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Factors influencing rapid progress in child health in post-conflict Liberia: a country case study on progress in child survival, 2000-2013

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ABSTRACT

Objectives: Only 12 countries in the World Health Organization's African region met Millennium Development Goal #4 (MDG#4) to reduce under-five mortality by two-thirds by 2015. Given the variability across the African region, a four country study was undertaken to examine barriers and facilitators of child survival prior to 2015. Liberia was selected for an in-depth case study due to its success in reducing under-five mortality by 73%, and thus successfully meeting MDG#4. Liberia's success was particularly notable given the civil war that ended in 2003. We examined the factors contributing to their reductions in under-five mortality.

Design: A case study approach drawing on data from quantitative indicators, national documents, and qualitative interviews was used to describe factors that enabled Liberia to rebuild their maternal, neonatal and child health (MNCH) programs and reduce under-five mortality following the country's civil war.

Setting: The interviews were conducted in Monrovia (Montserrado County) and the areas in and around Gbarnga, Liberia (Bong County, North Central region).

Participants: Key informant interviews were conducted with Ministry of Health officials, donor organizations, community-based organizations involved in MNCH, and health care workers. Focus group discussions were conducted with women who have experience accessing MNCH services.

Results: Three factors contributed to the reduction in under-five mortality: national prioritization of MNCH after the civil war; roll-out and scale-up of integrated packages of services that expanded access to key interventions and promoted inter-sectoral collaborations; and community outreach and provision of MNCH services using community health workers and trained traditional midwives to expand access to care and improve referrals.

Conclusions: Although Liberia experiences continued challenges related to limited resources, the strategies employed by Liberia enabling their rapid progress may provide insights for reducing under-five mortality in other post-conflict settings.

Keywords: Public health, Qualitative research, Community child health < Paediatrics, International health services < Health services administration & management

Strengths and limitations of this study

- Presents qualitative and quantitative data on implementation of maternal, neonatal and child health (MNCH) interventions in Liberia, which has been understudied in Liberia.
- Most studies exploring progress in child survival only present qualitative data from key informants working within the healthcare system, but this paper also provides data from women attempting to access services for themselves and their children in both urban and rural contexts.
- For the review of national MNCH documents, policies and strategies were not issued until after 2007 due to the civil war. While these documents contained retrospective assessments of the preceding period, assessments of the impact of more recent policies or strategies were not available.
- The qualitative data was limited to a non-random sample of participants and conducted in two counties (one urban, one rural). It is possible that the changes in under-five mortality in these areas do not reflect changes at the national level and that the views and experiences of some participants do not reflect those from other areas of Liberia.

INTRODUCTION

The under-five mortality rate has declined in sub-Saharan Africa from an estimated 180 deaths per 1,000 live births in 1990 to 83 deaths per 1,000 in 2015 [1], yet this was not sufficient for this region to meet Millennium Development Goal (MDG) #4 of reducing under-five mortality by two-thirds between 1990 and 2015 [2]. Nevertheless, as of 2015, 12 African countries had met their MDG#4 goal [1]. There is thus much interest in understanding why some countries were able to meet MDG#4 while others were not. Liberia has witnessed a dramatic reduction in under-five mortality from 255 to 70 deaths per 1,000 live births between 1990 and 2015 (Fig 1) [1]. This 73% reduction in mortality rates means that Liberia effectively met MDG#4 ahead of schedule. Infant mortality has undergone a similar 69% reduction over the period, while neonatal mortality has declined much less rapidly.

Fig 1. Under-five, infant, and neonatal mortality rates for Liberia in 1990, 2000, 2010, and 2015 (solid circles) with annual rates of reduction (ARR) for each period (solid and dashed lines).

Source: Levels and Trends in Child Mortality: Report 2015 - Estimates Developed by the United Nations Inter-agency Group for Child Mortality Estimation [1]. Report and data accessed July 2015 from www.childmortality.org.

Liberia's accomplishments are especially notable given the 14 years of civil war, ending in 2003, that destroyed most of Liberia's national infrastructure, eroded the country's social fabric, and cost at least 200,000 lives. Many health facilities were destroyed, skilled personnel were lost, and essential medicines and supplies were scarce [3]. Liberia emerged from this crisis with extremely limited health infrastructure and poor maternal, neonatal and child health (MNCH) services. As a result of a strong commitment by the Liberian government in collaboration with individuals and organizations from across civil society, the private sector and the general public, the country made notable gains towards re-

establishing peace and security, revitalizing the economy, strengthening governance and the rule of law, and rebuilding the national health infrastructure and MNCH services [3]. Bornemisza, et al. [4] describe how the post-conflict period provides a unique opportunity for countries to address problems with their health care systems, as it is easier to create widespread change during a rebuilding period. Thus, identifying the factors that enabled Liberia to rapidly improve MNCH services after the civil crisis can inform other countries coming out of conflict or looking to make large-scale changes. In addition, Liberia could use information from its post-conflict successes to inform and contribute to its own recent rebuilding efforts after the 2014-2015 Ebola virus epidemic.

There is a growing body of literature on MNCH in Liberia that explores the country's efforts to implement proven MNCH interventions and expand access to care. Little research was published during the years of the country's civil crisis and MNCH studies since have been primarily localized or quantitative [5-15]. These studies focused on access and utilization of specific MNCH interventions. Much of the qualitative or mixed-methods literature from Liberia to-date has focused primarily on maternal and reproductive health [16-19]. Only one of the mixed-methods studies from Liberia evaluated integration and delivery of MNCH services [20]. A few studies have reported on positive outcomes of specific interventions related to mobile data collection and monitoring [21 22], and training of community health workers [23] and midwives to deliver MNCH interventions at the community level [24 25]. There have also been recent studies examining service usage, links between aspects of the healthcare system and the West African Ebola outbreak [26-29]. There thus remains much to be understood about implementation of MNCH interventions and services and progress in reducing under-five mortality. While case studies from other countries making significant gains in child survival such as Niger, Uganda, Malawi, Ethiopia, Rwanda, and Tanzania [30-34] have evaluated system-level factors contributing to their success, only Tanzania included qualitative information from individuals attempting to access services for themselves or their children.

Therefore, this paper contributes to the growing literature about how progress in reducing under-five mortality can be achieved in a resource-limited country in Sub-Saharan Africa.

