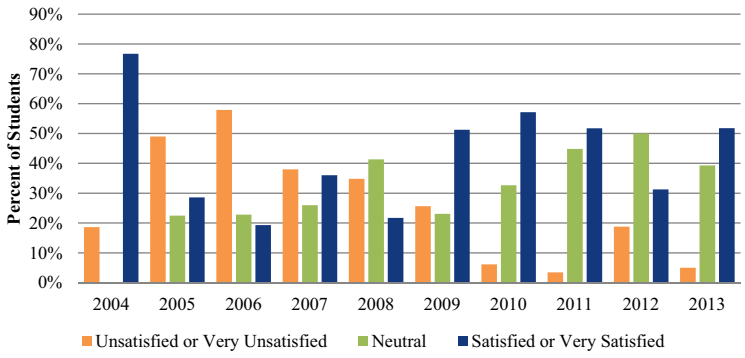
Institutional Review Board Processes

All students are required to have Collaborative Institutional Training Initiative (CITI) certification and to obtain Emory IRB review for human subjects research. Each year between 32% and 71% of SFE students engage in human subjects research. However, how the IRB processed and classified applications changed over the duration of the study period. For example, during 2005–2007, the IRB expedited most SFE proposals. In contrast, after 2007, the IRB classified most proposals as exempt. In 2013, of 56 proposal submissions, 28 were exempt, 13 expedited, and 6 underwent full review.[18–22]

Students are often required to submit their proposals to multiple IRB or ethics review committees, depending on their research topic, location, or host organization. Proposals may need to be submitted to not only Emory but also the host organization and/or host government IRB-type mechanisms. For example, in 2013, 62% of students working outside the United States received approval from an external IRB, in addition to the Emory IRB. Moreover, 58% of students provided training on ethics, privacy, confidentiality, or informed consent to project staff during their SFE.

In 2006, the student surveys documented long delays in IRB staff responses, such as an average of 32 days from protocol submission to receiving a response, problems communicating with IRB staff, issues related to international research, and problems with protocol review. That survey led to the IRB process providing faculty and students with clearer instructions about protocol submissions, how to obtain appropriate informed consent in different settings, how to present appropriate research methods and appropriate data security, and what confidentiality steps required for working in international settings. In addition, IRB staff clarified informed consent guidelines for international populations. Concurrently, our department began requiring that all new students complete the CITI certification before enrolling. These changes led to improved student protocol submissions and IRB responsiveness (Figure 3).

FIGURE 3. Proportion of Students Who Are Satisfied With the Institutional Review Board Review Process, 2004–2013



Note: Data from 2010 to 2013 reflect only SFEs based outside of the United States. A mistake in the survey questionnaire for 2013 did not allow students to select "very unsatisfied" as an option. Data include students who submitted to the IRB themselves and students whose IRB submission was completed for them by their host organization or a faculty member. In 2004, students were not able to select a "neutral" option.

Source of data: References 8-11, 18-22.

Prior Coursework and Experience

Finally, questions related to which coursework most prepared students for their fieldwork have assisted students, mentors, and academic advisors to determine the best courses to take prior to their practicum. About a third of students said their coursework prepared them "a lot" for their practicum, while a fifth said it prepared them only "a little" or not at all. Students were most likely to list methods courses—such as survey design and

qualitative methods—as the most useful and were also likely to list these among skills they wished they had before their practicum. Students also reported that prior international and research experiences helped them as much as the academic courses.

Limitations

The survey is limited to student observations. At present, we lack the resources to conduct a systematic evaluation of the value of student projects to the host organizations. By challenging students to have expertise and resources for useful and doable projects, we try to ensure the SFE is beneficial to the host community. Host organizations occasionally offer jobs to students, co-author publications, or use the projects to further their organizations' missions. In 2013, 83% of students reported they debriefed their host organization.

CONCLUSION

Using SFE survey data to monitor, evaluate, and report on student activities has been an invaluable experience for the Department of Global Health at RSPH. Because of the amount of autonomy students have to set up their practicums, without this survey, we would have a much more limited picture of the work students do over the summer, the challenges they encounter, and the preparation they require. We have learned the importance of the funding provided to students, and how it opens up opportunities for many of them to work for small organizations in developing nations. We have also gained insight into the physical and emotional challenges that students face during international practicums. Having adequate insurance in order to assist students requiring evacuation for health or security reasons has proven essential.

Because of the amount of autonomy students have to set up their practicums, without this survey, we would have a much more limited picture of the work students do over the summer, the challenges they encounter, and the preparation they require.

The early surveys were intended to provide guidance for students, faculty, and administrators of the school's global programs. Serendipitously, in 2006, we found that students' documentation of challenges with the IRB process was also useful for the university.[4] In 2013, an MPH student conducted his master's thesis on how to improve the use of SFE information. After focus groups and individual interviews, he recommended the provision of 9 specific short reports with relevant information for the following designated recipients: (1) The Director of Graduate Studies, Global Health Department; (2) all RSPH students; (3) Associate Directors for Academic Programs (ADAPs); (4) Career Services; (5) faculty and staff; (6) Emory IRB; (7) Emory Travel Clinic; (8) Health and Safety for GFE Committee; and (9) Highlights for Global ADAPs.[10]

Although we do not provide students with practicum opportunities, we have been able to help them identify networks to find them, select appropriate coursework, provide some funding, and give health and safety information before their departure (Worrell MC, SFE Organizations Google sheet, 2013; Worrell MC, Peters K, Countries SFE Surveys Google sheet, 2013).[3–22] While we have not yet found solutions to all the problems raised, the survey has allowed us to be more responsive to changing concerns and needs among the student body and to document the growth of interest in global field experiences. We hope that the experience and results shared here can assist other schools of public health and educators as they seek to develop and improve practicum programs as well.

Acknowledgments: We would like to thank the RSPH graduate student cohort of 2015 for supporting our efforts to bring them the best information possible about summer field experiences and for taking our 113-question survey. Our gratitude goes to the 9 previous students who have conducted the SFE survey: Lara Hendy, Sara Wright, Trisha Moslin, Cait Unites, Elizabeth Mueller, Ha Phuong Nguyen, Marc Cunningham, Anita Patel, and Jeff Freeman.

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GLOBAL HEALTH: SCIENCE AND PRACTICE
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FIELD ACTION REPORT

The Tobacco-Free Village Program: Helping Rural Areas Implement and Achieve Goals of Tobacco Control Policies in India

Nilesh Chatterjee,[a] Deepak Patil,[a] Rajashree Kadam,[a] Genevie Fernandes[b]

Tobacco control and prevention in rural areas are possible as demonstrated by a community-driven tobacco-free village program in India. Success factors included community ownership with supportive program guidance, motivated and committed local leaders, collaboration with grassroots organizations, rewards and sanctions to establish new social norms, and provision of other income-generating options for vendors who sell tobacco. While the program required time and dedicated effort and was not successful in all villages, it holds promise for helping to achieve the goals of tobacco control policies, especially in resource-scarce settings.

ABSTRACT

India has 274 million tobacco users and a tobacco use prevalence of 38% in rural areas. Tobacco consumption causes 1 million deaths and costs the health system nearly US$23 billion annually. Tobacco control policies exist but lack proper implementation. In this article, we review the Tobacco-free Village (TfV) program conducted in Maharashtra state in India and describe its process to help villages in rural India achieve "tobacco-free" status (i.e., the sale and use of tobacco are prohibited by law). We reviewed program documents and conducted 22 qualitative interviews with program staff and village-level stakeholders. From 2008 to 2014, Salaam Mumbai Foundation implemented the TfV program in 60 villages in Maharashtra state. The program used a number of strategies to help villages become tobacco free, including collaborating with a community-based organization, leveraging existing health workers, conducting a situation analysis, training health workers, engaging stakeholders, developing TfV assessment criteria, mobilizing the community, conducting health education, imposing sanctions, and offering incentives. By 2014, 4 villages had achieved tobacco-free status according to 11 assessment criteria. Successful villages demonstrated strong local leader involvement, ownership of the program, and commitment to the cause by residents. The TfV program faced barriers including poor motivation of health workers, difficulty in changing social norms of tobacco use, and refusal of local vendors to stop tobacco sales due to financial losses. This low-cost, community-driven program holds promise for helping public health practitioners and governments implement and achieve the goals of tobacco control policies, especially in resource-scarce settings.

BACKGROUND

With 274 million adults using some form of tobacco, India has the second largest number of tobacco users in the world after China.[1,2] Tobacco consumption causes nearly 1 million deaths and costs the Indian health system US$23 billion annually.[3–5] An estimated 5 million children in India are addicted to tobacco; 4 in 10 tobacco users start consuming tobacco before the age of 18 years.[6] Nearly 38% of adults in rural India use some form of tobacco, especially smokeless products. Many view tobacco use as a traditional practice,[2] and many believe that tobacco relieves stress and reduces oro-dental pain.[7,8] Tobacco consumption is strongly associated with low socioeconomic status.[9–11]

Following advocacy efforts at national and regional levels, the Indian government enacted the Cigarettes and Other Tobacco Products Act (COTPA) in 2003.[12] The COTPA prohibits smoking in public places, advertisements of tobacco products, and sale of tobacco products to and by minors (less than 18 years old); bans the sale of tobacco products within 100 yards of all educational institutions; enforces a mandatory display of pictorial health warnings on tobacco-product packaging; and mandates testing of all tobacco products

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for their tar and nicotine content. In 2004, India became the eighth country in the world to ratify the World Health Organization's (WHO's) Framework Convention on Tobacco Control.[6]

Despite these strides in tobacco control policy, studies assessing the implementation of the WHO's Framework Convention on Tobacco Control via the COTPA in India found lack of compliance with almost every provision.[13,14] In Maharashtra, 1 of the 5 major tobacco-producing states in the country where 1 in 3 adults and 15% of adolescents consume tobacco,[15,16] an observational study revealed only partial compliance with COTPA provisions on smoking and sale of tobacco to minors.[17]

In this article, we review a tobacco control program and describe its process to help villages in rural India achieve "tobacco-free" status (i.e., the sale and use of tobacco are prohibited by law). The aim of the Tobacco-free Village (TfV) program, implemented between 2008 and 2014, was to stop the sale and use of tobacco in villages in Chandrapur district, in rural Maharashtra state, in order to reduce tobacco-related morbidities and mortality.

METHODS

We analyzed program documents and conducted 22 qualitative interviews to describe the TfV program process and identify success factors and barriers in implementing a tobacco-free program. The program documents included operational plans, annual reports, meeting minutes, quarterly and monthly visit reports, local village council resolutions, financial budgets, and expenditure reports. We conducted 22 qualitative interviews with purposively identified program managers and coordinators, health workers, and village-level stakeholders.

TOBACCO-FREE VILLAGE PROGRAM PROCESS

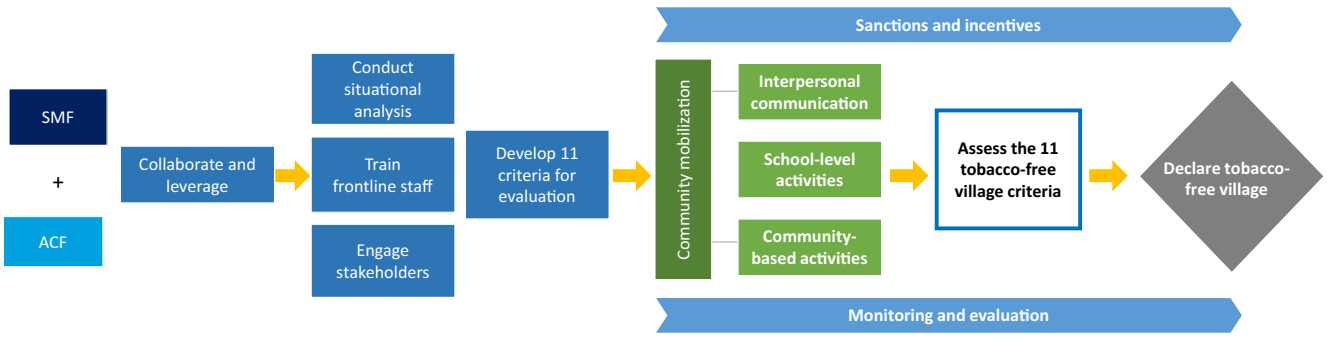
Rationale, Collaboration, and Coverage

The TfV program was an initiative of the Salaam Mumbai Foundation (SMF), the rural wing of the Salaam Bombay Foundation (SBF), a nonprofit organization. SBF works on life-skills development for tobacco prevention and cessation with children and adolescents from low-income municipal schools in the city of Mumbai (previously Bombay), capital of the state of Maharashtra in western India. Inspired by the success of the urban program, SBF started SMF in 2007 to implement a similar program with children and adolescents in other districts of the state, with a special emphasis on rural areas.[18] SMF initially started the rural tobacco-prevention program only in schools but soon realized that to achieve its goal of tobacco-free children in rural areas, it was imperative to involve and engage communities. This realization led to the rationale for designing a tobacco-free intervention at the village level. The TfV process for achieving a tobacco-free village is illustrated in the flowchart (Figure).

Tobacco consumption causes nearly 1 million deaths and costs the Indian health system US$23 billion annually.

Studies found that India lacked compliance with almost every provision of WHO's Framework Convention on Tobacco Control via the country's Cigarettes and Other Tobacco Products Act.

FIGURE. The Tobacco-Free Village Program Process



Abbreviations: ACF, Ambuja Cement Foundation; SMF, Salaam Mumbai Foundation.

Note: Many steps are iterative.

In 2008, SMF signed a formal collaborative agreement to implement the TfV program with Ambuja Cement Foundation (ACF), the corporate social responsibility division of a large cement manufacturing company in India. ACF works on livelihood programs related to health and agriculture in several districts in Maharashtra, including Chandrapur. ACF implements its health programs in villages via trained female health workers called *sakhis* (good friends), who conduct interpersonal counseling and referrals for government health services. SMF strategically implemented the TfV program in collaboration with an established organization like ACF to leverage ACF's grassroots presence in communities and its existing network of *sakhis*.

Between 2008 and 2014, the Tobacco-free Village program extended to 60 villages in Chandrapur district in Maharashtra state.

SMF initiated the TfV program in Chandrapur district in eastern Maharashtra, starting with 10 villages in 2008. The TfV program extended to 60 villages in Chandrapur district by 2014—specifically, 23, 22, and 15 villages in the 3 blocks (i.e., district subdivisions) of Rajura, Korpana, and Jiwati, respectively—serving a population of nearly 48,882 people in 11,375 households.

SMF spent 1.74 million Indian Rupees (INR) (approximately US$27,000) to implement the TfV program from 2008 to 2014; 75% was spent on program activities and the remainder on staff salaries in villages. Additional allocations of INR 500,000 (approximately US$7,800) on a part-time manager or coordinator at SMF and INR 245,000 (approximately US$3,800) on local and interdistrict travel were made over these 7 years. In the fiscal year April 2014 through March 2015, after ACF took over program implementation from SMF, it spent INR 300,000 (about US$4,700). Thus, between April 2008 and March 2015, the cost of implementing the program in 60 villages was approximately INR 2.8 million (about US$43,000). This amount does not include costs such as electricity, telecommunication, rent, and other organizational expenses.

Tobacco-Related Situation Analysis

The first step of the TfV program was to conduct a situational analysis of tobacco consumption and socioeconomic factors in program villages in order to provide program planners with a contextual understanding to design appropriate change strategies. The findings of this analysis are summarized below.

The program villages had 683 residents, on average, with farming as the most common occupation, followed by work in coal mines and cement factories. Program villages had a total of 24 government schools that served grades 1 to 4 and 36 schools that served grades 1 to 7. Each village had more than 1 shop that sold tobacco. The villages were characterized by poor connectivity to district centers, with a transportation service frequency of 2 state-run buses each day. Few households owned televisions; *sakhis* used interpersonal communication and wall paintings as their main channels of communication.

In the program villages, almost half of the men, women, and youth consumed tobacco in some form.

Almost half of the men, women, and youth consumed tobacco in some form. Men generally used *kharra*, which is a mixture of tobacco, *chuna*, and cardamom (Table 1). Women consumed *kharra* and *mishri*, which is tobacco powder used for cleaning teeth; they put *mishri* in their mouths before going to work in the fields. Adolescents and

TABLE 1. Forms of Tobacco Consumed by Different Segments of the Rural Population, Chandrapur District, Maharashtra, India

Type of Tobacco	Description	Predominant Consumer
Kharra	A mixture of tobacco, areca nut, lime (*chuna*), and katechu (*katha*)	Men and women
Mishri	Powdered tobacco containing teeth-cleaning powder	Women
Gutkha	A powdery mixture of crushed areca nut, tobacco, katechu, paraffin wax, lime, and sweet or savory flavorings	Adolescents and youth
Paan masala	A mixture of betel leaf with lime, areca nut, clove, cardamom, mint, and tobacco, with other flavorings	Adolescents and youth
Beedi	A type of cigarette made of unprocessed tobacco flakes wrapped in tendu leaves (found widely across central India)	Elderly men

youth consumed *gutkha* and *paan masala*, whereas elderly men preferred smoking *beedis*.

Unlike alcohol consumption, which carried a stigma, chewing tobacco was a culturally accepted practice that formed part of residents' daily routines. Several households served tobacco to guests as a welcoming gesture. Some families also held the belief that tobacco kills hunger pangs; they consumed it frequently during the day, especially when they could not get enough food.

Training Existing Community Workers

SMF leveraged ACF's existing networks of *sakhis* to achieve the objectives of the TfV program in the program villages. For each village, ACF nominated 1 to 2 *sakhis* for program training in how to provide tobacco-related information and conduct community activities, including a step-by-step protocol for communication with households, with periodic supportive supervision.

Stakeholder Involvement

After training the *sakhis*, the next step of the TfV program was to engage influential stakeholders from each village. A key stakeholder, the *sarpanch*, elected leader of the *gramsabha* (village governing council), generally has influence over the community. In Thutra village, for example, the *sarpanch* owned a shop that sold tobacco and initially refused to be a part of the TfV program. After SMF made several visits to discuss the issue with the *sarpanch*, he agreed to participate and ultimately closed his shop and became a champion for tobacco control in his village as well as neighboring areas.

Other influential stakeholders included members of the village council, local police officers, principals and teachers of local schools, and members of self-help groups, community-based organizations, and religious groups. SMF conducted an average of 30 meetings with village-level stakeholders every year to equip them with the information and skills needed to mobilize public support for tobacco control.

Development of Assessment Criteria for Tobacco-Free Villages

The TfV program relied on a list of criteria for assessing the progress of villages in becoming tobacco-free. These criteria provided set targets and a road map to implement activities and monitor and evaluate the program in each village. SMF staff developed the criteria by holding meetings with stakeholders to discuss the provisions from the COTPA and then deliberating on which provisions to include and adapt as criteria for assessing tobacco-free villages. The final list included 11 criteria (Table 2).