To increase understanding of the factors influencing progress in child survival in the Africa Region, we conducted an ecological study of factors associated with reductions in under-five mortality [35], followed by four mixed methods case studies of countries both on-track (Liberia and Zambia) and not on-track (Kenya and Zimbabwe) to meet MDG#4 [36-38]. Our case study of Liberia within this larger parent study provides a notable opportunity to examine in-depth the specific factors influencing child survival in a post-conflict setting in sub-Saharan Africa. By evaluating national policies and strategies, qualitative data, and quantitative indicator data we identified several overarching factors, which were consistently reported in our study data sources to have improved access and utilization of care for children under-five, and reduced under-five mortality.

METHODS

The period of interest for the parent study on child survival in Africa, from which this case-study arose, was from the beginning of the MDG movement in 2000 through 2013. The objective was to better understand positive and negative factors influencing child survival in sub-Saharan Africa as countries approached the end of the MDG period (2015). Prior to 2000, country-level data for these factors were not reliably available from many African countries. This case study utilized indicator data for the years closest to 2000, 2005, and 2013 (details below), a review of national policies and strategies issued between 2007 and 2013, following the civil conflict, and key informant interviews and focus groups with community women conducted in 2013.

MNCH indicator data

Data were obtained on those core MNCH indicators monitored by Countdown to 2015. Most data were obtained from the World Bank Data Catalogue [39], a repository of national, regional, and global indicator data compiled from officially-recognized sources, including national Demographic and Health Surveys (DHS) and other national surveys. Data for indicators not readily available from the World Bank Data Catalogue were obtained from the 2007 and 2013 Liberian DHS [40 41].

Given the scope of the larger study within which this case-study is nested, this study aimed to include indicator data most closely corresponding to the beginning and end of the study period to enable description of trends during the period. Unfortunately, no DHS was conducted in Liberia between 1986 and 2007 due to the civil war, resulting in substantial missing data for the time period around 2000. We therefore also included 2007 DHS data to better visualize changes over time. Estimates were not always available for exact years 2000, 2007, and 2013, but data were available within a one to two-year window (see Fig 2).

Review of MNCH policies and strategies

An information abstraction guide based on relevant global strategies related to child survival [42-47] was developed to guide the document procurement and review process according to the following eight content areas: 1) Health care system (including leadership, structure, human resources for health, access & utilization, monitoring & evaluation, and accountability), 2) National health strategies and policies (and regulations and laws, when applicable), 3) MNCH interventions, 4) Clinical standards and guidelines, 5) Commodities and essential medicines, 6) Financial flows and resources, 7) Effective partnerships, and 8) Other contextual factors (e.g., conflict, political environment, sanitation and hygiene, nutrition and food security, education, and human rights).

Policies and strategies pertaining to overall national health, MNCH, and those from other sectors related to MNCH (e.g., education, water and sanitation, and agriculture and nutrition) were obtained

from the WHO African Region office, the WHO country focal points for Liberia, and Liberia's Ministry of Health (MOH; formerly Ministry of Health and Social Welfare). These documents were reviewed and any additional documents referenced and deemed important for the review (according to the abstraction guide) were obtained from WHO or MOH. The final list of reviewed documents can be found in S1 Table.

Table 1. Content areas and key questions and themes related to child survival explored during the review of national health policies and strategies, key informant interview, and focus groups with community women.

Specific questions for review of national policies and strategies	**Specific themes explored across content areas with key informants**	**Specific themes explored across content areas with community women**
What policies and strategies related to child health were in place between 2000 and 2013 (including changes during this period)?	Issues related to program evaluation, access and utilization, coverage, impact, and sustainability, as appropriate.	Barriers and facilitators to accessing and utilizing MNCH services, including cultural and community factors.
What challenges were stated as hindering progress towards MDG#4?	Knowledge and experiences related to MNCH across the *health care continuum* (prenatal care through age 5 years).	Experiences related to MNCH across the *health care continuum*.
What facilitators were stated as enabling progress towards MDG#4?	Knowledge and experiences related to MNCH across the *health system continuum* (community to tertiary hospitals).	Experiences related to MNCH across the *health system continuum.*
What plans for change or improvements were either implemented after 2013 or were proposed as a measure to improve child survival?		

Each document was reviewed by two authors (MAB, CAH) and information was recorded and summarized according to the abstraction guide. In order to avoid biased interpretation of the information documented, the abstracted information was reported as it was stated in the original source, and efforts were made not to overstate or minimize the original information or to add commentary not contained in the source.

Qualitative study procedures

Study location and participants

Because important differences in MNCH often exist between urban and rural areas, participants for the qualitative study were included from both urban and rural areas. The study design of the parent study (consisting of four country case-studies) called for utilizing the country DHS to compare region-specific under-five mortality rates and declines in mortality over the study period. Urban and rural sites for the qualitative study were to be selected from the region or county whose annual rate of reduction in under-five mortality most closely matched that of the nation as a whole. In the case of Liberia, the 1986 DHS only reported mortality for three counties, while the 2007 DHS reported mortality rates for Monrovia and six regions comprised of three counties each [41 48]. As such, specific locations representative of Liberia's progress as a nation could not be conclusively identified. Following discussions with the in-country Primary Investigator (SBK) Monrovia (Montserrado County) was selected as the urban location with focus groups conducted in the Paynesville and New Kru Town areas, and the areas in and around Gbarnga (Bong County, North Central region) were chosen as the rural location with focus groups conducted in Gbarnga and Totota. While we cannot ensure these locations experienced declines in under-five mortality similar to Liberia as a whole, the other country case studies were often conducted in the capital (urban site) and a nearby rural region. Bong County was selected because it was reasonably

accessible for conducting the study in a timely manner and was not drastically different from other areas of the country in terms of demographics and infrastructure (including health infrastructure).

Data were obtained from semi-structured, key informant interviews with Ministry of Health (MOH) officials, donor organizations, community-based organizations (CBO) involved in MNCH, and health care workers (HCW). Data were also obtained from four focus group discussions, two in Monrovia and two in Bong County, with women who have experience accessing MNCH services. Interviews and focus groups were conducted between October 30 and December 19, 2013.

Eligibility criteria and identification of study participants

All participants, whether key informants or focus group women, were eligible for the study if they met the following criteria: 1) being 18 years of age or older, 2) having adequate knowledge or experiences related to childhood survival specified for each participant group below, 3) speaking English or Liberian English, and 4) being able to provide written informed consent. Specific inclusion criteria for each key informant group included the following: national or provincial-level officials working in government-level health care system administration, policy-making, program development, leadership, or any aspect of MNCH (MOH officials); directors, managers, or other leaders of entities providing financial or other aid for MNCH services, or international or national organizations focusing on MNCH or having MNCH as one component of their mission (Donor organizations, DO); directors, leaders, or managers working for a CBO involved in or providing referrals to MNCH services; and professionally trained physicians, nurses, clinical officers, or other health-related staff working in a health facility providing MNCH care (HCPs).

Similar numbers of participants from each key informant group were enrolled, and a range of ages, work experiences, and positions/roles within each group was sought through the use of department registers when available. Additionally, efforts were made to balance the number of urban

and rural participants among the HCWs and CBO workers. Lists of potential key informants from each group were developed by the in-country research team with assistance, as needed, from the WHO National Professional Officer for Family Health and the MOH Deputy Programme Manager for the Expanded Program on Immunizations. A letter signed by an official from the MOH was sent to each potential key informant participant informing them of the purpose of the study, risks and benefits of participation, and describing the interview process. These were followed-up with a phone call or email from the research team to set up a meeting time for those interested. Basic demographic characteristics of the key informants are shown in Table 2.

Table 2. Characteristics of key informants in Liberia.

	Ministry of Health (N=11)		**Donor organization (N=8)**		**Community Based Organization (N=14)**		**Health Care Worker (N=14)**	
Sex, N (%)								
Male	8	(73)	5	(62.5)	10	(71)	5	(36)
Female	3	(27)	3	(37.5)	4	(29)	9	(64)
Age, M (IQR)	45	(38, 55)	40	(36, 49)	40	(36, 50)	45	(40, 54)
Ethnicity, N (%)								
Bassa	1	(9)	1	(12.5)	0	(0)	0	(0)
Grebo	2	(18)	1	(12.5)	1	(7)	2	(14)
Kissi	1	(9)	0	(0)	1	(7)	0	(0)
Kpelle	2	(18)	1	(12.5)	4	(29)	6	(43)
Lorma	2	(18)	0	(0)	0	(0)	1	(7)
Mano	2	(18)	1	(12.5)	4	(29)	1	(7)
Other*	1	(9)	4	(50)	4	(29)	4	(28)
Education, N (%)								
Secondary	1	(9)	0	(0)	0	(0)	0	(0)

Post-secondary	10	(91)	8	(100)	14	(100)	14	(100)
Median (IQR) years working for organization	7	(6, 9)	1	(1, 6)	5	(3, 13)	7	(2, 15)

* Other includes one each of Belleh, Dahn, Gbandi, Gola, and Kru; five foreign nationals (Ghana, Kenya, Nigeria, Sierra Leone, and Uganda); and 3 not reported

Women were recruited to participate in focus groups using informational flyers or advertisements posted in different health centers and surrounding communities. As with the key informants, a balance was sought in the level of education and participants with live and deceased children, as well as a diversity of experiences and opinions regarding access and utilization of MNCH services. Written informed consent was obtained from all enrolled participants. Community women were provided with a small monetary incentive for their participation. Basic demographic and health characteristics of the community women are shown in Table 3.

Table 3. Characteristics of female focus group participants in Liberia.

	Rural participants (N=16)		**Urban participants (N=21)**	
Age, M (IQR)	26	(22, 32.5)	28	(21, 38)
Ethnicity, N (%)				
Kpelle	12	(75)	1	(5)
Lorma	2	(13)	2	(10)
Bassa	0	(0)	9	(43)
Kru	0	(0)	7	(33)
Vai	0	(0)	2	(10)
Other*	2	(13)	0	(0)
Education, N (%)				
None	2	(14)	2	(10)

Primary	7	(50)	5	(24)
Secondary	3	(21)	13	(62)
Post-secondary	2	(14)	1	(5)
Travel time to health care (dry season), N (%)				
Less than one hour	15	(94)	19	(90)
One to two hours	0	(0)	2	(10)
More than two hours	1	(6)	0	(0)
Number of living children, M (IQR)	1	(1, 3)	2	(1, 4)
Age of youngest child, M (IQR)	2 yr	(11 mo, 4 yr)	2 yr	(1 yr, 3 yr)
Any children who died <5yrs old, N (%)				
No	12	(80)	12	(57)
Yes	3	(20)	9	(43)
Place of delivery for latest pregnancy, N (%)				
Health facility	16	(100)	17	(81)
Home	0	(0)	4	(19)
Birth attendant for latest pregnancy, N (%)				
Doctor	2	(13)	3	(14)
Nurse/midwife	14	(88)	17	(81)
Traditional birth attendant	0	(0)	1	(5)

* Other includes one each Kisii and Mandingo

Interview and discussion guides

Interview guides for key informants and discussion guides for focus groups with community women were developed, pilot tested through cognitive interviewing [49], and revised as needed. The guides focus on barriers to and facilitators for improving child survival in areas related to MNCH (Table 1), corresponding to the structure for the review of national health policies and strategies. Not all

content areas were appropriate for each key informant group, but each topic was asked of at least two of the four groups. Focus group discussions with community women focused only on the health care system, MNCH interventions, medicines, and contextual factors content areas. While participants could discuss the entire period from 2000 forward, most participants recalled more recent information and experiences.

Data collection

Key informant interviews were conducted in English by one research assistant using the appropriate interview guide and were audio recorded. The focus group discussions were conducted in Liberian English and also audio recorded. Two research assistants were present at each focus group to facilitate discussion and note-taking.

Following completion of the interviews and focus groups, audio recordings were transcribed by the research assistants and field notes incorporated into the transcript. Transcripts were coded and analyzed using the software Atlas.ti (Atlas.ti Scientific Software Development GmbH, Berlin, Germany) [50]. Deductive themes were determined *a priori* based on interview guides and key topics of interest based on literature review. Additional themes were also identified upon review of the transcripts. Text was coded and reviewed for patterns of consistency, variation, relationships between themes and exemplary cases or quotations [51 52]. Ethical approval for the qualitative portion of the study was obtained from the Vanderbilt University Medical Center and the University of Liberia-Pacific Institute for Research and Evaluation.

Patient involvement

Patients were not involved in the design of this study. Results were disseminated to Ministry of Health and WHO representatives from Liberia, and a presentation and report detailing results were made available to these representatives to aid further dissemination to other stakeholders.