For each village to be declared tobacco free, an external observer had to assess it and determine whether it successfully met all 11 criteria. The *sakhi*, *sarpanch*, or other villagers assigned to the task used these 11 criteria to monitor the program (Table 2).

Community Education and Mobilization

The program trained *sakhis*, female health workers, to provide tobacco-related information and conduct community activities in villages.

Sakhis conducted home visits, held group meetings, and trained group members to conduct educational sessions in the villages.

The Tobacco-free Village program developed a list of 11 assessment criteria based on the Cigarettes and Other Tobacco Products Act of 2003.

The TfV program used multitiered communication channels for educating and mobilizing community members to participate in tobacco control and prevention activities in each village. *Sakhis* conducted interpersonal communication activities during home visits using various information, education, and communication materials such as flipbooks and posters to educate families about the harms of tobacco and how to quit using it. *Sakhis* also held group meetings with youth, adolescents, and pregnant women, and they trained women members of self-help groups, who then conducted educational sessions with different audiences in the village.

In schools, the program trained teachers to conduct classroom sessions on the harmful effects of tobacco use, and students learned how to refuse if an adult asked them to buy tobacco. Competitions—including drawing, essay writing, rallies, and poster campaigns—incentivized students to become involved in tobacco prevention efforts. The program helped schools form student groups called *Bal Panchayats* (child governing councils) to raise awareness about problems associated with tobacco use. Schools organized tobacco-prevention events around commonly celebrated religious festival days, as well as World No Tobacco Day and World Cancer Day, encouraging participation from families. School principals and staff were encouraged to use every possible opportunity to talk to parents about the harms caused by tobacco use. Parents attended anti-tobacco sessions in the schools, conducted by trained self-help groups.

The TfV program organized community-based activities, such as wall paintings, poster campaigns, street plays, and village rallies, to focus public attention on the tobacco problem. Since few households owned televisions, the program staff organized tobacco-prevention film screenings followed by group discussion every month. The films were entertaining and were considered stress

TABLE 2. Criteria for Tobacco-Free Villages[a]

Criterion No.	Description of Criterion	Corresponding Section of COTPA or Guidelines for Tobacco-Free Educational Institutions
1	Signboards that say "No Smoking Area: Smoking and tobacco chewing are offenses here," of 60 x 30 cm size, should be displayed at main public places.	Section 3 of the COTPA enforces warnings on signboards displayed prominently at the entrances of and inside public premises.
2	No smoking or chewing of tobacco inside the village by children, young people, men, women, aged, and other members/visitors.	Rule 3 of the Guidelines for Tobacco-Free Educational Institutions prohibits smoking or chewing of tobacco inside the premises of institutions.
3	Direct and indirect advertisements of tobacco products are banned in the village.	Section 5 of the COTPA prohibits advertisement of tobacco products.
4	Display of posters on harmful effects of tobacco at prominent points in the village.	Section 3 of the COTPA.
5	A copy of the COTPA shall be available with the head of village council and made available at any time for all villagers.	Rule 6 of the Guidelines for Tobacco-Free Educational Institutions requires a copy of the COTPA to be available from the head of the institution.
6	No sale and purchase of tobacco products inside the village and mandatory signage shall be displayed prominently near the main gate and on boundary wall of the village.	Rule 2 of the Guidelines for Tobacco-Free Educational Institutions prohibits the sale of tobacco products inside the premises of and within a radius of 100 yards from educational institutions; it requires mandatory signage in this regard to be displayed prominently near the main gate and on the boundary wall of the institution.
7	The village council should pass the resolution to implement the COTPA in the village and strictly follow its provisions.	Not applicable.
8	A tobacco control committee must be instituted in the village; it can be chaired by the village council head, and should include 2 members of the village council, a teacher, at least 2 parent representatives, a member of the school management committee and village council, and local police. The committee should monitor the tobacco control initiatives of the village, meet quarterly, and report to the block-level administration.	Rule 7 of the Guidelines for Tobacco-Free Educational Institutions requires the setting up of a tobacco control committee, which is chaired by the school head/principal and comprised of a school teacher and counsellor (if available), at least two students, at least two parent representatives, a local member of the legislative assembly, the Municipal Councillor, and members of community-based organizations. The committee is to monitor the tobacco control initiatives of the village, meet quarterly, and report to the district administration.
9	All prominent groups such as self-help groups, youth *mandals* (groups), NGOs, schools, women's groups, local committees, and school management committees should be tobacco free and take initiative to make the village tobacco free.	Emerged from discussion with village-level stakeholders.
10	Visitors/outsiders cannot carry tobacco products when they enter the village.	Emerged from discussion with village-level stakeholders.
11	The village council must take up tobacco-control initiatives, including following up on the TfV process during meetings and prohibiting visitors from consuming tobacco in the village.	Rule 8 of the Guidelines for Tobacco-Free Educational Institutions requires the integration of tobacco-control activities with the ongoing School Health Programme of the State.

Abbreviations: COTPA, Cigarettes and Other Tobacco Products Act; SMF, Salaam Mumbai Foundation; TfV, Tobacco-free Village.
[a] Developed by Salaam Mumbai Foundation and village-level stakeholders, based on the COTPA (2003)[12] and Guidelines for Tobacco-Free Educational Institutions (2009).[19]

relievers after hard days of work in the fields. More importantly, this medium was persuasive—it got villagers to consider tobacco-related behavior change. Community activities reinforced the interpersonal and school-level efforts for tobacco prevention and behavior change.

Finally, program staff set up educational booths during village fairs and cultural festivals, where they spoke about the benefits of a life without tobacco. Stakeholders such as the *sarpanch*, village council members, and police officers attended such community-based events and encouraged villagers to quit tobacco use and choose a healthier life.

Sanctions and Incentives for Change

The village governing councils in Mangi and Thutra passed resolutions that made the sale of tobacco punishable by law; these sanctions acted as a major facilitator in prohibiting the sale and use of tobacco in order to meet the criteria for becoming tobacco-free villages. Financial incentives in the form of a cash award of INR 100,000 (US$1,556) for outstanding work in tobacco control were awarded by SMF's parent organization, Narotam Sekhsaria Foundation. The *sarpanch* from Thutra village and a motivated *sakhi* from a non-TfV village each received the coveted cash award based on their approaches and efforts in tobacco control. The disbursal of financial awards to someone they knew motivated *sakhis* and stakeholders to amplify their tobacco control efforts; and helped push the tobacco control agenda further in the selected villages. These incentives also encouraged winners to intensify and sustain their work. While financial rewards were found to be helpful in the initial phase of the TfV program, the program had to include nonmonetary incentives to ensure sustainability, such as appreciating the efforts of *sakhis* during biannual meetings and public recognition in village meetings and events.

Sustainability

Until 2011, ACF's network of *sakhis* served the program on a voluntary basis. After this year, SMF provided 5-year funding to ACF for implementing the TfV program, so ACF would not have to rely entirely on voluntary resources. *Sakhis* received financial compensation and program staff had higher budgets to conduct comprehensive activities. SMF integrated all TfV program activities into the ACF operational system for seamless implementation in the future. After the 5-year funding period ended, ACF continued to implement the TfV program with internal financing.

Tobacco control posters by students in a government school in the village of Mangi, India.

Monitoring

Program staff and stakeholders conducted 3 levels of monitoring, using the 11 assessment criteria. At the first level, ACF staff, including *sakhis*, conducted day-to-day monitoring of program activities. At the second level, local school teachers and village-level stakeholders acted as watchdogs by periodically assessing the program status and providing feedback to the program staff. At the third level, senior SMF staff conducted annual observational visits and comprehensive monitoring of all program activities and adherence with the 11 tobacco-free village criteria. Additionally, ACF field teams sent monthly monitoring reports to SMF. Regular meetings also were held between the SMF and ACF program teams, as well as annual review meetings for the *sakhis*.

Tobacco-prevention film screenings were a persuasive medium to encourage villagers to change tobacco-related behavior.

CHALLENGES

Community Norms

Addressing the long-standing tradition of tobacco use proved to be the greatest challenge for program staff. It was difficult to persuade villagers to stop using a product they had been consuming for years and that was embedded in their daily routines. It was considered normal for a child, adolescent, adult, or elderly person to consume tobacco. Furthermore, villagers had little or no

Persuading villagers to abandon long-standing traditions of tobacco use was the greatest program challenge.

information about the ill effects of tobacco consumption. In the 4 tobacco-free villages, influential leaders and stakeholders, positive role models, consistent discussions at all levels about the harms of tobacco, and sanctions changed the existing community norms around tobacco use.

Behavioral Constraints

Sakhis received support to stop using tobacco themselves, which improved their credibility as counselors on the ill effects of tobacco.

At the start of the TfV program, *sakhis* were unable to successfully broach the topic of tobacco among households, as many of the *sakhis* were tobacco users themselves. As a result, villagers questioned their credibility as health workers counseling on the ill effects of tobacco. ACF addressed this behavioral barrier through an organizational initiative in which they provided *sakhis* with individual counseling and cessation support in the form of information about nicotine withdrawal symptoms and management techniques, oral health screenings, and reminders by supervisors to maintain positive behaviors. ACF also passed a no-tobacco policy that prohibited all program staff, including *sakhis*, from using tobacco. Although ACF conducted oral health screenings for villagers in some program villages, regular monitoring, follow-up, and cessation enforcement were not possible administratively.

The Tobacco-free Village program declared 4 villages tobacco free according to its criteria.

In villages where the *sarpanch*, village council member, or other important stakeholder owned a tobacco shop or used tobacco, stopping the sale and use of tobacco was difficult because people pointed to this leader as justification for their own tobacco use behavior. Even in villages where tobacco was prohibited, it was possible that some people went to neighboring villages to buy tobacco products and consumed it in the privacy of their homes.

Economic Loss

A complete ban on the sale of tobacco products meant that shopkeepers would face losses in income, which made them unwilling to participate. Providing alternative means of income for tobacco vendors was challenging, as the sale of tobacco products was more lucrative than the sale of many other consumer products. Wherever tobacco vendors were reluctant to stop sales after many rounds of discussion, local police intervened. However, in some villages, local police officers refused to intervene because they had a connection with the vendors. In such cases, ACF and SMF program staff lobbied with higher-level officers in the district to intervene and stop tobacco sales.

Motivated and committed local leadership stood out as the critical success factor for change in each of the 4 tobacco-free villages.

Programmatic Barriers

Training the *sakhis* in tobacco control was time-consuming and took almost a year. Since the *sakhis* did not receive monetary benefits for their work until 2011, they viewed TfV-related tasks as a burden beyond their regular duties, and they did not want to spend much time on them. Conducting regular follow-up visits to monitor and enforce tobacco-free status of the villages was therefore difficult. In the absence of financial compensation, these programmatic barriers were addressed by providing the *sakhis* with non-monetary rewards and recognition during meetings and events. Another barrier was that any change in the team's composition affected program implementation. This challenge was addressed by integrating TfV processes into ACF's system such that any staff member could conduct all program activities seamlessly.

LESSONS LEARNED

Beginning with 10 villages in 2008, the TfV program expanded to 60 villages by 2014. The TfV program declared the 4 villages of Thutra, Khairguda, Mangi, and Loldoha to be tobacco free according to the 11 program criteria. Although 2 other villages—Koolimadu[20] and Gariphema[21]—had been declared tobacco free according to non-TfV program criteria, Thutra, Khairguda, Mangi, and Loldoha were the first to be declared tobacco free using the 11 criteria based on COTPA provisions.

Why did some villages meet the TfV criteria while the overwhelming majority did not? We gained insights into the differences between these villages through interviews with village-level stakeholders such as the *sarpanch*, school principals, teachers, health workers, owners of shops previously selling tobacco, and police officials.

All the program villages, which were distributed across 3 blocks, had similar socioeconomic profiles, with farming and employment in coal mines and cement factories as the main sources of livelihood. Tobacco-free villages were found to be smaller compared with other villages, in terms of households (126 versus 194 on average) and population (531 versus 835 on average), although there was no significant statistical difference.

Motivated and committed local leadership stood out as the critical success factor for change in each of the 4 tobacco-free villages. Thutra village became tobacco free in 2012, and it was

a motivated *sarpanch* who was responsible. In Khairguda village, which achieved TfV status in 2013, an inspired tobacco seller lit a symbolic bonfire of tobacco products from his shop, which made a persuasive case for others to join the movement. Mangi village also achieved tobacco-free status in 2013 after its local governing council passed a resolution and involved the police in stopping sale of tobacco. In Loldoha village, which became tobacco free in 2014, a committed *sakhi* worked adeptly through regular group meetings and door-to-door visits to inspire behavior change among villagers.

Achieving tobacco-free status has to be a process owned and led by the community. It must involve local leaders who are passionate and committed, have influence over people, and are willing to volunteer their time and efforts. Identifying, recruiting, and motivating the right leaders are the most important steps for achieving tobacco-free villages. This has to be followed by strengthening the capacity of leaders and stakeholders, providing supportive supervision of activities, offering feedback, and creating reward and recognition systems. This kind of a community-led model seems useful for tobacco control in resource-scarce settings; however, generating community ownership is an arduous process. For instance, bringing together local leaders and villagers to form a tobacco control committee required constant, consistent guidance and follow-up from program staff. Program planners need to sustain community participation in and ownership of activities, and enable families to champion the cause, rather than let the TfV program be perceived as an external agency's agenda.

Many villages that did not achieve tobacco-free status lacked the involvement of local leaders and community stakeholders, especially the village governing council, highlighting the need for strategic approaches to achieve buy-in and ownership from these influential community members. Many of the village governing council members are tobacco users themselves. There is also the issue of political patronage of tobacco vendors. The long-standing normative practice of tobacco use in rural India was another major obstacle to achieving tobacco-free status in the large majority of the villages. However, using a contextually appropriate, multitiered approach of community education and mobilization, advocacy with influential members including government officials, along with village-level sanctions, helped the TfV program to change norms in the 4 tobacco-free villages. Changing norms is difficult; it can take time. Therefore, an effective social and behavior change communication strategy at the state or national level has to be designed and implemented for tobacco control in rural India.

Program staff with *sakhis*, community members, and children in the village of Khairguda, India.

In 2016, the Public Health Department of Maharashtra circulated guidelines for setting up district-, block-, and village-level enforcement committees to ensure COTPA implementation.[22] Ensuring tobacco-free villages requires more steps by the government: incentivizing village participation in the tobacco-free movement through rewards and recognition of TfVs as model villages; putting sanctions in place to dissuade noncompliant villages from continuing tobacco use; and partnering with established grassroots organizations to implement tobacco control and prevention activities in their program areas along with ongoing health and development projects.

One of the major lessons learned was that collaboration with grassroots organizations is critical for successful implementation and sustainability of the rural tobacco control model. Working with established agencies and leveraging their existing staff, networks, resources, and tools were beneficial from a financial standpoint. However, we also learned that getting buy-in from the staff and frontline workers of the organization is required from the start; in many cases, they become burdened by multiple responsibilities and may not be compensated appropriately. Need-based training of staff for implementing tobacco control measures is also required.

Collaborating with a grassroots organization and leveraging its existing staff and resources was key to successful implementation and sustainability.

Formative research and needs assessment among the villagers, tobacco users, vendors, and workers of grassroots organizations are useful for examining many factors: sociodemographic characteristics, knowledge, attitudes, and levers of change among various community groups; capabilities of frontline workers with respect to delivery of tobacco control interventions; and ways in which vendors can be informed and involved in the TfV process.

Providing other income-generating options for tobacco vendors is critical in achieving tobacco-free status in rural areas.

Providing alternative income-generating options for vendors who sell tobacco is another critical factor in achieving tobacco-free status in rural areas. Program planners have to include assistance for such stakeholders in the form of financial training or informational support on government schemes for alternative livelihoods. While such measures may convince vendors to switch from selling tobacco to other consumer products, police and legal intervention mechanisms also have to be built into the program. Furthermore, villagers have to be trained in advocacy measures, and provided with timely support and contacts of influential stakeholders who can successfully work with reluctant tobacco vendors who have connections with the local police and political groups.

Interviewers with stakeholders revealed that some of the TfV criteria were difficult to achieve, such as criterion 2, which bans the use of tobacco, and criterion 10, which prohibits visitors from bringing tobacco products into the village. Stakeholders agreed that it was possible that people used tobacco within the private confines of their homes, and residents or visitors purchased tobacco from neighboring areas and smuggled it into the village. There was no mechanism to check if residents or visitors carried tobacco in their bags or pockets when they entered the village. However, stakeholders emphasized that tobacco use in the open public areas visibly stopped due to a change in social norms in tobacco-free villages.

Although these 11 TfV criteria were developed through participatory discussions with local stakeholders using the COTPA provisions as a basis, the criteria need to be reexamined with respect to feasibility and accountability. This should occur in the context of a broader dialogue between state and national health ministry officials, international agencies such as WHO, and local village council leaders. Rural tobacco prevention would be well served by meetings that foster dialogue between global, local, and national stakeholders.

CONCLUSION

Despite national tobacco control policies in India, contextual barriers and lack of proper implementation have enabled tobacco use to persist, especially among rural populations. While tobacco control requires time and dedicated efforts, the TfV program demonstrates that rural tobacco consumption can be controlled and prevented through continuous engagement with village-level stakeholders, motivated local leaders and community workers, contextual and tailored activities, and sanctions and incentives that establish new social norms in villages. This low-cost, community-driven program holds promise for helping public health practitioners and governments implement and achieve the goals of tobacco control policies, especially in resource-scarce settings. Future research, especially in the form of a community trial, is required to further examine program effectiveness. By building on the lessons learned from the TfV intervention, nongovernment and government institutions can ensure better implementation of existing tobacco control policies.

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FIELD ACTION REPORT

A Mobile-Based Community Health Management Information System for Community Health Workers and Their Supervisors in 2 Districts of Zambia

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Using simple-feature mobile phones, CHWs sent weekly reports on disease caseloads and commodities consumed, ordered drugs and supplies, and sent pre-referral notices to health centers. Supervisors provided feedback to CHWs on referred patient outcomes and received monthly SMS reminders to set up mentoring sessions with the CHWs. Scale-up limitations include: (1) staff shortages at health centers to supervise the CHWs, (2) need for ongoing technical support to troubleshoot challenges with mobile phones and software, and (3) recurring costs for data bundles.

ABSTRACT

Introduction: Effective community health management information systems (C-HMIS) are important in low-resource countries that rely heavily on community-based health care providers. Zambia currently lacks a functioning C-HMIS to provide real-time, community-based health information from community health workers (CHWs) to health center staff and higher levels of the health system.