RESULTS

MNCH coverage Indicators

Indicator coverage data from 2000 were not available for six of the thirteen core indicators shown in Fig 2. Liberia has improved coverage of nine of these indicators during the study period. Highest current indicator coverage is seen for pregnant women receiving antenatal care (ANC) (96%), vitamin A supplementation (88%), pregnant women receiving at least four ANC visits (78%), and improved water sources (75%; Fig 2). Coverage was below 50% for improved sanitation (17%), postnatal visits within two days for all deliveries (35%), use of insecticide treated bednets (38%), and diarrhea treatment (46%; Fig 2).

Fig 2. Changes in child survival indicator coverage in Liberia, 2000, 2007, and 2013*.

*Estimates were not always available for years 2000, 2007, and 2013, in which case the nearest estimate between 1999 and 2000, 2005 and 2007, or 2012 and 2013 was used; data were not available for the six indicators showing an asterisk (*) during the 2000 time period.

[†]Among all births, both inside and outside a health facility

[‡]Children 12-23 months old who have received BCG, measles and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth)

[§]Children under 5 receiving oral rehydration and continued feeding

Source: World Development Indicators Data Catalogue from the World Bank (http://datacatalog.worldbank.org; accessed August 2015) and Liberia DHS

National document review and qualitative study

National Prioritization of MNCH

Both national documents and key informants at nearly all levels highlighted the strong commitment the Liberian government made to re-building the health care system soon after the civil war ended. Key informants and national documents also described how MNCH was prioritized, not just within the MOH, but also by top leadership throughout all sectors of the government. As an example of Liberia's high level commitment to MNCH, key informants described how maternal and neonatal deaths were reported to the president of Liberia. Routine audits of maternal and neonatal deaths were also undertaken by county health boards to identify problems with care, and improve accountability and oversight. Community women rarely specifically commented on the government's prioritization of MNCH, but some did express appreciation for the government's role in rebuilding services after the conflict. This prioritization of MNCH by multiple levels in the government is illustrated in the quotations below:

"I mean it has been a painfully slow process, due to advocacy, to get government to that level of commitment but a lot of progress, a lot of gain has been made and I can tell you for instance now the President of Liberia is the president of the commission for women health in Africa and that's under the WHO-AFRO, I can tell you that the government had launched, had made maternal and newborn health one of the conditions that will undergo surveillance, meaning that maternal death should be reported, maternal and newborn death should be reported." (49 year old, male donor partner)

"…I think all the things we do medication and everything government has been involved [in]…if you have anybody dying from giving birth they have this audit in this particular team that reports

directly to the President of Liberia, so they are even involved in it…" (35 year old, female from CBO partner)

"[NGOs and the government] are giving us knowledge [on] how to take care of ourselves and what to do when you are pregnant, where to go and where not to go and what for you to eat…I think, things have improved, because we having NGOs, we having government, we having UN, many people coming in they helping us too. So things have improved bit by bit." (39 year old, rural woman with 4 children)

Although child health has been recognized as an important priority by both the Liberian government and donor partners working with Liberia, national health documents and key informant interviews all indicated consistent concern that Liberia's high dependence on donor aid is unsustainable. Due to strong donor funding and some government funding, most MNCH services were free during much of the study period. Key informants and community women felt that the free services had contributed to increased access and utilization. However, key informants and national documents indicated that the government of Liberia needs to institutionalize services currently provided by external partners and take more financial responsibility for the health sector.

"…we are donor dependent; the sources of funding either from the donor or the GOL [Government of Liberia] but what comes into the ministry for maternal and child health issue is very small but the input that partners are making if you count it, it's very huge. So we think that for sustainability the government needs to play more roles because if these partners leave, the gains that we are making, to sustain it might be difficult..." (46 year old, female MOH official)

The Development and Implementation of Integrated Packages of Services

Key informants indicated that the MOH did a good job of implementing extensive reforms of the health system soon after the civil war, as well as continuously attempting to evaluate and update policies and strategies to make gradual improvements. An often-cited example by key informants of this process was the implementation of integrated packages of services, detailed in the quotations below:

> "…I think there is an enabling environment from the government through the Ministry of Health that is in place through the development of the ten years plan and the expanded program which is the EPHS [Expanded Package of Health Services], which addresses child health and maternal health, so first there is a will on the part of the government to address child health and maternal health in the country." (49 year old, female donor partner)

> "…the Ministry of Health, from the beginning a postwar country had a policy first that was guiding the process; the BPHS [Basic Packages of Health Services]…So it had bases on how people should implement the policy and also as time went by, maternal services improved over time based on evaluation from the Ministry of Health and Social Welfare through their annual accreditation looking at service delivery." (35 year old, male donor partner)

The National Health Policy and Plan [53] focused on establishing the Basic Package of Health Services (BPHS). National documents and key informants attributed rapid scale-up of MNCH interventions immediately following the civil war to the effective framework set forth by the BPHS. According to national documents, the BPHS also aimed to improve distribution and supervision of healthcare providers through establishment of a salary scale, standardized job descriptions, and supervision tools for all cadres. Although the BPHS is credited with restoring MNCH service delivery across Liberia, several key informants stated that the BPHS did not adequately integrate services across different sectors of MNCH, which they felt hindered delivery of maternal health and family planning,

nutrition and PMTCT. Additionally, components of the BPHS intended to improve human resources for health were not fully implemented or did not appear to have the intended impact, as many key informants and community women cited continued human resource issues such as a lack of qualified and quality providers.

Recognizing the shortcomings of the BPHS, the National Health and Social Welfare Policy and Plan [54] was developed and established the Essential Package of Health Services (EPHS) which aimed to scale-up interventions (especially MNCH interventions), reduce inequities, improve collaboration across different sectors, and improve quality at secondary and tertiary healthcare centers. The EPHS also sought to increase the number of skilled workers available for labor and delivery to ensure that emergency obstetric and neonatal care (EmONC) is available at all facilities. Key informants were quite positive about the EPHS, feeling that it had improved collaboration between sectors and had improved quality of care in some areas. Some key informants also felt that the clearer language in the policy documents enabled the government to better set expectations and hold partners accountable when implementation goals were not met.

> "…from the BPHS to EPHS, it was EPHS they were able to strengthen that MCH part to include in addition to nutrition, adolescence, reproductive health care and all of that sexual health but in the past, those were very weak and gray areas; as long as the policy did not address them, they became difficult for anyone to hold a partner accountable for any implementation. Uh, now, the ministry has included that and there are more services." (47 year old, male CBO partner)

However, some key informants felt that the EPHS had not been completely implemented at all levels, particularly the primary care level, due to lack of resources, both human and financial. The incomplete implementation limits not only delivery of MNCH interventions, but also the collaboration and coordination the EPHS was intended to promote. In addition, both key informants and some

community women described continued shortages of healthcare providers, especially those trained in delivery-related interventions, certified midwives, and pediatric specialists outside the capital of Monrovia. As illustrated in the quotations below, community women and key informants noted that limited availability of MNCH providers and poor attitudes of providers remained a barrier to utilizing and accessing care.

"…When I gave birth, the girl that attended to me because she left, her shift was over and she left…that night I could die because I started bleeding right after giving birth. But because my friend was a nurse she went there and attended to me that night. Those that were on shift that night… never had time for me because nothing was there for me to tip in, so they just acted careless on [with] me." (38 year old, urban woman with 4 children)

"Clinics are…not running twenty- four seven services, we have heard these challenges from them, people go overnight with complaints and the health care provider says I am not paid for overnight services so you have to wait until tomorrow; so lack of motivation at the service provider end is also impeding the process." (37 year old, male CBO partner)

Although key informants were concerned about incomplete implementation of the EPHS, they attributed improvements in malaria, PMTCT services, nutrition and reproductive health to the improved integration between sectors that the EPHS provided, as illustrated in the quotations below. Community women did not specifically describe implementation of the EPHS or differentiate between levels of the healthcare system, but did discuss the quality of care they received at the facilities. Specifically, women felt very positive about the care received during pregnancy and delivery, as well as educational and preventive services provided at facilities.

"…I think it has changed over the period because, in the past we had the BPHS that provided minimum service at the health facility where when the pregnant woman comes, they only check them and when they have malaria, they treat them and they go home. But this time around, the BPHS has been modified to EPHS and where, we look at a full package, the standards have improved, the services have improved and they receive a whole package and deliver it to the mother… [including] PMTCT services, immunization, nutrition, and other laboratory findings so as to reduce the number of visits, she has to do at the health facility." (33 year old, male MOH official)

"…the nurses and the doctors especially at the hospital here, whenever they carry pregnant woman there, they always cater to the person and talk [to] the person in a polite manner, try to help the person…They always treat us free and at time [delivery] they give baby's clothes free of charge." (43 year old, rural woman with 6 children)

"…when you give birth and the baby is growing up, you don't have to wait for the child to fall sick before you carry the child to hospital. You can take the child to hospital so the child will get drugs [anti-malaria prophylaxis]..." (35 year old, urban woman with 4 children)

Community outreach and service delivery

Liberia's use of community outreach and service delivery was a third overarching factor identified as facilitating achievement of MDG#4. The national Community Health Services Policy first issued in 2008 and revised in 2011 [55] outlined a standard set of outreach, health promotion and referral services and specified the roles and responsibilities of community-based staff including general community health volunteers (GCHVs) and Trained Traditional Midwives (TTMs). It further outlined how they should be distributed geographically, supervised, evaluated, and that TTMs are to be compensated

with monthly salaries while GCHVs work as volunteers but receive an incentive package. Both key informants and community women were positive about their efforts at the community level, recognizing how these cadres enhance referrals from the community to healthcare facilities and follow-up with mothers and children in the community after they return home. GCHVs and TTMs were also highly valued by community women for their assistance with the outreach campaigns "Reach Every District" (RED) and "Reach Every Pregnancy" (REP), which were intended to improve immunization coverage and maternal health, respectively. Both key informants and community women further described that GCHVs and TTMs had likely increased coverage of antenatal and post-natal care by connecting women with the healthcare system earlier in pregnancy and increased immunization coverage through outreach with mobile vaccination sites, and improved education and communication.

> "…the vaccine team most of the time come around to give our children vaccine and deworm them with the medicine. At time we can see some people with the megaphone educating…pregnant women on how to take care of your children and even how to take care of your community. As for the health campaign we can see them and we can benefit from them." (38 year old, urban woman with 3 children)

> "Number one thing that is trying to work well is the TTMs and GCHVs, they are trying their best with the referrals. They get any patient in the community, they bring them here… we have family planning, we have EPI under MCH, we have PMTCT, ANC, labor and delivery, post-partum care provided and ANC…and also do STI [testing] too…malaria…The only problem we have with our GCHVs is that they are saying they are not been compensated so we don't expect them to work full time." (43 year old, female health care worker)

While attributing success at the community level to the efforts of GCHVs and TTMs, study participants also felt these staff needed better compensation beyond what is currently provided to

enable them to work more often. The insufficient number of GCHVs and TTMs was also cited as a challenge affecting availability of health services. Key informants and national documents noted that due to limited human and financial resources, local health clinics were not always staffed and community-based interventions such as the RED and REP campaigns had not been implemented or adequately supported in all areas.

> "…I remember some time ago they were trying to integrate the…reach every pregnant women; reach every district, that is for the supervision for vaccine…but for the reach every pregnant woman actually it is not working 100%. If I will have to grade it may be it is working around 40 to 45% because of may be some supplies that supposed to be given or put into place it is not into place so for that it is not 100%." (34 year old, female CBO partner)

DISCUSSION

This case study identifies three components that have likely contributed to Liberia's rapid post-conflict decline in under-five mortality and attainment of MDG#4. First, the Liberian government made re-establishment and funding of MNCH a top priority as it rebuilt its health system after the civil war. Second, the development and implementation of integrated packages of services, first the BPHS followed by the EPHS, enabled Liberia to restore basic MNCH services and interventions at all levels of the healthcare system. The development and implementation of the BPHS and EPHS also demonstrated Liberia's ability to evaluate and re-work policies and strategies. The EPHS fostered further integration and collaboration across multiple sectors, which allowed for expansion of PMTCT, nutrition, and other MNCH services. The EPHS also sought to improve the availability of trained health workers and fully functional health units, although challenges persisted despite these efforts. Third, provision of services at the community level, such as outreach campaigns and use of GHCVs and TTMs to deliver basic MNCH interventions, contributed to improved coverage of ANC, post-natal care, and immunizations, and also

improved access and continuity of care in post-conflict Liberia by strengthening referrals between the community and healthcare facilities. Each of these components is supported by the qualitative data collected.