Program Description: We developed a C-HMIS mobile platform for use by CHWs providing integrated community case management (iCCM) services and their supervisors to address challenges of frequent stock-outs and inadequate supportive supervision of iCCM-trained CHWs. The platform used simple feature mobile phones on which were loaded the District Health Information System version 2 (DHIS2) software and Java 2 platform micro edition (J2ME) aggregation and tracker applications. This project was implemented in Chipata and Chadiza districts, which supported previous mHealth programs and had cellular coverage from all 3 major network carriers in Zambia. A total of 40 CHWs and 20 CHW supervisors received mobile phones with data bundles and training in the mobile application, after which they implemented the program over a period of 5.5 months, from February to mid-July 2016. CHWs used the mobile phones to submit data on iCCM cases seen, managed, and referred, as well as iCCM medical and diagnostic supplies received and dispensed. Using their mobile phones, the supervisors tracked CHWs' reported cases with medicine consumption, sent CHWs feedback on their referrals, and received SMS reminders to set up mentorship sessions.

Observations: CHWs were able to use the mobile application to send weekly reports to health center supervisors on disease caseloads and medical commodities consumed, to make drug and supply requisitions, and to send pre-referral notices to health centers. Health center staff used the mobile system to provide feedback to CHWs on the case outcomes of referred patients and to receive automated monthly SMS reminders to invite CHWs to the facility for mentorship. District- and central-level staff were able to access community-level health data in real time using passwords.

Lessons Learned: C-HMIS, using simple feature phones, was feasible and viable for the provision of real-time community-based health information to all levels of the health care system in Zambia, but smartphones, laptops, or desktop computers are needed to perform data analysis and visualization. Ongoing technical support is needed to address the hardware and software challenges CHWs face in their day-to-day interaction with the application on their mobile phones.

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INTRODUCTION

According to Theo Lippeveld, at the time he was working for the Rebuilding Basic Health Services project in Monrovia, Liberia, "only what gets measured gets attention."[1] But it is also true that only what gets collected gets measured, and only what gets recorded or documented and disseminated gets the attention of policy makers and service providers.

Lippeveld argued that the availability of information on health services performance can empower community health workers (CHWs) and their supervisors to improve the quality of community-based health services. He added, "there is [also] a need to link the health information generated by CHWs to the facility-based routine health information systems . . . . Yet, in most countries, this vital information on health services provided by CHWs is not routinely captured."[1] These observations are very much true for Zambia. The importance of a robust, well-functioning community health management information system (C-HMIS) cannot be overemphasized.

Globally, mHealth technologies are increasingly used by health systems to improve health worker effectiveness by documenting relevant data.[2–4] To that end, the Zambian government set the goal to "improve hospital and community level health information, by ensuring their access to fully functional HMIS" in its *National Health Strategic Plan 2011–2015*.[5] In Zambia, the current national HMIS captures data only from the health-facility level and up, including some data from health posts reported by a new cadre of staff called community health assistants (CHAs). The system, however, does not capture data collected by community-based agents like CHWs. Although a paper-based reporting system that transmits data from CHWs to health facilities does exist, it is not fully functional; this is due in part to the challenges of sustaining availability of reporting forms and delivering completed forms to the health centers.

The Zambian Centre for Applied Health Research and Development (ZCAHRD) and Boston University, in collaboration with the United Nations Children's Fund (UNICEF), Ministry of Health (MOH), and Akros, are implementing an mHealth-enhanced C-HMIS. The C-HMIS is an adaptation of District Health Information System version 2 (DHIS2) software, referred to as community DHIS2 (C-DHIS2) mobile in Eastern Province, Zambia.

The C-DHIS2 was implemented in the context of a cluster randomized controlled trial (RCT) that aimed to improve the quality of integrated community case management (iCCM) of malaria, pneumonia, and diarrhea (Clinicaltrials.gov protocol ID# 4980/A0/04/001/010). This article describes the technical feasibility and implementation of this innovative C-DHIS2 and the rural setting in which the mHealth innovation was implemented; full results of the clinical trial will be reported elsewhere. The aim of the project was to provide information on implementation issues related to C-DHIS2 to the Zambian government and to countries that have no C-HMIS or where paper-based community-to-facility reporting is faced with logistical challenges. The pilot project was implemented in the natural Zambian health system context, with the introduction of mHealth as the only intervention.

ZAMBIAN HEALTH SYSTEM CONTEXT

The Zambian health service delivery system operates at 3 levels:

1. Primary health care services serve as the first point of contact and are located within communities and districts. Within this category are district hospitals, health centers, health posts, and community-based health care services, which provide a range of promotive, preventive, curative, and rehabilitative services. Health posts are staffed by nurses, clinical officers, environmental health technologists, or CHAs. CHAs are a fairly new cadre of paid health workers who are trained for 12 months and deployed to the health posts to work hand in hand with the CHWs. However, because their numbers are small, they have not yet been fully integrated into the community health system.
2. Facilities at the provincial level serve as referral points from the primary level.
3. Teaching and specialized referral hospitals comprise the third level.

Although CHWs are not part of the formal health care system—as they are volunteers and not paid by the government—they are recognized and trained by government or its partners using a government-approved curriculum. CHWs are members of the communities where they work, and are selected by and answerable to their communities.[6] Official government literature in Zambia describes CHWs as "members of

communities who work either for pay or as volunteers in association with the local health care system ... and usually share ethnicity, language, socioeconomic status and life experiences with the community members they serve.[7] In Zambia, these CHWs bear different titles—from health promoters, community health advisors, lay health advocates, lay counselors, and community health representatives to peer health educators and malaria agents—depending on their day-to-day duties. Some CHWs have been specifically trained in iCCM, a program being rolled out and scaled up countrywide in Zambia. These CHWs were trained in the diagnosis and management of malaria, pneumonia, and diarrhea—based on a World Health Organization (WHO)-recommended iCCM training package—and use of the WHO *Sick Child Recording Form* job aid. In general, CHWs provide preventive, promotive, and basic curative services to people of all ages at the community level.

PROJECT CONTEXT

The implementation of the C-DHIS2, described in this article, is part of a cluster RCT implemented in Chipata and Chadiza districts of the Eastern Province of Zambia. A cluster was defined as a health center/post, and included all CHWs in its catchment area that were providing iCCM and all children under 5 years old who presented with suspected malaria, pneumonia, or diarrhea to the CHWs. Intervention clusters included CHWs trained in both mHealth and the basic 7-day MOH iCCM training, while control clusters included CHWs who had received only the basic 7-day MOH iCCM training. The primary outcome for the cluster RCT was the proportion of children under 5 appropriately treated for malaria, diarrhea, or pneumonia by CHWs. The intervention used mHealth-enhanced inventory management and supportive supervision and mentorship. A total of 80 CHWs were trained under the cluster RCT, 60 from Chipata (30 intervention, 30 control) and 20 from Chadiza (10 intervention, 10 control).

Chadiza district has 14 health facilities—including 4 health posts, 6 rural health centers, 2 zonal community health centers, 1 urban community health center, and 1 level-1 (district) hospital—that serve a population of about 92,300. In contrast, Chipata district has 42 health facilities—including 7 health posts, 30 rural health centers, 4 urban health centers, and 1 level-2 (provincial) hospital—that serve an estimated population of 486,500.

THE DHIS2 MHEALTH PLATFORM

The Zambian national MOH HMIS is built on the DHIS2 database platform. The DHIS2 is the leading global open-source data warehousing software for low-resource countries. It combines multiple modalities of data capture, aggregated form, entity tracking, and single event data, with streamlined data warehousing and data analytics tools. The DHIS2 also serves as the national database platform for the Ministry of Local Government and Housing (MLGH) and is being piloted by the Ministry of General Education (MOGE). The widespread use of the platform has built a strong foundation of DHIS2 technical expertise in Zambia. To that end, we chose the DHIS2 mobile platform because: (1) it can be easily integrated and adapted into the existing MOH's HMIS, (2) the MOH also already possesses the technical knowledge to integrate and maintain the C-DHIS2, and (3) the DHIS2 works well with data entry Java applications, particularly DHIS2 mobile.

In order to run the DHIS2 mobile application, a mobile feature phone must be able to support Java, support installation of Java-based applications, and have a heap size of at least 512 KB. The heap size describes how much of the phone's memory an application can use.

While it is easy to find out if a phone supports Java applications—this information can usually be found in the phone's user manual or online—it is more difficult to determine the phone's heap size, since this is not a specification that is normally of interest to an everyday user. Phone manufacturers rarely supply the information, and service personnel do not usually have this information. However, there are 3 ways of finding a phone that supports DHIS2:

1. Purchase a device that is already known to be able to run the application
2. Buy a phone in a high enough price range so it is more likely to have the required specifications
3. Acquire a selection of cheap non-carrier-provided phones and test each to see if they will run the application

We selected the third option, deciding not to use carrier-provided phones, and visited a phone shop with a good selection of models. Several

models seemed to fit the required specifications, but the most promising one was the Samsung B313E, which is widely available in local markets across the country. This phone was tested and found to be suitable for use with DHIS2 mobile. The phone has a 2-inch screen and a basic 3x4 number pad with T9 predictive text technology (Figure). The project procured these phones for CHWs and provided data bundles through a selected mobile network service provider.

The benefit of having a non-carrier branded phone is that it will work with SIM cards from any telecommunication provider because it is not locked to a single carrier. If the program is scaled nationwide, unlocked phones will allow the implementing team to choose the network with the best coverage in a given area.

The C-DHIS2 mobile consists of 2 separate applications: the DHIS2 Java 2 platform micro edition (J2ME) aggregate capture application and patient tracker application. Both applications are enabled for offline data entry if a mobile network connection is not available, and will automatically send the data once the phone reconnects with a mobile network. The following is a summary of the functionalities of the 2 applications:

Aggregate Application: This application is used to capture the number of cases seen, managed, and referred by CHWs, and reports and requisitions for iCCM drugs—artemether-lumefantrine, amoxicillin, oral rehydration solution (ORS), and zinc—and diagnostic tools, such as malaria rapid diagnostic tests (RDTs), on a weekly basis. Three forms may be selected for data entry by the CHWs:

- The *iCCM Disease Management Form*, which is used to report the number of cases seen, cases referred, and deaths from diseases such as diarrhea (bloody and non-bloody), pneumonia, and RDT-confirmed malaria.
- The *Reports and Requisition Form*, which is used to report stock information on artemether-lumefantrine, amoxicillin, zinc, ORS sachets, and RDTs.
- The *Newborn Care at Home Form*, which captures the number of newborn babies who have been visited or referred or have died in the CHW catchment area.

Patient Referral Tracker and Alert Application: This application is used to track patients who have been referred by CHWs to health facilities and to provide feedback from health facility staff to CHWs on the referred patients. The tracker application also supports mentorship activities and provides alerts for the submission of mentorship reports. This consists of 2 major components:

- The patient referral tracker is used to notify clinicians/health center staff of the name of the patient referred to the clinic, the observed signs and symptoms, and any pre-referral treatment administered. Pre-referral messages are only sent to a specific mHealth-enabled mobile phone at the health facility. To ensure that the messages reach the clinician on duty, the receiving mobile phone is usually left with a specific person on duty. The referral tracker is also used by the clinicians to provide feedback to CHWs on the case outcome of referred patients—referred to hospital, treated and discharged, or deceased.
- The mentorship report alerts the supervisor when it is time to schedule a mentoring session. Once a month, an automated short message service (SMS) message is sent out to the supervisors to remind them to conduct mentorship with the CHWs under their supervision. After the mentorship session at the health facility,

FIGURE. Samsung B313E Mobile Phone Used by Community Health Workers in the Community Health Management Information System Program

the supervisor records the 3 main weaknesses observed, enters them on the mentorship report through the simple feature phone, and submits the results to the C-HMIS after providing feedback to the CHW. While the recording of weaknesses may appear negative, it is meant to identify issues that require supervisor intervention and follow-up support. During the mentorship sessions, however, the supervisor does make sure to recognize and appreciate a CHW's good performance.

An important feature of this mHealth innovation is the online availability of the application to supervisors at facility, district, provincial, and national levels. This makes the iCCM data visible at all levels, making it a potential management tool for analyzing community-based health management information and for decision making.

PROGRAM DESCRIPTION

Within this program, the C-DHIS2 was implemented within the context of iCCM. Zambia adopted the iCCM strategy in May 2010 and has since been scaling up the program countrywide with support from donors such as UNICEF and the Global Fund to Fight AIDS, Tuberculosis and Malaria (the Global Fund). Although the CHWs in our study sites were the first to be trained in iCCM in these 2 districts, the training used the national curriculum and national trainers that were already part of the national iCCM training scale up. As of December 31, 2015, 4,002 CHWs and 833 health center supervisors had been trained in 58 of 106 districts.[1] In addition to scaling up training, the country was also scaling up iCCM implementation nationwide. Trained CHWs used the *Sick Child Recording Form* as a job aid to diagnose, treat, and report on management of malaria, diarrhea, and pneumonia for children under 5. However, 2 major challenges to the effective implementation of iCCM in Zambia were identified: frequent stock-outs and inadequate supportive supervision of iCCM-trained CHWs.[8–10]

To address these challenges, ZCAHRD designed a pilot implementation science research study entitled, "Strengthening the delivery of integrated community case management (iCCM) in two districts of Eastern Province, Zambia." The aim of the project was to strengthen the delivery of iCCM in Chipata and Chadiza districts of the province supported through mHealth technology, improved supply chain management of iCCM commodities, and enhanced supportive supervision of iCCM-trained CHWs. In collaboration with Akros, ZCAHRD designed and developed the iCCM C-DHIS2 mobile application, which was adapted from the existing DHIS2 platform. As part of the program, 80 CHWs and 40 CHW supervisors/health facility staff were trained in a basic 7-day iCCM training course using a standard MOH training curriculum.[11] The health facility supervisors were either nurses or clinical officers. In addition to the training provided by the project, all the CHWs, both intervention and control, were provided with job aids, in form of the *Sick Child Recording* Form; acute respiratory infection timers; a bicycle; gum boots; and a bag. The CHWs (n=40) and their supervisors (n=20) in the intervention arm of the pilot project were also given a feature mobile phone, loaded with DHIS2 mobile. While the phones could have been used for conversations and activities beyond iCCM duties, a snap survey undertaken as part of the costing exercise showed that the phones were rarely used outside of iCCM work. Although the phones could have been used to send or receive voice calls, the CHWs were provided with data bundles only, meaning any voice calls would not be covered by the project. All the CHW supervisors were trained in iCCM supervisory skills. Following their training in iCCM, both CHWs and their supervisors in the intervention arm were trained in the C-DHIS2 mobile application. After training, all the CHWs and their supervisors implemented the program over a period of 5.5 months, from February 2016 to mid-July 2016.

Below is a summary description of the mHealth intervention activities by role.

CHWs: On a weekly basis, CHWs summarized iCCM cases seen, managed, and referred, used the data to complete the electronic forms on the applications installed on their mobile phones, and submitted those forms electronically to the DHIS2 database. They also summarized iCCM medicine and diagnostic tools received and dispensed, determined the order quantity using allowable maximum stock levels, and then completed an electronic Reports and Requisition form installed on their mobile phones and submitted it electronically to the DHIS2 database. For each sick child with danger signs, CHWs completed and submitted an electronic referral note with a unique patient ID, personal details, signs and symptoms, diagnosis, and pre-referral treatment, if any.

Supervisors: On a regular basis, the CHW supervisors logged into C-DHIS2 and accessed

weekly reports submitted by their CHWs, and compared cases reported with medicine consumption, such as the number of positive RDTs compared with the number of artemether-lumefantrine tablets dispensed. The supervisors identified who was reporting and followed up those who did not in order to determine why they were not reporting. The supervisors received electronic referral notes on their mobile phones and sent electronic feedback notes to their CHWs on their mobile phones. On a monthly basis, supervisors received mentorship SMS reminders and invited their CHWs to their health centers and provided mentorship. After each mentorship session, the supervisors completed a mentorship report and submitted it electronically to the DHIS2 database. Based on the Reports and Requisition forms received from CHWs, supervisors supplied medicines and RDTs to CHWs, ordering the CHWs' drugs and RDTs alongside their own medicines and diagnostic tools from the district pharmacist.

OBSERVATIONS FROM EARLY FIELD IMPLEMENTATION

From early in the implementation process, we had 3 key observations. The first was that the automation of the patient referral, feedback, and SMS reminders for monthly mentorship were unique features of this pilot, which was the first of its kind. The weakness in most community referral systems has been the provision of feedback to CHWs.[12–14] This particular iCCM C-DHIS2 platform provided a solution to the feedback problem. Although we did not carry out an evaluation of the effect of this feedback on CHWs, the results from a study from Uganda suggest that such feedback could be highly motivating because communication between health workers and supervisors had increased.[15] The second observation was that because an electronic referral note—with all patient details, including diagnosis made and pre-referral treatment, if any—reached the health center before the patient arrived, it gave health center staff the opportunity to prepare for the arrival of the patient. It also enabled health center staff to follow up on referred patients that did not reach the health facility. Our final observation was that the automated monthly SMS reminders sent to health center staff to invite CHWs to the facility for mentorship were enhancements to current supervisory activities—routine quarterly supportive supervision that combines iCCM and all other health-related supervision of CHWs. Considering the low staffing levels at most rural health facilities and the amount of work done at the facility, including travel out of stations for workshops, using the C-DHIS2 as a monitoring and supervisory tool is expected to improve technical efficiencies in the implementation of iCCM in contexts similar to the areas where this project is being implemented.

LESSONS LEARNED

The simple feature phones were able to accommodate the reporting applications and were suitable for uploading reports into the DHIS2 database. However, they were not useful for the visualization or analysis of data. Therefore, health center-, district-, and central-level supervisors and users of C-DHIS2 data need to have smartphones, laptops, or desktop computers to perform data analysis. We also observed that routine technical support—troubleshooting and fixing both software-related problems (related to the applications) and hardware-related problems (related to the phones and SIM cards) — was required to address the technical challenges CHWs face in their day-to-day interaction with the application on their mobile phones. While mobile network and Internet connectivity limited the use of the applications in selected parts of the district, no problems were encountered in the submission of weekly reports. This was likely due to the ease of opening the applications after the CHWs successfully logged in the first time: they did not have to log on the next time they needed to use the application, except when the application had to be initialized or the CHW accidentally clicked on the initialize option. In a few isolated locations with mobile network connectivity challenges, weekly report forms were completed offline and then sent once the CHW reached a location where the network is available. The biggest challenge to using this program was sending and receiving patient referrals in those locations with limited network access. For the referral form to be sent and received, the CHW's mobile phone and the receiving health facility mobile phone had to be in locations where the network was available. In cases where connectivity was an issue, the reporting or referral forms were completed offline and as soon as network access was available, the reports were sent from the CHW's mobile phone and received by the health facility supervisor.