Liberia utilized a healthcare system recovery approach that has shown promise in other post-conflict or conflict-affected settings. Specifically, Kruk, et al. (2010) emphasize the need for strong national leadership and governance that makes restoration of basic health services a top national priority. They also documented that, when a national government makes a strong commitment to providing healthcare to the most vulnerable populations (such as mothers and children), this commitment can contribute to the country's long-term stability and recovery efforts. A basic package of health services enabling rapid roll-out and scale-up of MNCH and other primary health services has also been deployed with some success in Afghanistan, South Sudan, Rwanda, and Bosnia and Herzegovina [56-60], and is specifically recommended for conflict-affected settings [4 12]. These packages of services typically include key maternal, neonatal, and child health interventions, nutrition, and treatment for communicable diseases (such as TB and HIV) [56-62]. Afghanistan, similar to Liberia, revised their basic package to also include additional services (for disability and mental health), recognizing the specific needs of their population and the gaps in their original package. Researchers have suggested that basic packages of services may help in initial scale-up and improvements, but require additional inputs and adjustments to sustain these improvements [56 57 59 63].

Community-level education, empowerment, and outreach are also recommended to improve utilization and access to basic interventions and improve referrals from the community to the facility levels [4 64-67]. Expanding cadres of traditional birth attendants and community health workers has been found to be particularly key in restoring maternal and neonatal services in conflict-affected settings [56 68-72]. Community health workers and community-level outreach and service delivery has also been a key factor in the successes of other countries successfully reducing child mortality [30-34 38 73]. Although many

conflict-affected settings have difficulties with referrals [64 74 75], this is one area where Liberia appears to have made great progress through their use of GCHVs and TTMs, as described by key informants and community women.

Although Liberia has made significant progress in MNCH, national documents and study participants noted a number of challenges that persist and need to be addressed as Liberia moves forward to achieve their post-2015 goals [76]. This includes a shortage of healthcare providers, particularly community-based midwives and pediatricians in rural areas, where the available providers are often overburdened. The lack of healthcare providers and challenges associated with training and retaining general and MNCH providers is well-documented in the literature from other conflict-affected countries where brain-drain is common during and after conflict [4 12 56 64 66 77-80]. Another weakness described in the study is Liberia's high dependence on donor aid to provide many of the MNCH services. Although heavy reliance on donor aid is consistent with other conflict-affected countries, there is little consensus on how donors can best support post-conflict countries and few recommendations as to how and when post-conflict settings should make the transition from donor-provided services to government-provided services [81-83].

This study provides one of the few country-case studies to assess progress towards achieving MDG#4. Perhaps more importantly, it provides much needed insight into MNCH infrastructure and experiences from an understudied, post-conflict, yet highly successful African country. This case-study utilized a number of data sources, including national indicator data, country-authored health policies and strategies, and qualitative data from key informants with different roles in MNCH and four focus group discussions with women from urban and rural areas. By bringing together such diverse sources of data, this study was able to assess the national-level measures used to enhance child survival and the facilitators and challenges that affected full implementation and impact.

Nevertheless, there are limitations for each of the study components. For the review of national MNCH policies and strategies, new policies and strategies were not issued until after 2007 due to the civil war. While these documents contained a retrospective assessment of the preceding period that provided a comprehensive understanding of the earlier part of the study period, assessments of the impact of more recent policies or strategies were not yet available. Moreover, country policies and strategies covered different and sometimes overlapping time periods, making it difficult to distinguish current from outdated information, and whether a stated plan had been implemented unless stated in a document. Input from co-authors affiliated with the WHO and the MOH helped to clarify uncertainty.

With regards to the interviews and focus groups, this study was limited to a non-random sample of participants and conducted in two counties (one urban, one rural). It is possible that the changes in under-five mortality in these areas do not reflect changes at the national level and that the views and experiences of some participants do not reflect those from other areas of Liberia. However, participants were selected to represent five different cadres of individuals who could share a diversity of MNCH experiences, including some key informants with national-level responsibilities and 37 women from the community. In addition, although we asked participants to reflect on long-term changes, most of the participants recalled their current experiences and opinions on MNCH.

In spite of these limitations, this study contributes to the growing literature on effective approaches to scaling-up availability and use of MNCH services in conflict-affected settings. The factors identified as contributing to Liberia's success in reducing under-five mortality can be applied in the many other countries recovering from conflict, and can also be used to help Liberia recover from the 2014-2015 Ebola epidemic. To further improve the delivery of essential health services and reduce under-five mortality in the post-2015 era, Liberia needs to maintain its prioritization of the health and welfare of pregnant women and children, continue to conduct comprehensive evaluation and enhancement of

programs and interventions, and ensure sufficient human and financial resources are consistently available to ensure MNCH services are available close to the population.

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Authors' contributions

Brault: Involved in conceptualization of research, development of methodology, data collection, data analysis, data management, and manuscript development.

Kennedy: Involved in development of methodology, data collection, data management, and manuscript development.

Haley: Involved in conceptualization of research, development of methodology, data collection, data analysis, data management, and manuscript development.

Clarke: Involved in development of methodology, provision of study resources, and manuscript development.

Duworko: Involved in development of methodology, provision of study resources, and manuscript development.

Habimana: Involved in conceptualization of research, development of methodology, funding acquisition, and manuscript development.

Vermund: Involved in conceptualization of research, development of methodology, funding acquisition, and manuscript development.

Kipp: Involved in conceptualization of research, project administration, development of methodology, funding acquisition, data collection, data analysis, data management, and manuscript development.

Mwinga: Involved in conceptualization of research, project administration, development of methodology, funding acquisition, provision of study resources, and manuscript development.

Data sharing statement

Annual mortality estimates used in Figure 1 are publicly available, without restriction, from http://www.childmortality.org/index.php?r=site/graph#ID=LBR_Liberia. Indicator data used for Figure 2 are publicly available, without restriction, from the World Development Index, Africa Development Index, and Health Nutrition & Population Statistics databases of the World Bank Data Catalog (http://data.worldbank.org/data-catalog/) or Liberia Demographic and Health Survey reports available at http://dhsprogram.com/Where-We-Work/Country-Main.cfm?ctry_id=22&c=Liberia&r=1. A detailed description of each indicator's source can be found in the supplemental material from a previously published study (Kipp et al. BMJ Open. 2016. http://dx.doi.org/10.1136/bmjopen-2015-007675).