Sustainability and Cost Implications

Each mobile phone costs the equivalent of US$38.50. On a monthly basis, the selected network service providers send data bundles worth US$5.00 to all CHWs' and supervisors' mobile phones. To scale up this program, recurring costs would have to be budgeted for in the government district health plan. The government of Zambia has already requested an estimate of the full cost of implementing this program throughout the country, including set-up and recurrent costs. A costing exercise has been completed and the report is almost finalized for submission to the donor; we will publish the results in a separate paper. The cost information will be shared with the Zambian government to inform its scale-up planning. The project was designed in such a way that it can be sustained after the project funding ends, by making sure that it is fully owned by the Zambian MOH at all levels. MOH officials at the central and district levels are part of the implementation team, and plans are underway to hand over the program to the government once the implementation research study ends. iCCM, as a strategy, is currently being scaled up countrywide with support from the government of Zambia and partners, such as UNICEF and the Global Fund. Since the MOH has decided to integrate the C-DHIS2 into the national DHIS2 HMIS, its implementation and scale up after the pilot will be funded as part of the national HMIS. The MOH has plans to engage network service providers to highly subsidize the cost of data bundles and consider the arrangement as part of the company's corporate social responsibility.

Limitations for Delivery to Scale and Data Use

The main limitation to scale up of this intervention is continued shortage of staff at the health-center level, particularly the nurses and clinical officers who would supervise the CHWs. This problem may be resolved by the addition of the new cadre of CHAs. As of September 2016, 1,403 CHAs had been trained and deployed across 597 health posts throughout Zambia, serving around 4 million people. The country's 2 CHA training schools currently have the potential to graduate at least 500 CHAs annually.[16] These CHAs can be trained in iCCM and the use of mHealth technology in order to increase the number of supervisors at the facility level.

Another limitation is the need for ongoing technical support to troubleshoot technical challenges with the mobile phones. This issue can be overcome by empowering district iCCM coordinators and the district information officers with the skills to troubleshoot the functionalities of the mobile DHIS2 application. Although financial sustainability might be a limitation in the future, the current government's commitment to integrating this application into the national DHIS2 means that the national budget should cover costs and might mobilize support from mobile service providers to provide free or highly subsidized data bundles. While data utilization may be a challenge—in the light of shortage of staff at the health center level—more sensitization of providers, structured data review forums, and the creation of the DHIS2 dashboards may motivate the staff at the health center, district, and higher levels of the health system to use the data generated for decision making.

Contextual Adaptability and Replicability

This application has only been implemented as part of a pilot study in 2 districts of Zambia. However, since it uses the basic DHIS2 platform and stock DHIS2 Java applications, which are currently being implemented nationwide, we do not see a challenge in adapting and/or replicating the implementation elsewhere in Zambia or in other countries where DHIS2 is also used as an mHealth platform.

Data Security

Access to the mHealth system can be gained by users and super users—those with special privileges—through user name and password-protected authorization.

Compliance with National Guidelines

This pilot is in compliance with the Information and Communications Technology Act No. 15 of 2009 and the 2006 National Information and Communications Policy of Zambia.[17,18] Additionally, the development and implementation of the C-HMIS tool is in agreement with the MOH's e-Health Strategy 2014–2016, which expresses the objective, "to increase access to quality of healthcare and health-related information through the use of mobile technologies."[19]

Fidelity of the Intervention

The intervention delivered what it was programmed to deliver, and proved to be reliable and robust enough to accommodate indicators from other community health programs. As a result, a roadmap has been designed to transform this

intervention into a national C-HMIS. However, the technical sustainability of this intervention depends on (1) the provision of regular technical support to users, especially CHWs; and (2) the provision of data bundles. The latter would ideally be accomplished by contracting with network service providers to provide data bundles to all registered SIM cards consistently, weekly or monthly, over an agreed period of time—through reverse billing.

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FIELD ACTION REPORT

Community-Based Noncommunicable Disease Care for Syrian Refugees in Lebanon

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The high prevalence of noncommunicable diseases (NCDs) among Syrian refugees in Lebanon required a shift in the humanitarian response, from direct care provided through mobile medical clinics to community-based primary health care and health promotion provided through trained refugee outreach volunteers (ROVs). During the first 2 months after training, these ROVs conducted 753 blood pressure monitoring visits and 657 blood glucose checks; monitored medication adherence among 387 patients with NCDs; referred 293 refugees to the local primary health care facility for additional care; and provided 346 targeted health education messages.

ABSTRACT

In the sixth year of the Syrian conflict, 11 million people have been displaced, including more than 1.1 million seeking refuge in Lebanon. Prior to the crisis, noncommunicable diseases (NCDs) accounted for 80% of all deaths in Syria, and the underlying health behaviors such as tobacco use, obesity, and physical inactivity are still prevalent among Syrian refugees in Lebanon. Humanitarian agencies initially responded to the acute health care needs of refugees by delivering services to informal settlements via mobile medical clinics. As the crisis has become more protracted, humanitarian response plans have shifted their focus to strengthening local health systems in order to better address the needs of both the host and refugee populations. To that end, we identified gaps in care for NCDs and launched a program to deliver chronic disease care for refugees. Based on a participatory needs assessment and community surveys, and building on the success of community health programs in other contexts, we developed a network of 500 refugee outreach volunteers who are supported with training, supervision, and materials to facilitate health promotion and disease control for community members, target NCDs and other priority conditions, and make referrals to a primary health care center for subsidized care. This model demonstrates that volunteer refugee health workers can implement community-based primary health activities in a complex humanitarian emergency.

CONTEXT

Global and Regional Refugee Trends

The world is currently experiencing the highest levels of displacement on record, with 65.3 million people forced from their homes by the end of 2015, including nearly 21.3 million refugees, over half of whom are children.[1] More than half of all refugees have fled from only 3 countries: Syria, Afghanistan, and Somalia. Syria's civil war in particular is considered the worst complex humanitarian emergency of our time, with more than 11 million people displaced in the sixth year of the conflict. According to the United Nations High Commissioner for Refugees (UNHCR), which is leading the regional emergency response, 4.8 million Syrians have fled to Turkey, Lebanon, Jordan, Egypt, and Iraq; another 6.6 million are internally displaced within Syria; and about 1 million have requested asylum in Europe.[1] As a result, the refugee crisis has created tremendous strains on host countries such as Lebanon, where more than 1.1 million Syrian refugees account for 25% of the entire population.

After 6 years of conflict in Syria, the protracted nature of displacement has substantially strained the health resources of host countries and even international organizations. For the regional response to the Syrian crisis in 2016, UNHCR intended to support 4.2 million primary health consultations, 308,000 referrals for secondary or tertiary care, and expand access at 300 health facilities for 4.8 million refugees; however, funding at the end of 2016 only reached 56% of the target.[2] As a consequence, national health systems lack

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sufficient delivery capacity to support a significantly larger population, consequently impacting the health needs of the host populations as well. In Lebanon, this is further complicated by the lack of universal health care and a system dominated by private health service providers,[3,4] in which private spending accounts for 52% of total health expenditures.[5] The result was that some vulnerable low-income host Lebanese communities were initially not eligible for the same health subsidies as refugees. To reduce those disparities, recent crisis response plans have emphasized integration of services through public primary health care (PHC) centers.

Noncommunicable Diseases Among Refugees

The massive growth in migration from and to more developed countries has altered the balance of health issues faced by refugees and internally displaced persons (IDPs). While acute infectious diseases remain a priority in some refugee contexts, noncommunicable diseases (NCDs) make up a greater share of the burden of those displaced from conflicts in Iraq, Syria, and Ukraine. NCDs accounted for 19% to 46% of mortality in the top 5 source countries for refugees in 2015.[6] This parallels a global trend in which deaths due to infectious diseases have declined, life expectancy has increased, unhealthy lifestyle behaviors have spread to developing economies, and the overall proportion of deaths due to NCDs has risen to more than 50%. Already, more than 80% of deaths from NCDs occur in low- and middle-income countries.[7,8] The trend toward a higher prevalence of chronic diseases among refugees is further reinforced by flows into developed countries where lifestyle risk factors, such as tobacco and alcohol use, poor diet, and inactivity, favor the development of diabetes, cardiovascular disease, cancers, and chronic lung diseases. For the 6.7 million refugees worldwide who have been displaced for more than 5 years,[9] the profile of health needs has begun to more closely reflect that of their host country's population, as behaviors adapt to the local environments over time.

For the 6.7 million refugees worldwide who have been displaced for more than 5 years, the profile of health needs has begun to more closely reflect that of their host country's population.

In the case of Syrian refugees in Jordan, Lebanon, and Turkey, in 2010 (before the influx of refugees), NCDs accounted for 77% to 90% of mortality in the region, while the rate in Syria was estimated at 80%.[10] In Lebanon, 43% of men and 27% of women smoke tobacco,[11] per capita alcohol consumption is 2.4 liters per year,[12] 37% are overweight, 28% are obese, and 68.7% are physically inactive.[13] Prior to the civil war in Syria, 48% of men and about 9% of women smoked, per capita alcohol use was 1.2 liters per year, 27% were obese, and 25% had hypertension.[6] Thus, Syrians who were already highly affected by NCDs before displacement are now living in environments that continue to support unhealthy behaviors and are likely to provide less support to mitigating or managing those diseases.

During rapid-onset emergencies, health action has necessarily focused on acute conditions. However, in the past several years, the humanitarian community has also recognized the importance of caring for displaced people with NCDs. According to the United Nations Interagency Task Force on NCDs, emergencies interrupt the normal coordinated systems of care for chronic diseases, which exist to prevent, detect, monitor, treat, and manage these diseases and their complications.[14] In emergency settings, people living with NCDs may experience complications or challenges, such as acute exacerbations of heart and lung conditions, loss of access to medications, physical strains of displacement on the elderly and disabled, and destruction of infrastructure and resources, such as dialysis equipment. These issues are gaining consideration, with peer-reviewed journals publishing articles on identified research gaps on effective interventions[15,16] and recent symposia focusing on NCDs in humanitarian settings.[17] This new attention builds on high-level advocacy for NCDs in developing countries, including the World Health Organization (WHO)'s *Global Action Plan for the Prevention and Control of NCDs*[18] and *Package of Essential Noncommunicable (PEN) Disease Interventions for Primary Health Care in Low-Resource Settings*.[19]

Community-Based Primary Health Care

Constrained health facility-based resources limit the scale at which NCD care can be provided in countries that are still grappling simultaneously with high rates of communicable diseases and malnutrition.[20] Community health models have a successful history of task shifting the delivery of care out of facilities enabled, in part, by WHO's endorsement of community-based primary health care in the Alma-Ata Declaration of 1978.[22] There are an estimated 1.3 million community health workers (CHWs) worldwide.[21] Large-scale CHW programs have proven the value of mobilizing communities to extend the delivery of preventive and curative services—particularly for maternal

and child health—by filling health gaps not met by facilities alone.[22]

Community outreach programs have been expanded to include NCDs as well, with evidence that CHWs can accurately assess and manage cardiovascular risk,[23,24] reduce the onset of hypertension through behavior change messages,[25] improve control of hypertension and diabetes,[26] conduct health screenings, provide referrals to health facilities, monitor patients, and track health outcomes.[27] Some efforts have also recently been made to mobilize refugees as CHWs, through training and support, to provide basic maternal, newborn, and child health services. A recent review of the published evidence on the impact of refugee CHWs found positive population health outcomes across a variety of interventions, including reproductive, maternal, and child health.[28] The demonstrated value of a trained community-based workforce led the Global Health Workforce Alliance to promote expanding CHW programs for disaster risk reduction, preparedness, emergency response, and recovery.[29] Given the evidence for successful community health programs in NCDs and experience with mobilizing refugees as health workers, we describe our program for integrating these approaches in the context of the Syrian refugee crisis in Lebanon.

PROGRAM DESCRIPTION

Mobile Service Delivery Phase

During the early response to the refugee crisis in Lebanon, health agencies, including ours at Medical Teams International, focused on providing care through mobile medical clinics to patients with acute medical needs who had been otherwise unable to access care due to financial constraints, lack of mobility, and residency issues. However, research conducted in 2014 found that most Syrian refugee (50.4%) and Lebanese (60.2%) households have a member with an NCD,[30] and almost 83% of refugees with an NCD sought care for their disease, with 58% going to a public PHC facility for their condition. In 2013, our organization conducted an assessment in collaboration with the UNHCR Bekaa Health Working Group, and identified significant gaps in NCDs and dental health services for refugees. In 2014, we launched an NCD and children's dental project in the Bekaa Valley, which served 32 informal settlements (ISs) through mobile medical clinics providing clinical consultations, medications, disease monitoring, health education, and referrals to supported PHC facilities for diagnostic tests and children's dental care. In 2015, we expanded the project area to 120 ISs, and started to refer some Syrian refugees to nearby PHC facilities that had begun to receive support from other health agencies. During the 2 years of the mobile medical project, our local clinicians managed the care of 2,000 NCD patients, with more than 18,000 consultations; delivered almost 54,000 prescription medications; screened 10,500 children for dental problems; and facilitated acute dental care for 1,450 children (Box).

Large-scale CHW programs have proven the value of mobilizing communities to extend the delivery of preventive and curative services by filling health gaps not met by facilities alone.

To further investigate the effectiveness of the ongoing NCD project and potential gaps and barriers, in 2015, we conducted a random survey, using Lot Quality Assurance Sampling,[31] of 320 NCD patients attending 10 mobile medical clinics, and analyzed the data using EpiInfo 7 (U.S. Centers for Disease Control and Prevention, Atlanta, GA, USA). The results showed evidence of strong clinical NCD management but ongoing gaps in the underlying unhealthy behaviors and disease knowledge. For

BOX. Mobile Clinic Patient Characteristics of Syrian Refugees in Lebanon, 2014–2016

- 2,000 NCD patients
  - Median age: 53
  - Female to male ratio: 1.27 to 1.00
  - Average systolic blood pressure: 140.7 mmHg
  - Average random capillary blood glucose: 181
  - Sedentary lifestyle: 66%
  - Obese: 39%
  - Smokers: 37.5%
  - Consume excess salt: 32%
- 18,274 patient consultations
  - Dyslipidemia: 13.8%
  - Hypertension: 76%
  - Type 2 diabetes: 39%
  - Asthma/COPD: 10%
  - Cardiovascular disease: 7%
  - Type 1 diabetes: 1.4%
- 53,785 prescriptions
  - Adherence to medication regimen most or all of the time: 95%

Abbreviations: COPD, chronic obstructive pulmonary disease; NCD, noncommunicable disease.

During the 2 years of the mobile medical project in Lebanon, our local clinicians managed the care of 2,000 NCD patients from 120 informal settlements.

example, about 80% of the patients said they took their medications all of the time; about 97% of patients with hypertension reported checking their blood pressure monthly; and approximately 96% of patients with diabetes indicated they get their blood glucose checked at least 1 time each month. But 34% of patients said they currently smoked, 21% of patients with hypertension said they add salt to their food most or all the time, and only 64% of patients with diabetes said that eating fewer sweets would help control their disease (Table 1).

With this evidence, we then organized a community-based needs assessment as a step toward establishing a community health program. Using participatory learning and assessment tools,[32] a representative sample of 117 refugees from 15 ISs was consulted on their perceived health priorities. We discovered that their main health concerns, in order of importance, were NCDs, acute respiratory illnesses, skin infections, arthritis, gastrointestinal problems, vaginal infections, urinary problems, diarrheal illnesses, tuberculosis, anemia, cancer, eye infections, and other less common conditions. To verify that these health conditions were important to the wider refugee community and to establish a baseline of health indicators, we conducted a 30-cluster household survey randomly sampled on probability proportionate to size of IS.[33] Standardized Knowledge, Practices, and Coverage (KPC) questionnaires[34] were used in parallel interviews of 300 adults and 300 mothers; the survey of adults covered issues of prevalence of NCDs and related risk factors, access to, use of, and satisfaction with PHC facilities, while the survey of mothers covered issues related to breastfeeding, child vaccination, and experience of episodes of diarrhea and respiratory infections among their children. The results were analyzed with EpiInfo 7 and are summarized in Table 2 and Table 3. The results confirmed that most refugees had access to a PHC facility at a reasonable cost and quality, but significant gaps in knowledge and behaviors and high rates of childhood diseases still remained.

Out of an initial recruitment of 500 ROVs, 120 leaders were selected to be the main focal points for health in the informal settlements, with women making up 90% of the cohort.

A community health promoter trains refugee outreach volunteers to facilitate health promotion and noncommunicable disease control in their communities.

Health Systems Strengthening Phase

With this evidence, in 2016, most health agencies including ours began following new guidance from the Lebanon Crisis Response Plan[35]—produced by the Government of Lebanon and the United Nations—to transition from mobile medical clinics to more sustainable forms of health systems strengthening. We initiated support for a PHC facility operated by a local NGO in Central Bekaa, through subsidized consultations and diagnostic tests for Syrian refugees and low-income Lebanese; quality improvement through continuous monitoring and staff supervision and training; and linkages to community outreach and referrals through refugee outreach volunteers (ROVs).

ROVs are a community-based health workforce for refugee communities endorsed by UNHCR, with standard terms of reference. We adapted this model to mobilize refugees in ISs who demonstrated an initiative to help their community, thereby developing health reference points in the settlements. We identified potential ROVs by selecting those who previously volunteered to participate in mobile clinic services, screening them first for literacy and interest, and then on NCD and technical knowledge.

Many settlements consist of large extended families, giving ROVs a starting advantage in recognition and authority. There is now at least 1 ROV per IS, and up to 5 for larger settlements. One or 2 of the most active ROVs per settlement were further selected as leaders through knowledge testing. Out of an initial recruitment of 500 ROVs, 120 leaders were selected to be the main focal points for health in the ISs, with women making up 90% of the cohort. While this may appear to be a gender imbalance, it does reflect the larger proportion of female refugees overall and the distribution of NCD diagnoses treated in the mobile clinics—two-thirds of our patients with chronic respiratory disease, type-2 diabetes, and hypertension are women. Due to cultural norms, female ROVs are also

TABLE 1. Mobile Clinic Noncommunicable Disesase Patient Survey of Syrian Refugees in Lebanon, 2015 (N=320)

	%	95% CI
Demographics		
Age, years, mean (SD)	54.6	(11.4)
Female	59.4	(53.8, 64.8)
Disease control among all patients		
Adhere to medications "all of the time"	79.9	(74.95, 84.1)
Follow a diet to control their hypertension or diabetes	70.7	(64.8, 76.2)
Currently smoking	34.4	(29.2, 40.1)
Have reduced or quit smoking	13.0	(9.5, 17.4)
Patients with hypertension (n=227)		
Check their blood pressure monthly	97.4	(94.3, 99.0)
Add salt to food most or all of the time	21.2	(16.0, 27.0)
Eat salty processed food daily	10.9	(7.0, 15.9)
Eat salty processed food weekly	24.6	(19.0, 31.0)
Patients with diabetes (n=114)		
Get at least 1 glucose check monthly	95.6	(90.1, 98.6)
State that taking medication will help to control their disease	72.8	(63.7, 80.7)
State that eating fewer sweets, candies, and pastries will help to control their disease	64.0	(54.5, 72.8)
State that avoiding sugar in tea or coffee will help to control their disease	70.2	(60.9, 78.4)
State that weight loss could improve their disease control	0.0	(0.0, 0.0)
Patients with chronic lung disease (n=56)		
Have heard messages about their condition	85.7	(73.8, 93.6)
Know that one type of asthma/COPD medication is for prevention	55.4	(41.5, 68.7)
Know that one type of asthma/COPD medication is for rescue	64.3	(50.4, 76.6)

Abbreviations: CI, confidence interval; COPD, chronic obstructive pulmonary disease; SD, standard deviation.
All data reported as % (95% CI) unless otherwise specified.

uniquely able to facilitate discussions on recently added women's health, antenatal care, and postnatal care topics.

Once selected, ROVs were equipped with blood pressure cuffs and glucometers, and trained to monitor disease control. Training was delivered through participatory adult education sessions, led by our 5 staff community health promoters (CHPs), which covered disease knowledge basics and provided hands-on equipment demonstrations. Subsequently, ROVs worked alongside the CHPs in mobile clinics to learn how to measure blood pressure and glucose and how health education messages should be shared. Over the course of the following year, as their skills improved and refugee communities developed further trust in the system, ROVs became more independent and capable of monitoring NCD disease control on their own; they are now responsible for following patients with

TABLE 2. Knowledge, Practice, and Coverage Survey of Adult Syrian Refugees in Lebanon, 2016 (N=300)

	%	95% CI
Age, years, mean (SD)	36.5	(12.9)
Have diabetes, high blood pressure, heart disease, asthma, or emphysema	22.8	(17.87, 27.20)
Access to a PHC facility		
Have been to a PHC facility	76.8	(71.60, 81.10)
Have been to a PHC facility within the last month	25.0	(19.74, 31.35)
Barriers to seeking care at a PHC facility		
Medical costs	17.0	(9.18, 28.03)
Lack of transport	11.0	(5.07, 21.28)
Legal reasons	4.0	(0.89, 12.02)
Lack of time	4.0	(0.89, 12.02)
Did not have a medical need to go to a PHC facility	47.0	(35.09, 59.45)
Transportation to a PHC facility[a]		
Transportation method		
Taxi	44.0	(37.57, 50.97)
Walking	36.0	(30.01, 42.84)
Bus	13.0	(9.02, 18.17)
Cost of transport, LBP, mean (SD)	2,000	(282)
Time to get to the PHC facility, minutes, mean (SD)	21.9	(17.2)
Services and costs at a PHC facility		
Medical cost of a PHC visit, LBP, mean (SD)	3,000	(833)
Diagnostic tests ordered	25.0	(19.26, 30.76)
Cost of tests ordered, LBP, mean (SD)	20,000	(4,386)
Received a prescription	78.0	(71.89, 83.30)
Able to get the medication at the time of their visit	34.5	(27.41, 42.14)
Cost of medical care including medications, LBP, mean (SD)	7,000	(2,886)
Reasons for visiting PHC facility		
Acute disease	45.0	(38.42, 51.67)
Chronic disease	14.0	(9.76, 19.15)
Antenatal care	14.0	(9.76, 19.15)
Well-child visit	10.0	(9.76, 19.15)
Dental care	23.0	(17.45, 28.69)

Continued

TABLE 2. Continued

	%	95% CI
Satisfaction with services at PHC facility		
Describe the care as either good or very good	67.8	(61.37, 73.82)
Feel the care could be improved	73.0	(66.54, 78.47)
Main concerns		
Respect	26.5	(19.97, 33.9)
Wait times	33.0	(26.03, 40.05)
Drug availability	58.0	(50.54, 66.02)
Cost	16.0	(11.00, 22.78)
NCD risk factors and knowledge		
Smoke tobacco	32.0	(26.88, 37.36)
Use extra salt for most/all meals	61.0	(55.32, 66.26)
Know how to prevent or control diabetes	33.0	(28.05, 38.60)
Have heard a message about asthma or emphysema	63.0	(57.20, 68.06)

Abbreviations: CI, confidence interval; LBP, Lebanese Pound; NCD, noncommunicable disease; PHC, primary health care; SD, standard deviation.
All data reported as % (95% CI) unless otherwise specified.
[a] Among respondents who have been to a PHC facility.

hypertension and diabetes every month in their own communities. CHPs and ROVs also map the epidemiology of NCDs in their communities through screening activities and individual cardiovascular disease risk stratification with a non-laboratory based method.[36] The National Health and Nutrition Examination Surveys (NHANES) I Follow-up Study tool classifies future risk based on gender, diabetes status, tobacco use, blood pressure, body mass index (BMI), and age. ROVs measure blood pressure and calculate BMI during household visits or group meetings, and refugees classified as having high cardiovascular risk are referred to a PHC facility for specialized attention and follow up for intensive behavior modification.

Community Health Methodologies

Using a social and behavior change framework, our staff CHPs facilitate behavior change sessions directly with refugees, train ROVs on priority health topics, and support them to act as referral and resource links between their communities and the health system. During monthly site visits, CHPs gather ROVs and other interested camp members for a participatory health education session on the topic of the month, usually meeting in a circle on the tent floor of the ROV leader or in a common area outside. The ROVs are given a pre- and post-test, and are tracked for attendance. Training methods incorporate strategies from the "Make Me a Change Agent" curriculum,[37] such as effective communication, negotiation, guided testimonials, storytelling, and group facilitation. CHPs use large flip charts for interactive drawing activities or posters that illustrate the key points of the session. After being trained as trainers, ROVs are equipped with job aids, such as brochures or flip charts, and begin by co-facilitating health education sessions for other refugees in the IS. These sessions are supervised by CHPs who use quality improvement verification checklists to provide specific feedback to the ROVs. In this way, the ROVs are progressively developed as health leaders with ownership for outcomes in their own settlement.

Training methods for ROVs incorporate strategies from the "Make Me a Change Agent" curriculum, such as effective communication, negotiation, guided testimonials, storytelling, and group facilitation.

TABLE 3. Knowledge, Practice, and Coverage Survey of Syrian Refugee Mothers of Children Under 2 Years of Age in Lebanon, 2016 (N=300)

	%	95% CI
Demographics		
Mothers over 25 years old	55.5	(49.83, 60.99)
Mothers who have no education	40.3	(36.65, 46.08)
Mothers who completed primary school	20.5	(16.03, 25.50)
Mothers who completed secondary school	6.04	(3.62, 9.38)
Breastfeeding		
Children under 2 ever breastfed	90.0	(85.71, 92.98)
Infants 0–5 months exclusively breastfed	3.0	(1.20, 6.40)
Mothers of infants 0–5 months who gave their infant water	92.0	(87.49, 95.12)
Mothers of infants 0–5 months who gave their infant formula	44.0	(37.07, 50.49)
Mothers of infants 6–9 months who gave their infant breast milk and complementary foods	81.0	(69.09, 89.75)
Mothers of children 0–23 months who continue to breastfeed their infant aged 6–11 months	81.5	(71.30, 89.25)
Mothers of children 0–23 months who continue to breastfeed their child aged 12–17 months	54.0	(40.75, 67.28)
Mothers of children 0–23 months who continue to breastfeed their child aged 18–23 months	27.0	(17.20, 39.10)
Child vaccination		
Children 0–23 months who currently have a vaccination card (Child Health Card) (verified)	50.0	(41.45, 59.31)
Children 12–23 months who received a DPT1, DPT3, and measles vaccine, as verified by a vaccination card	100.0	(100.00, 100.00)
Children 12–23 months who received a DPT3 vaccine, as verified by a vaccination card, by 12 months of age	24.0	(16.95, 32.34)
Water and sanitation		
Households with an improved source for drinking water	90.0	(86.51, 93.21)
Households using an improved toilet facility	93.0	(89.51, 95.39)
Households with soap at a place for washing hands	100.0	(100.0, 100.0)
Mothers of children 0–23 months who washed their hands with soap at ≥2 of the appropriate times	65.0	(59.23, 69.96)
Diarrhea		
Mothers of children 0–23 months who report that their child had a diarrhea episode in the 2 weeks prior to the survey	55.0	(49.34, 60.53)
Children with a diarrhea episode treated with ORS	57.6	(49.65, 65.22)
Children with a diarrhea episode treated with more fluids	56.0	(47.83, 63.47)
Children with a diarrhea episode offered the same amount or more food	39.0	(31.31, 46.67)
ARI		
Mothers of children 0–23 months who report that their child had a cough and difficulty breathing/fast breaths in the 2 weeks prior to the survey	30.0	(25.32, 35.64)
Children 0–23 months with ARI in the last 2 weeks who were taken to an appropriate health care provider	37.0	(27.44, 48.13)
Children 0–23 months with ARI in the last 2 weeks who were taken to an appropriate health care provider within 2 days	19.0	(11.28, 28.22)

Abbreviations: ARI, acute respiratory infections; CI, confidence interval; DPT1, first diphtheria, pertussis, and tetanus (DPT) vaccine dose; DPT2, second DPT vaccine dose; DPT3, third DPT vaccine dose; ORS, oral rehydration solution; SD, standard deviation.

Because of the important connections between modifiable risk factors for NCDs, behavior change communication tools were adapted from International Federation of the Red Cross and Red Crescent materials[38] to promote healthy lifestyle choices through participatory adult health education. Using these tools, CHPs and ROVs facilitate discussions and testimonials about realistic diet choices, such as avoiding high-fat, high-salt prepared foods, limiting sugar in tea and coffee, and reducing tobacco use. After our 2016 assessment and survey revealed additional gaps in women's and child health indicators, we adapted other health education materials to address yeast infections, skin diseases, and childhood pneumonia and diarrhea. Groups of pregnant women also gathered monthly to discuss antenatal and postnatal care and to monitor attendance at the PHC facility. In 2017, we began a collaboration with other NGOs to train specialized ROVs in basic mental health support—including group sessions on common concerns such as insomnia, psychosomatic symptoms, and child bedwetting—as well as early identification and referral for more complex psychological needs. This responsiveness to the changing priorities of beneficiaries has been an important element in building trust and partnership with refugee communities. We plan to undertake annual KPC surveys to monitor the impact of this behavior change strategy on indicators included in our baseline survey, such as tobacco use and changes in diet, and are currently using Barrier Analysis[39] techniques to explore specific factors that allow some people to succeed in changing their behaviors.

ROVs are also offered training opportunities from UNHCR and NGOs on relevant topics, such as referral mechanisms to PHC facilities or secondary care, breastfeeding, and mental health. Our staff facilitate twice-yearly visits for all ROVs to the PHC facility, to increase their visibility and connection to the health system. Throughout the year, the volunteers are also connected to supervisors and each other through a WhatsApp group on their mobile phones. Non-monetary incentives are given to ROVs, including bags, coats, mobile phone cards, and badges. However, unlike other ROV projects in the region, no monetary stipend is provided. This measure was taken to increase local ownership and sustainability as the crisis appears likely to continue for years.

In 2017, in collaboration with other NGOs, we trained ROVs in basic mental health support, including group sessions on common concerns such as insomnia, psychosomatic symptoms, and child bedwetting.

Project Health Information Systems

Project data collection forms are provided to each ROV to document health education target groups and participant numbers, health message content, referrals, blood pressure or sugar records, and NCD medication adherence. Each month, CHPs collect and aggregate the data on the ROV forms. In the first 2 months after the training and equipping phase by CHPs, ROVs in 80 settlements conducted 753 blood pressure monitoring visits for refugees with hypertension and 657 blood glucose checks for those with diabetes; monitored the medication adherence of 387 patients with NCD; referred 293 refugees to the local PHC facility for additional care for a wide range of conditions; and provided 346 targeted health education messages covering diarrhea, pneumonia, breastfeeding, and NCD topics (Table 4). Further impact data will be published in the future when the follow-up survey data are available.

Accountability for refugee services is managed by uploading aggregated reporting from the NGOs to UNHCR's ActivityInfo platform on a monthly basis. Our mobile medical clinics initially used a paper-based health record system in the field, after which selected patient data were then

TABLE 4. Refugee Outreach Volunteer Activities in Lebanon During Initial 2 Months of New Outreach Phase, 2016

	Blood Pressure Monitoring Visits	Capillary Glucose Monitoring Visits	NCD Patient Medication Monitoring Visits	Refugees Referred to PHC Facility	Home Visits for Health Education
Total number	753	657	387	293	346
Monthly number per IS, mean (SD)	7.5 (2.9)	6.4 (3.1)	3.7 (1.8)	2.2 (1.1)	2.9 (1.6)

Abbreviations: IS, informal settlements; NCD, noncommunicable disease; PHC, primary health care; SD, standard deviation.

Participatory assessment and statistical survey methods can be adapted to the refugee context to guide program decisions and empower displaced people to set their own health priorities.

consolidated into a computer database. This process required maintaining a large repository of paper records and many hours of transcribing information into a computer database. To simplify this process, we adapted the open-source mobile application CommCare (Dimagi, Cambridge, MA, USA) to create a health information system for refugees receiving NCD services. With consent, each patient was registered in the application on an Android tablet and the information stored in encrypted format and transmitted securely to a Health Insurance Portability and Accountability Act (HIPAA)-compliant central server when data connectivity was available. After registration, clinical data was recorded in linked forms, with diagnoses and medications stored and automatically populated in the digital file on each follow-up visit. Automatically aggregated data was then reported to UNHCR, as required. With the transition from mobile health clinics to community outreach, the application has been modified to collect information about CHP and ROV activities, mainly on antenatal and postnatal care. Because the application was free to deploy and can track cases over time, other health actors have expressed interest in adapting it as well. At the PHC level, we also facilitated the implementation of the national health information system software in order to integrate data collection with the Ministry of Health's network of public health facilities.

DISCUSSION

Noncommunicable diseases are an increasing burden worldwide,[40] particularly for Syrian refugees and the eastern Mediterranean region as a whole.[41] With displacement at an all-time high, NCDs are an increasingly important issue in humanitarian health. In this article, we demonstrate that NCDs can be addressed alongside other common acute conditions in Syrian refugee settlements, through community health outreach, behavior change promotion, disease monitoring, and linkages to ongoing clinical care. Initially, our paid staff delivered health education in parallel to direct services in mobile clinics, but follow-up surveys showed gaps in behaviors and knowledge, which prompted an increased focus on community outreach for social and behavior change. While others have also made efforts to conduct NCD awareness sessions using paid health educators,[42] we trained and equipped refugee volunteers with tools to facilitate changes in NCD-related behaviors and consistently monitor disease control. Early results are encouraging, with highly active ROVs gaining confidence in facilitating behavior change sessions, monitoring disease control, and making referrals.

Refugees are capable and invested in serving their own communities, and can be effectively supported to facilitate NCD prevention, health promotion, and referrals to primary health care.

We also found that participatory assessment and statistical survey methods could be adapted to the refugee context to guide program decisions and empower displaced people to set their own health priorities. Mobile health applications eased the burden of project data collection, improved reporting efficiency, and assisted in identifying long-term disease control trends. We are now applying these approaches to maternal, child, and mental health conditions in the same settlements alongside other health partners in Lebanon, an effort which should be explored and encouraged in other refugee contexts as well.

The successful provision of health services to vulnerable Lebanese and Syrian populations will require support for the public health system, coupled with a strong community presence and the task shifting of basic services to a community-based health workforce. The fragmented and highly privatized Lebanese health care system has historically focused on facility-based interventions, with limited community outreach. Prior to the refugee crisis, mechanisms for community-based health promotion, disease prevention, and linkages to the public health system were undeveloped and the use of community volunteers was rare.[43] Given the expectation that Lebanon may host Syrian refugees for years to come, access to equitable health care for all vulnerable populations is vital to the economic and political well-being of Lebanon, and will require health outreach programs to link communities to existing services. In a recent hopeful sign for scaling up this approach, UNICEF's proposed "THRIVE Initiative" contains a 3-year US$21 million package for integrating community outreach into a child survival strategy for Lebanon.

CONCLUSION

This article demonstrates one way humanitarian health programs can transition from direct service delivery into national health systems strengthening and community outreach. Refugees are capable and invested in serving their own communities, and can be effectively supported to facilitate NCD prevention, health promotion, and referrals to primary health care facilities. As global health experience has shown in development settings, mobilizing communities to participate in their own health outreach is highly effective and crucial for sustainable outcomes, a lesson that

now can be transferred to protracted refugee crises.

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FIELD ACTION REPORT

Infant Feeding Policy and Programming During the 2014–2015 Ebola Virus Disease Outbreak in Sierra Leone

Amelia Brandt,[a] Óscar Serrano Oria,[b] Mustapha Kallon,[c] Alessandra N. Bazzano[a]

Policies on breastfeeding and possible mother-to-child transmission of Ebola Virus Disease (EVD) during the outbreak evolved depending on public health priorities and the evidence available at that particular time. To improve responses to future outbreaks, research on vertical transmission of EVD should be prioritized; infant and young child feeding experts should be integrated into the outbreak response; and a digital repository of national policies and associated messages should be created.

ABSTRACT

Optimal breastfeeding is of vital importance to infant and child health and has been adopted by countries as a standard recommendation. However, in the context of an infectious disease outbreak, especially when the disease is poorly understood, policy makers must balance the benefits of breastfeeding against the risk of disease transmission through breastfeeding. During the 2014–2015 Ebola Virus Disease (EVD) outbreak in Sierra Leone, the development of correct and consistent messaging about infant feeding and nutrition programming was considerably delayed by numerous challenges. These challenges included a lack of sufficient information about the risk of transmission through human milk, numerous stakeholders, limited communication between coordination pillars, inconsistent and evolving messages from various stakeholders, and the public's distrust of the health system and international actors. For improved response to future disease outbreaks, research on vertical transmission of EVD should be prioritized, infant and young child feeding experts should be integrated into outbreak response collaboration, and a digital repository of potential and appropriately tailored messages should be created.

BACKGROUND

The 2014–2015 Ebola Virus Disease (EVD) outbreak in West Africa was unprecedented in its severity. In Sierra Leone, the first case was recorded in May 2014, and the outbreak continued for nearly 18 months until the country was declared Ebola-free by the World Health Organization (WHO) on November 7, 2015.[1,2] During that time, 14,124 total cases were recorded in the country.[1] Difficulties in developing infant feeding policy and programming during this outbreak closely mirror those of the early years of the HIV epidemic, albeit with a greatly accelerated timeline. In this article, we provide an overview of the infant feeding policies and programming that evolved during the 2014–2015 EVD outbreak in Sierra Leone.