Supplemental table S1 lists the national documents reviewed for the study. These were obtained with the permission and assistance of the Liberian co-authors and do not belong to any of the individual study authors. As such, they cannot be made available as they belong to the Ministry of Health or other agencies and some are still in draft form. Links to publicly available documents are provided in Supplemental table S1. For investigators wishing to obtain other policy documents used in this study, please contact Mr. Luke Bawo, Coordinator for Research and Health Management Information System, Ministry of Health, email: lukebawo@gmail.com; or Hon. C. Sanford Wesseh, Assistant Minister for Vital Statistics, Ministry of Health, email: cswesseh@yahoo.com.

Under the Agreement for Performance of Work with the World Health Organization (sponsor) that was used for this study, all rights to the data collected from key informants and community women belong to the WHO. The WHO will entertain any reasonable proposal for use of the data. Researchers who are qualified to manage and analyze qualitative data may request these data from Dr. Phanuel Habimana, Team Leader, Child and Adolescent Health and Nutrition, WHO Regional Office for Africa, Brazzaville, Congo; email: habimanap@who.int.

Interview, focus group discussion, and national document abstraction guides are available upon request from the corresponding author; email: aaron.kipp@vanderbilt.edu. These data are not considered part of the underlying data necessary to replicate the study.

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Supporting Information

S1 Table. Liberia policy, strategy, and other national documents reviewed

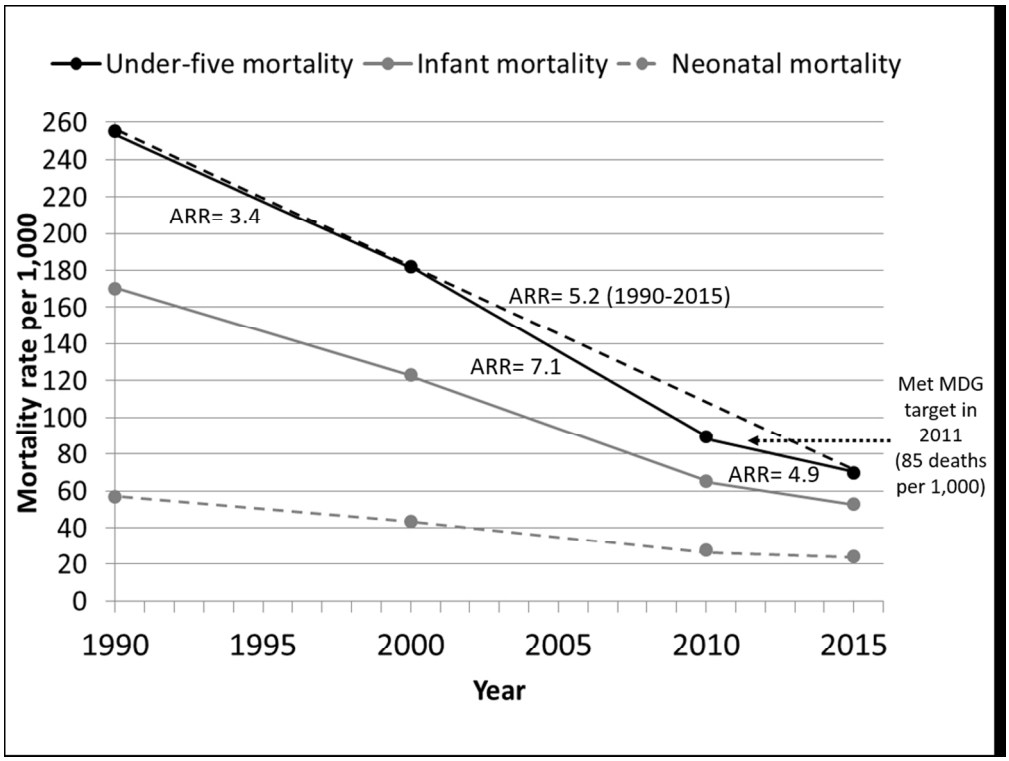

Figure 1: Under-five, infant, and neonatal mortality rates for Liberia in 1990, 2000, 2010, and 2015 (solid circles) with annual rates of reduction (ARR) for each period (solid and dashed lines).

197x148mm (150 x 150 DPI)

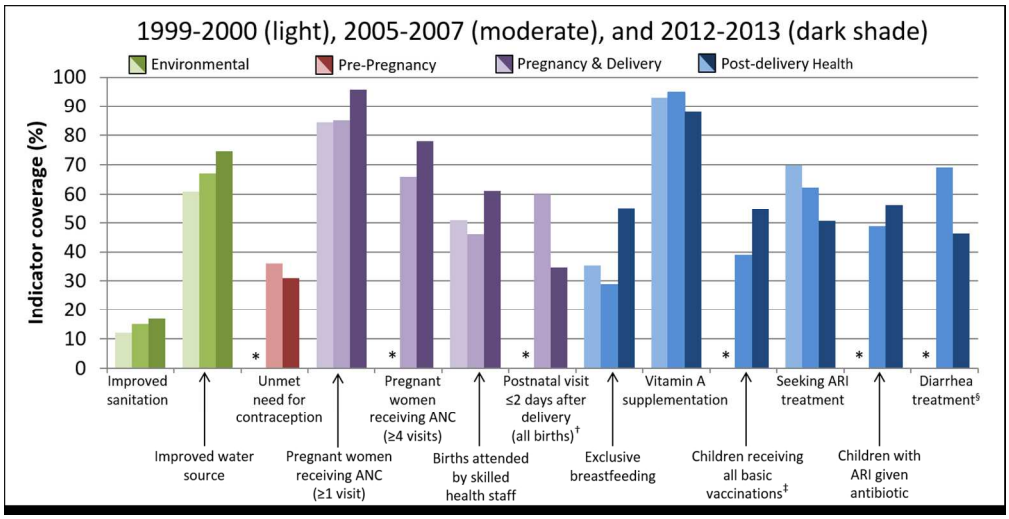

Figure 2: Changes in child survival indicator coverage in Liberia, 2000, 2007, and 2013*.