EVD, previously referred to as Ebola hemorrhagic fever, is a rare disease caused by contact with 1 of the 5 species of Ebola virus.[3] EVD was first discovered in 1976 in what is now the Democratic Republic of the Congo. Since that time, Africa has experienced small sporadic outbreaks,[3] the largest of which took place in Gulu, Uganda, in 2000–2001 with 425 cases. The 2014–2015 outbreak was by far the most severe in history.[4]

In humans, the virus spreads through "direct contact (through broken skin or mucous membranes) with the blood, secretions, organs, or other bodily fluids" of a person who is sick with or has died from EVD.[5] As such, public health professionals recognized that there was a feasible risk of transmission between a breastfeeding mother with EVD and her uninfected infant through both breast milk and close contact with other bodily fluids during breastfeeding.

The risk of transmission through breastfeeding for mothers who had survived EVD was difficult to estimate, although a number of studies are currently seeking to increase that understanding. At the start of the outbreak,

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what evidence was available indicated that the Ebola virus could persist in some bodily fluids in the convalescent stage. This viral persistence was thought to be due to the fact that certain organs of the body, such as the testes and mammary glands, are immunologically privileged—meaning, that they are able to tolerate disease antigens without causing an immune response.[6] While several studies focused on this viral persistence, only 1 tested human milk for Ebola virus during convalescence. The sample was found positive for the virus using both reverse transcription polymerase chain reaction (RT-PCR) and viral culture 15 days after disease onset.[6,7] In contrast, the virus had been isolated from semen samples up to 82 days following disease onset.[8]

From 2009 to 2013, exclusive breastfeeding of children from birth to 6 months increased from 11% to 32%.

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A woman in Sierra Leone breastfeeds her infant.

The identification of virus in human milk by RT-PCR, however, was not necessarily indicative of infectivity,[9] which further complicated the interpretation of the existing evidence.

In this context, the potential risk of EVD transmission through breastfeeding had to be balanced with the benefits of optimal breastfeeding. WHO-recommended breastfeeding practices include initiating breastfeeding within 1 hour of birth, "exclusive breastfeeding for the first 6 months of life, and introduction of nutritionally adequate and safe complementary (solid) foods at 6 months together with continued breastfeeding up to 2 years of age or beyond."[10] It is estimated that optimal breastfeeding could avert 800,000 deaths in children under 5 years old, although globally only 36% of infants from 0 to 6 months are exclusively breastfed.[10,11]

COUNTRY CONTEXT

Sierra Leone has one of the highest under-5 mortality rates in the world, which makes achieving optimal breastfeeding especially important.[12] The Sierra Leone Ministry of Health and Sanitation (MOHS) demonstrated a commitment to breastfeeding promotion prior to the outbreak, by launching a comprehensive nutrition program in 2009 with Infant and Young Child Feeding (IYCF) components that strongly encouraged breastfeeding.[13] This program had contributed to increases in recommended feeding practices within its first several years. In 2013, exclusive breastfeeding of children from birth to 6 months had increased from 11% to 32% within that period, and 97% of children were estimated to have been breastfed at some point.[14,15]

These gains in optimal breastfeeding coincided with a small reduction in under-5 mortality. In the 5-year period preceding the 2008 Demographic and Health Survey (DHS), under-5 mortality was estimated at 156 deaths per 1,000 live births.[14] In comparison, the rate for the 5-year period preceding the 2013 DHS was 140, a reduction of approximately 10%.[15] During and after the EVD outbreak, the MOHS and implementing partners were concerned that policies, messaging, and programming about infant feeding for women currently or previously infected with EVD could cause a reduction in optimal breastfeeding among uninfected women. This conflicted with the broad recognition that it was crucial to take every measure to prevent EVD transmission, especially among the most vulnerable.

STAKEHOLDERS

A number of health and nutrition organizations active in Sierra Leone during the outbreak were involved in the development of policies, messaging, and programming related to infant feeding within the context of the EVD outbreak. These stakeholders included the MOHS, WHO, the United Nations Children's Fund (UNICEF), the U.S. Centers for Disease Control and Prevention (CDC), the Emergency Nutrition Network (ENN), and numerous local, national, and international civil society organizations. While civil society organizations were not directly responsible for policy making, they contributed considerable technical expertise and experience.

The office of the President of Sierra Leone created the National Ebola Response Centre and District Ebola Response Centres to coordinate the outbreak response and a pillar system to facilitate coordination within specific sectors: child protection and psychosocial, case management, communications, logistics, safe burials, social mobilization, surveillance, coordination, and food security.[16]

POLICY AND MESSAGING

The Social Mobilization Pillar was responsible for developing and maintaining the *Consolidated Messaging Guide for Ebola Communication in Sierra Leone* (henceforth the *Consolidated Messaging Guide*) of approved messages, which was frequently revised as new information became available. While the Social Mobilization Pillar produced a majority of the health messaging, it is important to note that other pillars also created health communication tools specific to their sector. For example, the Psychosocial Support Pillar was responsible for the majority of survivor issues and created health communication tools for survivors, although messaging for survivors was also included in the *Consolidated Messaging Guide*. A formal mechanism to coordinate messages between the pillars did not exist, although informal coordination did occur.

Policy and Messaging Within Ebola Treatment Centres

To address infant feeding in the EVD context, guidance was developed for both women with acute EVD and those in convalescence (survivors). Initial breastfeeding guidance was issued on August 22, 2014, by the ENN through a consultation involving in-country staff and experts from the CDC, the Liberia Ministry of Health and Social Welfare, UNICEF, and WHO.[17] Although this guidance was used in Sierra Leone, Liberia was included in this initial consultation because of their experience addressing the outbreak. This guidance advised the cessation of breastfeeding for mothers with EVD in all cases, except when both mother and child were EVD positive.[17] Mothers who were EVD positive, but whose infants were EVD negative, were advised to stop breastfeeding as the risk of infection through continued breastfeeding outweighed the risks of replacement feeding.[17] These recommendations remained consistent when the guidance was updated in September 2014.[18] Although the guidance was incorporated into national technical guidance designed for use by professional stakeholders, as far as the authors know, it was not integrated into public messaging.

Several actors involved in the treatment of EVD patients argued that continuing breastfeeding would increase the already high mortality risk of patients and, as such, implemented total cessation of breastfeeding, even if both mother and infant were EVD positive. This approach became the final recommendation for Ebola Treatment Centres (ETCs) until the end of the epidemic, although "the rationale was based on anecdotal cases, limited field experience and the assumption that the presence of Ebola virus in breast milk increases the likelihood of severe Ebola in an already infected infant."[19] In these cases, ready-to-use infant formula (RUIF) was provided to replace human milk and administered by either ETC staff or the mother using the standard infection prevention and control procedures of the ETC. No further evidence was produced to argue for a less conservative approach. However, the same guidelines provided that the infected mother of an infected child must be given the choice of breastfeeding, if she prefers, as long as she was properly informed and advised.[18]

Ready-to-use infant formula was provided to replace human milk and administered by either ETC staff or the mother using the standard infection prevention and control procedures.

Messaging and Policy for Survivor Women in Convalescence

The first messages regarding breastfeeding during convalescence were included in the August 2014 ENN memo.[17] The memo recommended the cessation of breastfeeding by survivor mothers until their breast milk tested negative for the Ebola virus.[17] This guidance was updated in September 2014 to include WHO recommendations that when testing was not feasible, mothers could resume breastfeeding after 8 weeks.[18]

Expressing milk was recommended only to alleviate pain for the mother, although this guidance was not made clear to survivors in any standard way.

In January 2015, the CDC produced an information book for survivors recommending the cessation of breastfeeding by survivors until 2 months following recovery (Figure 1).[20] In March 2015, the Social Mobilization Pillar published the following messaging in the *Consolidated Messaging Guide* that was inconsistent with CDC's information book[21]:

> *If you have survived Ebola, it is best not to breastfeed IF you have other safe ways to feed your baby. But if there is no other way to feed your baby safely, breastfeeding will still provide the nutrition your baby needs.*

Interim clinical guidance from WHO was the most permissive, suggesting lactating women may want to test their milk but allowing women who did not know the status of their breast milk to continue breastfeeding.

The discrepancy in the existing messages was brought to the attention of the Social Mobilization Pillar, MOHS, CDC, and WHO in March 2015.

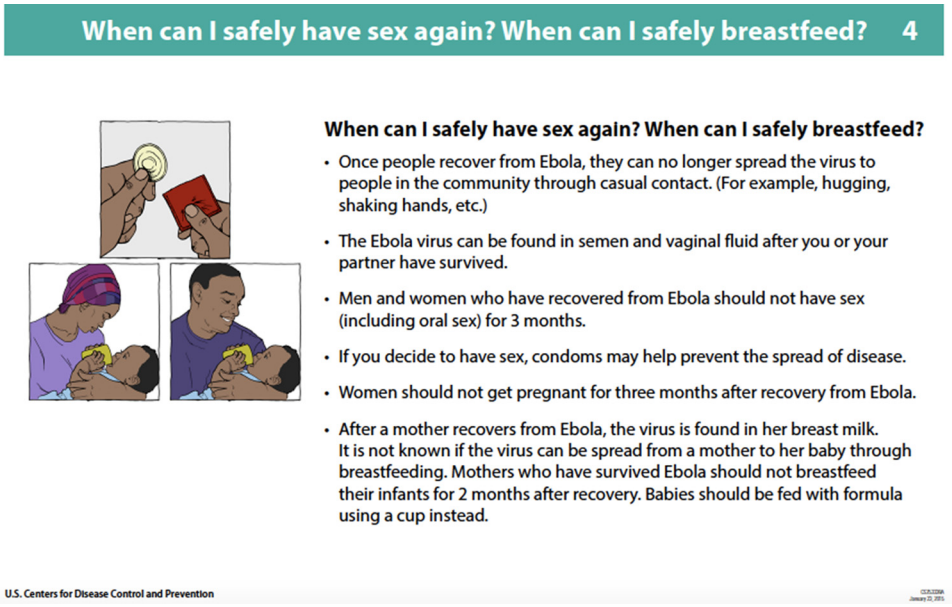
After an examination of the existing messages and the available information regarding risk to infants, all parties agreed to adopt the messaging found in the *Consolidated Messaging Guide*. In April 2015, the CDC revised their survivor information book to make the messaging consistent (Figure 2).[22] The earlier technical guidance from ENN had not been distributed to the Sierra Leonean public, and as such, official revisions were not made. Given the existence of conflicting messages at the policy and messaging level, it is likely that women were also given conflicting messages at the individual level, but this was not documented.

On April 11, 2016, WHO issued interim guidance on clinical care for EVD survivors that addressed breastfeeding.[23] This guidance was the most permissive, stating that lactating women may want to test their milk, but allowed women who did not know the status of their breast milk to continue breastfeeding.[23] The Table presents the above discussed recommendations.

PROGRAM RESPONSE

At the same time, the MOHS and UNICEF also launched a programmatic response to address

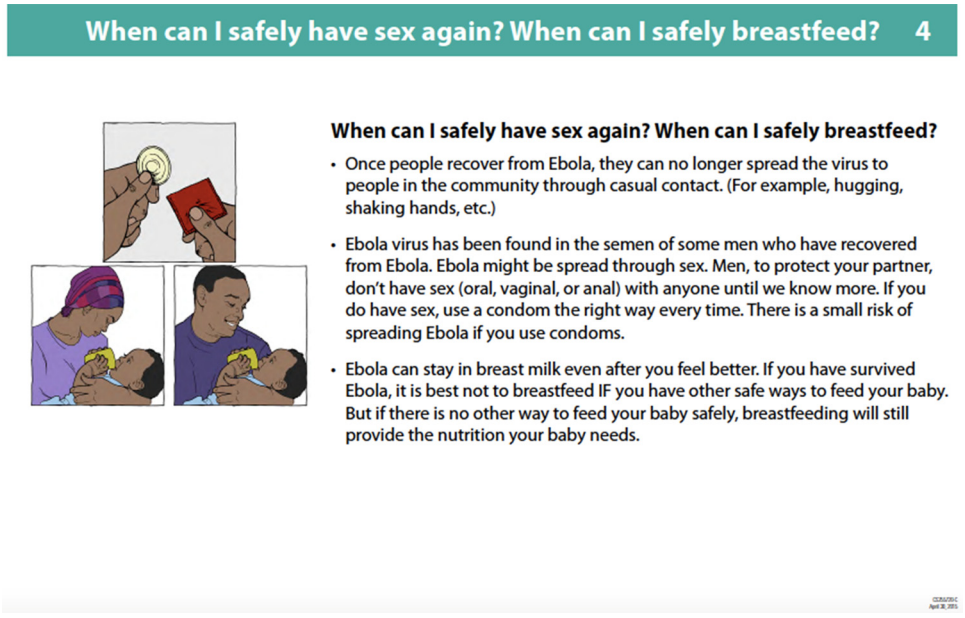
FIGURE 1. Initial CDC EVD Survivor Information Book Recommending Cessation of Breastfeeding by Survivors Until 2 Months Post-Recovery, January 2015



Abbreviations: CDC, U.S. Centers for Disease Control and Prevention; EVD, Ebola virus disease.

Note: This guidance was retracted and corrected after new information about breastfeeding risk emerged.

FIGURE 2. Updated CDC EVD Survivor Information Book Recommending Avoiding Breastfeeding by Survivors if Other Safe Feeding Methods Are Available, April 2015



Abbreviations: CDC, U.S. Centers for Disease Control and Prevention; EVD, Ebola virus disease.

infant feeding needs. The recommendation that survivors cease breastfeeding indefinitely created a need for additional feeding options for infant children of survivors. Children under 2 years who had been orphaned or separated from their mothers were often also in need of additional feeding options. The MOHS and UNICEF responded by providing RUIF to children 6 months old or younger of women survivors. RUIF was available at the District Health Management Team (DHMT) offices in each district, and the district nutrition teams managed distribution based on demand. Although not officially included in the program, a number of orphans and separated children 6 months old or younger who had been affected by EVD also received RUIF. Children over 6 months were not eligible for inclusion as RUIF is not appropriate for this age group and other appropriate products were not available. While wet nursing was discussed, it was not considered a viable option and was not recommended by any guidelines.

This programmatic response presented a dilemma for the country at a national and district level. The national Food and Nutrition Directorate as well as the district medical officers were concerned about meeting the nutritional needs of children affected by EVD while avoiding a reduction in breastfeeding rates for non-infected women.

During the outbreak, EVD survivors received certificates upon discharge from ETCs in order to allow them to access a range of services. Survivors were also recruited for jobs that presented an infection risk to others, due to their assumed limited susceptibility to reinfection. The unique services and opportunities available to survivors inadvertently led to a demand for fraudulent survivor certificates.[24] This posed a risk for the RUIF program, in that if the program was advertised publicly there would likely be a number of fraudulent requests for RUIF. This could contribute to a reduction in breastfeeding by women with no exposure to the Ebola virus, which would slow the progress made in optimal breastfeeding in the country. As such, the DHMT nutrition teams relied primarily on referrals from frontline health workers and civil society organizations to identify women and children who qualified for the program.

The RUIF program had 2 challenges: if the program was advertised publicly there would likely be a number of fraudulent requests for RUIF, which could lead to uninfected women requesting RUIF and a country-wide reduction in optimal breastfeeding.

TABLE. Key Breastfeeding Recommendations for Women Survivors of EVD

Date Issued	Source	Recommendation(s) or Message
August 22, 2014	ENN	• "For breastfed infants of Ebola infected mothers who are asymptomatic, the risks of Ebola transmission via breastmilk are understood to outweigh the risks associated with replacement feeding." • "For breastfed infants of Ebola infected mothers who have developed Ebola or are suspected Ebola cases themselves, the benefits of maintaining breastfeeding outweigh any possible benefits of replacement feeding." • "Where a mother has survived Ebola . . . she should return for testing of her milk every 2–3 days (or however often is feasible) . . . Ideally there should be 2 negative tests on different days . . ."
September 2014 (update)	ENN	• "If testing of breast milk is not feasible, then maternal breastfeeding should be avoided for 8 weeks post recovery.
January 2015	CDC	• "Mothers who have survived Ebola should not breastfeed their infants for 2 months after recovery."
March 2015	Social Mobilization Pillar	• "If you have survived Ebola, it is best not to breastfeed IF you have other safe ways to feed your baby. But if there is no other way to feed your baby safely, breastfeeding will still provide the nutrition your baby needs."
April 2015 (update)	CDC	• (Messages consistent with Social Mobilization Pillar message above.)
April 11, 2016	WHO	• "EVD survivors who are lactating may wish to have their breast milk tested . . . **Women who do not know the status of their breast milk or who were tested and for whom no Ebola virus RNA was detected should continue breastfeeding.** If Ebola virus RNA is detected, breastfeeding should be suspended and the breast milk restested every 48 hours until two consecutive 'undected' results are obtained. During this time, breast milk should be replaced with a sustainable appropriate breast-milk substitute."

Abbreviations: CDC, U.S. Centers for Disease Control and Prevention; ENN, Emergency Nutrition Network; EVD, Ebola virus disease; RNA, ribonucleic acid; WHO, World Health Organization.

CHALLENGES

The emergence of EVD in a country with weak infrastructure and limited services for child health, as well as an emerging national breastfeeding promotion program, created a very difficult environment for decision making on infant feeding policy and programming.

Lack of Necessary Information to Make Recommendations

As discussed, there was minimal evidence prior to the epidemic on the potential risk of EVD transmission through breastfeeding, especially in the case of survivors during convalescence. As more information emerged, policy makers were able to consider and incorporate it into relevant guidance and messaging. In some cases, such as the initial CDC messaging advising that breastfeeding could continue after 2 months, emerging information often necessitated the retraction and correction of previous health messages.

Numerous Technical Partners

Emergency responses require participation from a large number of technical partners with different backgrounds and expertise, which can result in challenges with coordinating efforts and delineating lines of responsibility for decision making. While WHO traditionally takes the lead during an outbreak, the early months of the EVD outbreak were extremely chaotic and fast-moving and the

focus of the response was primarily on immediate treatment and prevention. Recognizing the gap in infant feeding guidance, the ENN and WHO responded quickly to address that need.

Difficulty Maintaining Communication Between Response Pillars

The pillar system offers distinct advantages for emergency response because it allows technical partners to stay informed about progress and activities in their focus area. However, when crosscutting issues emerge, the pillar system can become a barrier if communication between pillars is limited, as it was in Sierra Leone. In this case, increased communication between the Psychosocial Pillar, where the CDC EVD Survivor Information Book was reviewed, and the Social Mobilization Pillar could have prevented the dissemination of contradictory messages for EVD survivors.

Distrust and Rumors

Behavior change in Sierra Leone is complicated due to the widespread distrust by the general population of the health system.[25] During the EVD outbreak, this distrust was further heightened by countless rumors surrounding EVD.[25] Messages that were disseminated and then retracted may have reinforced ideas that the government and other technical partners were incompetent or acting in their own self-interest.

LESSONS LEARNED

Policies related to nutrition and infant feeding are ideally developed over a long period in order to allow sufficient time for collecting evidence and gaining consensus among key stakeholders. In emergency contexts, that is not always possible because of the need for a rapid response. Often, there is no other choice than to use the best information and resources available to make decisions that can be reasonably expected to have a positive impact. From this standpoint, the lessons learned from the EVD outbreak are useful in order to inform emergency preparedness planning. The recommendations from this section are summarized in the Box.

Include Infant and Young Child Feeding Experts From the Beginning of the Outbreak Response

It is important that rapid response mechanisms include policy and messaging guidance development as infectious disease outbreaks become more common. These mechanisms should be headed by WHO and include country, regional, and global stakeholders. In future infectious disease outbreaks, infant and young child feeding experts should be included from the beginning of the response to ensure that nutrition issues are taken into account early on. Inclusion of these experts will also lead to faster development of relevant policies, messaging, and programming. It is also important to consider the need for appropriate breastfeeding messages for women who contract an infection while pregnant as well as those who contract an infection following birth but while still breastfeeding.

The inclusion of infant and young child feeding experts from the beginning of the response will lead to faster development of relevant policies, messaging, and programming.

Develop a Digital Repository for National Policies to Reduce Conflicting Messages and a Clear Strategy for Health Communication

Limited communication between technical partners with different foci has been identified as a challenge in this case. A well-maintained digital repository for national policies and associated messages would improve the ability of stakeholders to ensure consistency within the response. Additionally, a clear strategy for public service communication will also increase consistency and the effectiveness of health communication. Finally, it is important for countries to have a central list of technical partners that should be made aware of the existence of such tools.

Prioritize Research on Potential Vertical Transmission of Ebola Virus Disease

One of the major challenges to developing infant feeding guidance for EVD survivors was the limited information on the potential risk of vertical transmission during the acute and the convalescent phases of EVD through breast milk and other

One of the major challenges to developing infant feeding guidance for EVD survivors was the limited information on the potential risk of vertical transmission during the acute and the convalescent phases of EVD.

Box. Key Recommendations to Improve Responses to Future Outbreaks

- Include infant and young child feeding experts from the beginning of the outbreak response
- Develop a digital repository for national policies to reduce conflicting messages and a clear strategy for health communication
- Prioritize research on potential vertical transmission of EVD

paths. Although the outbreak is now over, those risk pathways are still poorly understood. The thousands of survivors in Sierra Leone and other affected West African countries could provide countries a unique opportunity to increase understanding of the virus's short- and long-term effects on the human body. It is vital that a better understanding of the potential risk of vertical transmission through breast milk is achieved in order to improve the breastfeeding policy response in future Ebola outbreaks.

PARALLELS TO HIV POLICY DEVELOPMENT

While there is now a large evidence base to draw from when making breastfeeding policy and programming recommendations for mothers with HIV,[26] this was not the case in the early years of the HIV epidemic.[27] It is not surprising that global and country-level guidance on breastfeeding by HIV-infected mothers has continuously evolved throughout the past several decades as new disease knowledge and prevention and treatment options emerged.[27] The HIV example provides insight into how guidance to reduce the risk of vertical transmission through breastfeeding should evolve as new evidence improves understanding. Acute outbreaks offer the opportunity to better understand how long-term international policy-making processes can be adapted to an emergency response within an accelerated period.

Acute outbreaks offer the opportunity to better understand how long-term international policy-making processes can be adapted to an emergency response within an accelerated period

CONCLUSION

In examining this Field Action Report, it is important to bear in mind the challenges of the environment in Sierra Leone during the EVD outbreak. Actors on the ground were faced with innumerable competing demands on their time and attention and were hindered by limited information about the potential risk of transmission through breastfeeding. The evolution of the messages that emerged during this period is reflective of the priorities and available information at different points in the outbreak. Earlier messages referred to a 2-month period after recovery when breastfeeding should be suspended, but as more evidence emerged about the length of viral persistence in breast milk, the messages evolved to be less specific regarding time frames. These messages also evolved to be more permissive, allowing that if no other safe way to feed the infant existed that breastfeeding was still the best option. This was evidenced by the final messages released by WHO after the end of the outbreak, which prioritized the well-documented benefits of breastfeeding over the risk of transmission, which, at that point seemed to be no longer a concern.

Intersections between infectious disease outbreaks and maternal and child health policies are becoming increasingly important. While this report focuses on the intersection of infant feeding policy in the case of the EVD outbreak, other examples are emerging, such as health policies related to the ongoing Zika epidemic. Public health practitioners focused on infectious diseases and maternal and child health have not always worked closely together, but there is a growing need to consider the links between them. The EVD outbreak in West Africa provides a case study of the nature of these links and can provide insight on the importance of working together to limit setbacks in maternal and child health due to infectious disease outbreaks.

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SHORT REPORT

Migration Experiences and Reported Sexual Behavior Among Young, Unmarried Female Migrants in Changzhou, China

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30% reported being sexually experienced, but only 38% reported using contraception at first sex and 58% consistently over the past year, leading to many unintended pregnancies and abortions. These findings document an unmet need for reproductive health education and services for young, unmarried female migrants in urban China.

ABSTRACT

Background: China has a large migrant population, including many young unmarried women. Little is known about their sexual behavior, contraceptive use, and risk of unintended pregnancy.

Methods: 475 unmarried female migrants aged 15–24, working in 1 of 6 factories in 2 districts of Changzhou city, completed an anonymous self-administered questionnaire in May 2012 on demographic characteristics, work and living situation, and health. We examined demographic and migration experience predictors of sexual and contraceptive behavior using bivariate and multivariate regressions.

Results: 30.1% of the respondents were sexually experienced, with the average age at first sex of 19 years (standard deviation=3). 37.8% reported using contraception at first sex, 58.0% reported using consistent contraception during the past year, and 28.0% reported having at least 1 unintended pregnancy with all unintended pregnancies resulting in abortion. Those who had had at least 1 abortion reported having on average 1.6 abortions [SD=1] in total. Migrating with a boyfriend and changing jobs fewer times were associated with being sexually experienced. Younger age, less education, and changing jobs more times were associated with inconsistent contraceptive use.

Conclusion: These findings demonstrate there is an unmet need for reproductive health education and services where these women work as well as in their hometown communities. This education must begin early to reach young women before they migrate.

INTRODUCTION

China has experienced rapid economic development since the early 1980s, which has produced massive internal migration to meet the labor needs of the industrialized urban areas of eastern China. The migrant population in China has progressively increased since the 1980s, from 6.5 million in 1982 to 48.4 million in 1995, 144 million in 2000, and 221 million in 2010, with most migrants from rural areas.[1–3] Under the current *hukou* (household registration) system, migrants leave their relatively poor and underdeveloped hometown, which remains their place of household registration, and move to work in other areas without official approval.[4]

Health care for migrants is not covered by the public service system because services are provided only for people with official local household registration.[5] Private health services are limited and expensive. Meeting the needs of this large and increasing migrant population has thus challenged the Chinese health care system.[6–9] The majority of the migrant population is young (about half are between the ages of 15 and 24 years), but few studies have focused on young migrants' health.[5,10,11]

A public system of family planning clinics provides reproductive health services including free contraceptives and abortion but only for married couples of childbearing age. Although half of migrant women are under age 25 and unmarried,[12] there are no government programs providing reproductive health services for unmarried young women, resulting in a large gap between

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available services and needs.[13] There is little sexual education in schools and sometimes not even within the family because of conservative social norms that unmarried young women should not be having sex.[14]

Traditional Chinese values prohibiting premarital sex for women are often not observed. No studies in China have directly compared sexual activity of young migrant women in urban areas with their non-migrant counterparts, but there are reasons to think migrant women may be at higher risk. One study found that 60.8% of unmarried male migrants and 40.2% of unmarried female migrants aged 15–24 were sexually experienced.[15] Another study showed that a greater percentage of rural-to-rural migrants aged 15–24 were sexually active than non-migrants of the same age in rural areas (53.5% vs. 47.4%, respectively).[16] A study of children of adult migrant workers found that more middle school students of the migrant workers (average age, 14 years) were sexually active than non-migrant adolescents of the same age (7.2% vs. 4.5%, respectively).[14] Other studies have shown a number of factors to be associated with sexual risk behavior, including gender, age, educational level, cultural background, rural vs. urban residence, and income level.[15–21] A qualitative study found that female migrants far from their family may feel lonely and regard sex with a partner as a reward for companionship.[22]

Condom use may be lower among migrant adolescents than non-migrants of the same age (52.7% vs. 65.7%, respectively, in one study[15]). In one study, 21% of sexually active young migrants reported never using any contraception,[16] and in another study 34.9% had unprotected sex in the last 3 months.[23] Reasons for non-use of contraception among young migrants included believing it isn't necessary with their boyfriends or girlfriends.[19] Many young women using the rhythm method could not compute the "safe" period correctly and had poor sexual and contraceptive knowledge.[12,22,24,25]

While adolescence and young adulthood are relatively healthy times of life, they can also be a period of social and health risks from unsafe sexual behavior, including sexually transmitted infections (STIs), unintended pregnancy, and abortion.[26] One study of young migrants aged 15–24 found that 8.7% of female migrants had STIs and 47.4% of those sexually active had had an unintended pregnancy.[15,23] Another study of young migrant women seeking abortion showed that 38.7% had had a previous abortion, 17.5% had never used condoms, and 9.7% had STIs.[27]

Although these studies indicate that young female migrants may be at reproductive health risk, little is known about what aspects of the migration experience are risk factors or which women may be at higher risk. This study examined sexual behavior of unmarried young female migrants working in factories in Changzhou, China, to determine patterns and predictors of risk, with particular attention to the migration experience.

Although half of migrant women in China are under 25 and unmarried, there are no government programs providing reproductive health services for unmarried young women.

Young female migrants in China may be at greater reproductive health risk than their non-migrant counterparts, but little is known about their migration experience and other risk factors.

METHODS

Setting

This cross-sectional, questionnaire-based study was conducted in 2 Economic Development Areas (zones designated by local government for building factories) in 2 districts of Changzhou city with large migrant populations. Changzhou is typical of the many rapidly developing cities in eastern China where the local population alone cannot meet the great demand for labor and a large number of young people, mostly from rural areas, move to the city for work. In 2010, the 6th Population Census showed 1.48 million migrants, including 0.38 million females aged 16–24 years, contributing to Changzhou's total population of 4.59 million (http://www.cztjj.gov.cn/class/OEJCMFCP). Most work in factories is located in Economic Development Areas far from the city center. As strangers to the city working long hours, they usually spend most of their time in factories and nearby worker quarters.[28]

Sampling

Data for this study were gathered in May 2012 as part of the baseline measure of a wellness program aiming to improve migrant workers' health and rights in Changzhou. Purposive sampling was used to select 6 factories, each producing different products (such as underwear, electronic elements, outdoor equipment, and trains) from the 2 Economic Development Areas, seeking a representative sample of migrant workers. In each factory, the sampling fraction was about one-fifth, yielding 200–300 migrant workers through a systematic sample based on workers' ID numbers. In total, 1,665 respondents aged 16–48 years were sampled. This analysis included 475 unmarried females aged 16–24 years old who were a subset of the 1,110 female respondents.

Instrument

A self-administered closed-ended questionnaire was pretested with 20 migrant workers in a sampled factory. We interviewed these respondents after administering the questionnaire to verify that they understood the questions; these respondents were then excluded from the formal survey. The instrument collected data on demographic characteristics, work situation, living situation, and health.

Methods of Administration

Eighteen trained fieldworkers conducted the survey, with 3 assigned to each sampled factory. Permission was obtained from management of the sampled factories, and investigators conducted the survey for 1 day in each factory. A survey coordinator at each factory provided a list of sampled workers to workshop supervisors. Factories have infirmaries that provide basic first aid, and supervisors asked sampled workers to go to the infirmary for an interview about migrants at the end of their work shift if they were willing. Investigators explained clearly what would be asked when the women arrived. They were reminded of anonymity and the voluntary nature of the study and signed a consent form that was not attached to the anonymous questionnaire. Refusals were rare (as is often the case for survey research by scientific research institutions in China) and not recorded. The questionnaires were distributed to 8–10 migrant workers at a time by a fieldworker. The respondents took approximately 20 minutes to complete the self-administered questionnaire. Afterwards, participants received a gift valued at US$1.50.

Independent Variables

We analyzed 2 main groups of independent variables: those related to demographic characteristics and those related to the migration experience. For the demographic characteristics, age was divided into 3 categories: 16–18 years, 19–21 years, and 22–24 years; education level was coded into 4 categories: elementary school, middle school, high school, and college; ethnic group was coded Han or Minority; only child in her family was coded yes or no; and hometown was coded rural or urban. For the migration experience variables, age at first migration was coded into 4 categories: 13–15 years, 16–18 years, 19–21 years, and 22–24 years. (Labor laws in China require women to be 16 years old; those migrating at younger ages either did not work right away or did so illegally.) Geographic spread was coded as originating in inner Jiangsu province (outside Changzhou) or another province; migrating with a boyfriend was coded yes or no; and number of jobs worked in different factories since migration was recorded as a number.

Dependent Variables

Regarding sexual behavior, 3 dependent variables were considered. The first was a yes/no question as to whether the respondent had ever had sex. Additional questions asked of women who were sexually experienced included whether they always used contraception with sex in the past year. To be considered "consistent," respondents had to answer yes to both of the following questions: "Did you use a contraceptive method at sexual behavior every time in the last year?" and "Did you use contraception at last sex?" The third question was "Did you ever have an unintended pregnancy?" If the answer was yes, they were asked, "How many abortions have you had in your lifetime?"

Data Analysis

Data were analyzed with SPSS version 20.0. The bivariate associations between sexual experience and demographic characteristics and migration experiences were examined using the chi-square test. Associations between dichotomous and continuous variables were assessed using the *t* test. Associations between ordinal variables were analyzed using gamma correlation. We assessed independent predictors of dependent variables with forward stepwise logistic regression that retained predictors with $P<.05$ in the final multivariate model. Because age at migration and chronological age were highly correlated (gamma correlation 0.83), we did not include age at migration as a predictor in the multivariate analysis.

Ethical Clearance

The Institutional Review Board at Nanjing College for Population Program Management approved the study protocol and survey instrument, and authorities of the local family planning commission also provided permission to conduct the study.

RESULTS

Demographic and Migration Characteristics

The sample consisted of 475 unmarried female migrants, of whom 59.4% were aged 16–21 years,

TABLE 1. Demographic and Migration Characteristics of Sampled Migrant Female Workers, Changzhou, China, 2012 (N=475)

Characteristic	No. (%)
Age group, years	
16–18	112 (23.6)
19–21	170 (35.8)
22–24	193 (40.6)
Ethnic group	
Han	442 (93.1)
Minority	33 (6.9)
Education level	
Elementary	45 (9.5)
Middle school	193 (40.6)
High school	156 (32.8)
College	81 (17.1)
Hometown	
Rural	418 (88.0)
Urban	57 (12.0)
An only child	
Yes	105 (20.1)
No	370 (79.9)
Age at first migration, years	
13–15	49 (10.3)
16–18	233 (49.1)
19–21	130 (27.4)
2224	63 (13.3)
Area of origin	
Inner Jiangsu	148 (31.2)
Other provinces	327 (68.8)
Migrating with a boyfriend	
Yes	28 (5.9)
No	447 (94.1)
No. of jobs held, mean (standard deviation)	4 (3)

90.5% had at least a middle school education, 20.1% were the only child of their parents, 6.9% were ethnic minorities, and 88.0% came from a rural area (Table 1). Regarding migration experiences, 86.8% left their hometown and started to work before 22 years of age, 68.8% were from provinces other than inner Jiangsu, 5.9% migrated together with a boyfriend, and the average number of jobs held since migration was 4 (standard deviation [SD]=3), with a maximum of 16.

Sexual Activity

30% of the respondents were sexually experienced.

Among the entire sample, 30.1% of the respondents were sexually experienced, and the average age at first sex was 19 years (SD=3), with a minimum age of 13 years (data not shown). Most sexually experienced young females (87.7%) had first sex with a boyfriend, and 72% of them first had sex after migration. Table 2 shows bivariate associations of being sexually experienced with demographic characteristics and migration experiences. Significant predictors of being sexually experienced included older age, minority ethnic status, lower educational level, being an only child, migrating with a boyfriend, and having held fewer jobs since migration.

In multivariate analysis, significant predicators of being sexually experienced included older age, minority ethnicity, being the only child, migrating with boyfriend, and holding fewer jobs since migration.

Table 3 shows significant independent demographic predicators of being sexually experienced in multivariate analysis, including older age, minority ethnic status, and being the only child in a family. As for migration experience, women migrating with their boyfriends were more likely to be sexually experienced than those migrating alone, and migrants having held more jobs since migrating were less likely to be sexually experienced.

Contraceptive Use

About 38% of respondents reported using contraception at first sex and 58% reported using it consistently over the past year.

At first sex, 37.8% of respondents reported using contraception: 55.6% used the "morning after pill," and 44.4% condoms (data not shown). Among those who did not use contraception at first sex, the 2 main reasons stated were "knew nothing about contraception" and "did not know how to use contraception."

Among those who were sexually experienced, 58.0% reported using contraception consistently over the past year. The most common methods used for consistent contraceptive users were condoms (62.6%) and hormonal pills (10.7%). Some women who used contraception consistently (23%) did not always use the same method, often using morning-after pills as a remedial measure if

TABLE 2. Bivariate Predictors of Being Sexually Experienced Among Young Female Migrant Workers, Changzhou, China, 2012

Characteristic	n/N (%)	*P* Value
Age group, years		<.001
16–18	21/112 (18.8)	
19–21	42/170 (24.7)	
22–24	80/193 (41.5)	
Ethnic		<.001
Han	121/442 (27.4)	
Minority	22/33 (66.7)	
Education level		<.001
Elementary	27/45 (60.0)	
Middle school	49/193 (25.4)	
High school	37/156 (23.7)	
College	30/81 (37.0)	
Hometown		.17
Rural	121/418 (28.9)	
Urban	22/57 (38.6)	
Only child in the family		.002
Yes	45/105 (42.9)	
No	98/370 (26.5)	
Age at first migration,[a] years		.08
13–15	14/49 (28.6)	
16–18	71/233 (30.5)	
19–21	37/130 (28.5)	
22–24	21/63 (33.3)	
Geographic spread of migration		.52
Inner Jiangsu	41/148 (27.7)	
Other provinces	102/327 (31.2)	
Migrating with a boyfriend		<.001
Yes	19/28 (67.9)	
No	124/447 (27.7)	
No. of jobs held, mean, sexually experienced group, unexperienced group	3.7, 4.4	.009

[a] Age at first migration was not considered in the logistic models because its gamma correlation with age group was 0.83.

TABLE 3. Multivariate Predictors of Being Sexually Experienced and of Inconsistent Contraceptive Use Among Young Female Migrant Workers, Changzhou, China, 2012 (N=143 Sexually Experienced Females)

	Being Sexually Experienced			Inconsistent Contraceptive Use		
Characteristic	**OR**	**95% CI**	***P* Value**	**OR**	**95% CI**	***P* Value**
Age group, years			<.001			.03
16–18	0.21	0.11, 0.41	<.001	4.32	1.21, 15.36	.02
19–21	0.45	0.27, 0.75	.002	3.55	1.18, 10.69	.02
22–24	1			1		
Education level			NS			.049
Elementary				4.15	1.11, 17.57	.046
Middle school				5.11	1.42, 43.32	.01
High school				1.74	0.46, 6.60	.41
College				1		
Ethnic group			<.001			NS
Han	0.19	0.08, 0.44				
Minority	1					
Only child in the family			.02			NS
Yes	1.8	1.10, 2.94				
No	1					
Migrating with a boyfriend			.001			NS
Yes	4.91	2.00, 12.08				
No	1					
No. of jobs held since migrating[a]	0.84	0.77, 0.91	<.001	2.02	1.56, 2.62	<.001

Abbreviations: CI, confidence interval; NS, not significant; OR, odds ratio.
[a] OR for number of jobs held is for each additional job held.

no contraception was used at sex. Other methods such as spermicides, hormonal injections, and intrauterine devices were almost never used by these young unmarried women.

Bivariate predicators of not using contraception consistently were lower educational level (44% with elementary school education reported not using contraception consistently compared with 57.1% with middle school education, 37.8% with high school education, and 20% with college education; *P*=.01); younger age at first migration (49.4% of those migrating at age 16–18 reported not using contraception consistently compared with 40.5% of those migrating at age 19–21 and 14.3% of those migrating at age 22–24; *P*=.01); and having held more jobs since migration (mean number of jobs with consistent contraceptive use 2.5 [SD=2] compared with mean for others 5 [SD=3]; *P*<.001). Other demographic predictors not significantly associated with consistent use of contraception included ethnic group, being the only child in the family, urban vs. rural hometown, province of origin, and migrating with a boyfriend.

Significant predictors of inconsistent contraceptive use in multivariate analysis included age and holding more jobs since migration.

Table 3 shows the significant predictors of inconsistent use of contraception in multivariate analysis. Older women had lower risk of inconsistent use of contraception, and those with middle

school education reported inconsistent use to the greatest extent. Regarding migration experiences, the only significant predictor in the multivariate logistic model was that women who had held more jobs were less likely to use contraception consistently.

Pregnancy and Abortion

28% of those who were sexually experienced reported having an unintended pregnancy, all resulting in abortion.

Among the respondents who reported being sexually experienced, 28.0% reported having had an unintended pregnancy (data not shown). All of these pregnancies resulted in abortion. This is not surprising because most pregnancies among unmarried women in China result in abortion,[12,19] and any women who might be exceptions probably would not continue working in these factories. The average number of abortions among women who had had at least 1 abortion was 1.6 (SD=1). Reasons reported for the last unintended pregnancy were non-use of contraception (75%) and contraceptive failure (25%). Among sexually experienced young females, 30.1% said they knew how condoms work, 38.5% knew about emergency morning-after pills after having unprotected sex, and 51.7% agreed that abortion is harmful to women's health. These percentages were not significantly different from women who were not sexually experienced.

Significant predicators of unintended pregnancy were age and education.

The only demographic characteristics that were significantly associated with unintended pregnancy in bivariate analysis were age group and educational level. In a logistic model including these 2 predictors, younger age (16–18, odds ratio [OR]=3.62, confidence interval [CI]=1.24 to 10.54; 19–21, OR=2.56, CI=1.01 to 5.51; index category, 22–24 years) and lower education level (elementary, OR=3.75, CI–1.01 to 14.71; middle school, OR=3.06, CI=1.01 to 10.56; high school, OR=0.91, CI=0.22 to 3.77; index category, college) were associated with unintended pregnancy. The migration experience variables examined had no significant association with unintended pregnancy.

DISCUSSION

Our findings show that a substantial proportion of young, unmarried female migrants in an urban area of China are sexually experienced, but only about half of them use contraception consistently.

This study of young, unmarried female migrants aged 16–24 in Changzhou, China, shows that a substantial proportion (30.1%) reported being sexually experienced. Of these, only about half report using contraceptives consistently, usually condoms. Many (28%) who are sexually experienced have had an unintended pregnancy. Although more report consistent contraceptive use in the past year than at first sex, many of these unmarried young female migrants continue to be exposed to the risk of unintended pregnancy.

The proportion of these women who report being sexually active seems relatively low compared with women internationally, although studies in other countries have not focused specifically on migrants.[29–31] This may be due to many reasons, but traditional Chinese culture is probably a key one. The strongly conservative tradition of Confucianism emphasizes abstinence for unmarried women, with abstinence linked to personal and family honor.[17] Nevertheless, many of these women are sexually active, and rates of sexual activity can only be expected to rise with modernization and globalization.

Findings from other studies about demographic predictors of sexual activity are consistent with our results regarding older age, lower educational level, and ethnic minority status.[17,21] We also found associations not previously described between sexual activity and specific migration experiences, including age at first migration, whether migrating with a boyfriend, and number of jobs held since migrating.[13,14,17,18]

An interesting and novel finding of this study was the relation between number of jobs women have held since migrating and sexual behavior. For these women, having held more jobs is an indicator of economic instability. There is little upward job mobility, so changing jobs usually indicates that a woman was not doing well in her job or did not find work conditions to be acceptable. In our study, women in more stable job situations (i.e., who had worked fewer jobs) were more likely to be sexually active. Most women who had sex did so with a "boyfriend" (the Chinese term indicates an affective relationship). It is possible that women had more opportunity to establish such relationships when in a stable work situation or, conversely, that those involved in a romantic relationship were less likely to change jobs. On the other hand, women in less stable work situations (who had held a greater number of jobs) were less likely to use consistent contraception if they were sexually active. These findings should be further explored in future research.

Limitations

As a cross-sectional survey, this study can only examine associations, not establish causality. Self-reported data may be subject to social desirability bias resulting in underreporting of premarital sex and overreporting of consistent contraceptive use. This study did not include a

non-migrant comparison group for direct comparison. The variables we examined included only certain aspects of the migration experience. Results of this study in one city may not generalize to young female migrants elsewhere in China. But there are millions of young female migrants working in thousands of factories in eastern China who likely face similar problems, as may other young migrant women elsewhere in China and in other industrializing countries.[12,14–15,32–34] Workers who migrate internationally likely face additional challenges. Nevertheless, we believe this study provides useful information about a large, poorly studied population of young migrant women at risk for unintended pregnancy.

CONCLUSION

Many young, unmarried migrant women in China report being sexually experienced but report not using contraception consistently, often leading to unintended pregnancies. While abortion is safe and legal in China, it is considered a failure of contraception rather than a good family planning strategy. It would be better to provide women with the education and reproductive health services they need to prevent unwanted pregnancies.

Women who are younger, who migrate at an early age, who are less educated, and who have less stable work situations are less likely to use contraception consistently, suggesting that young women need appropriate sexual education at an earlier age, before they migrate. After they migrate, many of these women still need more sexual education as well as friendly and accessible reproductive health care services. Unfortunately, they usually receive neither. These women could benefit from a national policy to support reproductive health and service provision for unmarried young people, as some have suggested for China,[12] or from direct provision of reproductive health services in the workplace or in partnership with nearby health facilities, as some have advocated internationally.[35–37] Schools and health care services need to do more to protect these vulnerable young women. Correct knowledge and timely, targeted services can make a difference.

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Young women in China need appropriate sexual education at an early age, before they migrate to urban areas.

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GLOBAL HEALTH: SCIENCE AND PRACTICE
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LETTER TO THE EDITOR

The Collapse of the Price of Oil and the Importance of Fair Market Competition and Optimizing Public and Private Resources: Assessing Angola's Contraceptive Market Landscape

Denise L Harrison[a]

See related article by Nieto-Andrade et al. and authors' response.

In GHSP's March 2017 article by Nieto-Andrade and colleagues, "Women's Limited Choice and Availability of Modern Contraception at Retail Outlets and Public-Sector Facilities in Luanda, Angola, 2012–2015," the authors assert that public health policies must ensure the availability and affordability of contraceptives on the market and expand the range of options for women.[1] I would argue that public health policies should instead support fair market competition and optimize the use of both public and private resources. If subsidies are necessary, they should be discrete, targeted, and time-bound to reduce crowding out the commercial private sector, which increases the cost of family planning for donors and governments (i.e., taxpayers). If the authors had provided more information about Angola's economic crisis, shared a deeper discussion around market competitiveness, and disclosed their own plans to launch both oral and emergency contraceptive pills in Angola, GHSP readers would have obtained a better understanding of Angola's contraceptive market landscape, as well as the interest of the authors as market players.

ANGOLA'S ECONOMIC CRISIS

In 2014–15, oil prices fell by nearly 50%. Annual inflation doubled from 7.5% in 2014 to 15.3% in 2015, and the Angolan Kwanza currency declined by more than 35% against the dollar.[2,3] Prices for pharmaceuticals (not just contraceptives), which are mainly imported, jumped. Exacerbating this situation was the Bank of America and Standard Chartered Bank's decision to stop supplying dollars to Angola based on their concern about lax banking regulations.

The authors state "the availability of different methods dropped significantly between 2014 and 2015—by up to 15 percentage points—with a subsequent price increase in many brands," linking the increase in contraceptive prices to the decline in method availability. However, it was the weak economy, rampant inflation, and a shortage of foreign exchange, which led to a steep decline in imports, that caused both the price increases and the decline in method availability. Since 2013, I have been visiting Luanda for work periodically and have seen firsthand the closing of many pharmacies starting in 2014. It was clear that the shortage of foreign exchange was causing pharmacies to go out of business.

MEASURING MARKET COMPETITIVENESS

The article by Nieto-Andrade et al. asserts there is limited choice and availability of contraceptives in Angola, pointing out that 85.9% of all outlets had only 1 method of contraception in 2014 (81.4% in 2015). These statistics are not strong evidence of limited choice and availability in a country where the modern contraceptive prevalence rate (mCPR) is under 20%.[4] Nigeria, like Angola, is also middle income, has an economy dependent on oil revenues, and an mCPR under 20%.[5,6] In 2015, Population Services International (PSI) conducted an "FPwatch" study in Nigeria, which found that only 2,553 of the 13,365 outlets surveyed carried condoms—let alone hormonal contraceptives.[7] "Limited" is contextual; a richer analysis is needed to support the title's assertion.

The authors state "the number of brands on the market is an indicator of the number of choices available to women in terms of quality and prices." This is only true where the number and size of manufacturers on the market is competitive. Bayer manufactures numerous oral contraceptive brands, most of which are available in Angola. Bayer contraceptives

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The weak economy, rampant inflation, and a shortage of foreign exchange caused both the contraceptive price increases and declines in method availability in Angola.

dominate Angola's market even when leaked donated Bayer contraceptives are taken out of the equation.[8] Manufacturer (or distributor) concentration can reduce family planning choice, availability, and affordability. Tracking manufacturer presence, entry, and exit is a more appropriate way to understand market health, growth potential, and consumer choice than tracking only the number of brands.[9]

The same assessment of market dynamics to determine market health applies to the condom market, as well. Because socially marketed condoms receive direct and indirect subsidies, to gauge market health, it is important to understand how well these condoms are targeted, their pricing, and their impact on current and future market growth and consumer choice. The article states "socially marketed, affordably priced condoms are successfully competing as indicated by their high market share in terms of both volume and value . . ." Legal and Sensual condoms distributed by PSI (the authors' affiliation) are highly subsidized either through a price subsidy, tax-free status, and/or support for advertising and operations. PSI has a cost advantage over other distributors, which contributes to its domination of the market. As a subsidized social marketing organization, PSI should have underscored its success in reaching its target population, changing their behaviors, and "crowding in" quality manufacturers, and explaining at what point subsidies could be phased out.

Leakage, market concentration, and overly or poorly controlled subsidization can impede market health and growth.

CLARITY ON PSI'S OWN INVOLVEMENT IN THE MARKET

Finally, for a deeper understanding of the market landscape, it is helpful to know all the ways in which the authors are involved in the market. With funding from the Bill & Melinda Gates Foundation, PSI is entering the hormonal contraceptive market in Angola with an oral contraceptive pill and an emergency contraceptive, a fact that was not disclosed in the article. Is this why the article says women have "limited choice" and emphasizes the importance of "preventing leakage of 'free' products from the public sector into the private sector (which are later sold at 'unfair' prices)" to ensure the private sector invests more? The price for leaked Microgynon oral contraceptive pills in Angola is around US$2.50, higher than many—if not most—PSI socially marketed oral contraceptives in sub-Saharan Africa. Is it PSI's goal to succeed by capturing a large part of the hormonal contraceptive market in addition to the condom market? What percentage of these subsidized sales will reach populations at low quintiles, "crowd out" commercial players, or raise the mCPR and lower the total fertility rate?

Leakage, market concentration, and overly or poorly controlled subsidization can impede market health and growth, reducing women's choices for family planning today and tomorrow. The authors rightly point out the new Angolan context, in which donors are reducing donation of products and focusing mostly on technical assistance, requires good public health policies. It also requires transparency and good will on everyone's part, including NGOs as well as governments and donors.

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LETTER TO THE EDITOR

Putting Consumers at the Center in a Context of Limited Choice and Availability of Modern Contraception in Luanda, Angola. Authors' Response to "Assessing Angola's Contraceptive Market Landscape"

Benjamin Nieto-Andrade,[a] Eva Fidel,[a] Rebecca Simmons,[b] Dana Sievers,[c] Anya Fedorova,[a] Suzanne Bell,[d] Karen Weidert,[e] Ndola Prata[e]

See related articles by Nieto-Andrade et al. and by Harrison.

We welcome the opportunity to respond to Harrison's Letter to the Editor regarding our GHSP article "Women's Limited Choice and Availability of Modern Contraception at Retail Outlets and Public-Sector Facilities in Luanda, Angola, 2012–2015." There is little recent market data available for Angola, and this article was an effort to share what we had learned about product availability in retail outlets and public-sector facilities in Luanda. We welcome debate and hope that the gaps identified in the market will inspire others to act.

Harrison makes 3 main points in her Letter to the Editor, and here we respond to each in turn.

ANGOLA'S ECONOMIC CRISIS

We agree with Harrison that the economic crisis, inflation, and shortage of foreign exchange are contributing factors affecting supply and availability, a point that our original article discusses as well. As supply constricts, increase in price is a common outcome.

MEASURING MARKET COMPETITIVENESS

Harrison questions our statement that there is limited choice and availability of contraceptives in Angola. Instead, she seems to suggest that contraceptive prevalence drives the current availability of modern contraceptive methods and that this relationship is unidirectional. We contend that the relationship between the modern contraceptive prevalence rate (mCPR) and availability of contraceptive methods is circular. We believe one of the main reasons mCPR is low in Angola is because contraceptive products and services are not easily available. A recent analysis of international data from 1982 to 2009 found that for each additional method available to at least half of the population, the percentage of married women using a modern method increases by 4 to 8 percentage points.[1]

We agree with Harrison that along with the number of brands, the number of manufacturers or distributors in a market is also worth considering. Brands do "speak" to consumer segments and offer different price points, thereby increasing the likelihood that a consumer finds a choice that's right for her. For that reason, the number of brands remains a useful, but not the sole, measure of choice in a market.

In our original article, we state that public health policies must ensure the availability and affordability of contraceptives on the market and expand the range of options for women. Harrison argues ". . . that public health policies should instead support fair market competition and optimize the use of both public and private resources." On that point, we agree with Harrison on the need to optimize use of public and private health resources, but we also believe that when public health goals are paramount, policy must consider public health outcomes in addition to the goal of creating a competitive market place.

We agree that subsidies need to be discrete and targeted to market failures in which market players are likely to underinvest. It is one of the reasons why Population Services International (PSI) spends a disproportionate amount of funding on health behavior change. If such investments were made by the

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commercial sector, they would need to be recouped from consumers, making health products and services unaffordable for most. Using subsidies and/or government policies to correct market failures could help to stimulate both demand and interest in market entry by commercial actors.

The questions on timing of phasing out subsidy and its effect in the market, although not a topic of our original article, are very interesting and should be explored further. Nevertheless, it is worth noting that PSI no longer uses donor subsidy to market its condom brands in Angola, as these products have become fully sustainable.

CLARITY ON PSI'S OWN INVOLVEMENT IN THE MARKET

PSI seeks to put the consumer at the center and bring health care closer to her. In contraceptive markets, this means ensuring women can easily access a broad range of contraceptive choices that are directly available on the market. In the oral contraceptive market in Angola, where PSI has not been playing a role until recently, there is a paucity of third-generation pills that are more suited to new and young users. With seed money from the Swedish government (the Swedish International Development Cooperation Agency, or Sida), in May 2017 PSI launched a third-generation oral contraceptive pill (note: our original article was accepted in November 2016) and will soon launch an emergency contraceptive, with the aim of providing additional choices to young women in Angola. With these oral contraceptive products, PSI is advancing a cost-recovery Social Enterprise model that will not require continuous subsidy from external sources.

On leakage, PSI believes in the role of public-sector subsidies to provide free contraceptives to consumers who cannot afford them. That subsidy is wasted when products meant for free distribution are misappropriated, essentially providing a subsidized product to consumers with ability to pay, and enriching those who manipulate the supply chain. Having found evidence of this in the marketplace in Luanda, the authors felt it important to share the finding.

Again, we offer our thanks to Harrison and to GHSP for this opportunity to discuss the contraceptive market in Angola.

Acknowledgments: The ideas expressed herein reflect only the point of view of the authors.

Competing Interests: Dr. Nieto-Andrade reports that PSI (www.psi.org), the authors' organization, is known as a nonprofit organization that has been distributing family planning products around the globe (among other products and services) for decades. Its goal is to improve the health and well-being of populations through social marketing and behavior change communication. PSI had received a grant from the U.S. Agency for International Development (USAID) to implement the "Ouakula" project in Angola in the areas of HIV, malaria, and family planning (2011–2016). The research studies to which Harrison's letter refers were funded by this USAID grant as part of program monitoring. PSI strongly values evidence-based decision making and uses data, as presented in our original GHSP article and in this letter, to design strategies that improve people's health while respecting the role of other players in the market. The authors did not receive any payment from any source to write the present response letter or the original article that received comments from Harrison.

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