254x129mm (150 x 150 DPI)

Supplemental Table

Table S1. Liberia documents reviewed

Document title (dates if not otherwise specified in title)
Primary source documents* (Newest to oldest)
Republic of Liberia Agenda for Transformation: Steps towards Liberia Rising 2030 (2012)
Accelerated Action Plan to Reduce Maternal and Neonatal Mortality, 2012-2016
Situational Analysis of Newborn Health in Liberia (Parts A and B) (Drafts) (2012)
National Health and Social Welfare Policy and Plan, 2011-2021
Country Situational Analysis Report, 2011
Road Map for Accelerating the Reduction of Maternal and Newborn Morbidity and Mortality in Liberia, 2011-2015
Revised National Community Health Services Policy (2011)
Essential Package of Health Services: Primary Care, 2011-2021
Essential Package of Health Services: Secondary and Tertiary Care, 2011-2021
National Strategy for Child Survival in Liberia, 2008-2011
Other documents reviewed† (Newest to oldest)
Micronutrient Powder Supplementation of Young Children Linked with IYCF community promotion, 2012-2015
National Policy on Immunization, 2012
National EPI Strategic Plan, 2011-2015
National Sexual and Reproductive Health Policy (2010)
Integrated Guidelines of Prevention, Testing, Care and Treatment of HIV and AIDS in Liberia, 2010
Report on the Assessment of Infant and Young Child Feeding Practices, Policies and Programmes in

Liberia 2009

*Primary documents extensively reviewed to obtain information on each content area identified in the abstraction guide

†Documents reviewed, but information on progress towards MDG#4 was sufficiently covered by the primary documents

BMJ Open

Factors influencing rapid progress in child health in post-conflict Liberia: a mixed methods country case study on progress in child survival, 2000-2013

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Factors influencing rapid progress in child health in post-conflict Liberia: a mixed methods country case study on progress in child survival, 2000-2013

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ABSTRACT

Objectives: Only 12 countries in the World Health Organization's African region met Millennium Development Goal #4 (MDG#4) to reduce under-five mortality by two-thirds by 2015. Given the variability across the African region, a four-country mixed methods study was undertaken to examine barriers and facilitators of child survival prior to 2015. Liberia was selected for an in-depth case study due to its success in reducing under-five mortality by 73%, and thus successfully meeting MDG#4. Liberia's success was particularly notable given the civil war that ended in 2003. We examined some factors contributing to their reductions in under-five mortality.

Design: A case study mixed methods approach drawing on data from quantitative indicators, national documents, and qualitative interviews was used to describe factors that enabled Liberia to rebuild their maternal, neonatal and child health (MNCH) programs and reduce under-five mortality following the country's civil war.

Setting: The interviews were conducted in Monrovia (Montserrado County) and the areas in and around Gbarnga, Liberia (Bong County, North Central region).

Participants: Key informant interviews were conducted with Ministry of Health officials, donor organizations, community-based organizations involved in MNCH, and health care workers. Focus group discussions were conducted with women who have experience accessing MNCH services.

Results: Three prominent factors contributed to the reduction in under-five mortality: national prioritization of MNCH after the civil war; implementation of integrated packages of services that expanded access to key interventions and promoted inter-sectoral collaborations; and use of outreach campaigns, community health workers and trained traditional midwives to expand access to care and improve referrals.

Conclusions: Although Liberia experiences continued challenges related to limited resources, Liberia's effective strategies and rapid progress may provide insights for reducing under-five mortality in other post-conflict settings.

Keywords: Public health, Qualitative research, Community child health < Paediatrics, International health services < Health services administration & management

Strengths and limitations of this study

- Presents qualitative and quantitative data on implementation of maternal, neonatal and child health (MNCH) interventions in Liberia, which has been understudied in Liberia.
- Most studies exploring progress in child survival only present qualitative data from key informants working within the healthcare system, but this paper also provides data from women attempting to access services for themselves and their children in both urban and rural contexts.
- For the review of national MNCH documents, policies and strategies were not issued until after 2007 due to the civil war. While these documents contained retrospective assessments of the preceding period, assessments of the impact of more recent policies or strategies were not available.
- The qualitative data were limited to a non-random sample of participants and conducted in two counties (one urban, one rural). It is possible that the changes in under-five mortality in these areas do not reflect changes at the national level and that the views and experiences of some participants do not reflect those from other areas of Liberia.

INTRODUCTION

Under-five mortality has declined in sub-Saharan Africa from an estimated 180 deaths per 1,000 live births in 1990 to 83 deaths per 1,000 in 2015 [1], yet this was not sufficient for this region to meet Millennium Development Goal (MDG) #4 of reducing under-five mortality by two-thirds between 1990 and 2015 [2]. Nevertheless, as of 2015, 12 African countries had met their MDG#4 goal [1]. There is thus much interest in understanding why some countries met MDG#4 while others did not. Liberia witnessed a dramatic reduction in under-five mortality from 255 to 70 deaths per 1,000 live births between 1990 and 2015 (Fig 1) [1]. This 73% reduction in mortality rates means that Liberia effectively met MDG#4 ahead of schedule. Infant mortality saw a similar 69% reduction over the period, while neonatal mortality declined less rapidly.

Figure 1 here.

Liberia's accomplishments are especially notable given the 14 years of civil war, ending in 2003, that destroyed most of the national infrastructure, eroded the country's social fabric, and cost at least 200,000 lives. Many health facilities were destroyed, skilled personnel were lost, and essential medicines and supplies were scarce [3]. Liberia emerged from this crisis with extremely limited health infrastructure and poor maternal, neonatal and child health (MNCH) services. As a result of strong commitment and collaboration among the government and organizations from across civil society, the private sector and the general public, Liberia made notable gains towards re-establishing peace and security, revitalizing the economy, strengthening governance, and rebuilding health infrastructure, including MNCH services [3]. Bornemisza, et al. [4] describe how the post-conflict period provides a unique opportunity for countries to address problems with their health care systems, as it is easier to create widespread change during a rebuilding period. Thus, identifying the specific factors that enabled Liberia to rapidly improve MNCH services after the civil crisis can inform other countries coming out of conflict or looking to make large-

scale changes. In addition, Liberia could use information from its post-conflict successes to inform and contribute to its own rebuilding efforts after the 2014-2015 Ebola virus epidemic.

A growing body of literature on MNCH in Liberia explores the country's efforts to implement MNCH interventions and expand access to care. Little research was published during the civil crisis and MNCH studies since have been primarily localized or quantitative [5-15], focusing on access and utilization of specific MNCH interventions. Much of the qualitative or mixed-methods literature from Liberia to-date has focused on maternal and reproductive health [16-19]. Only one of the mixed-methods studies from Liberia evaluated integration and delivery of MNCH services [20]. A few studies have reported on positive outcomes of specific interventions related to mobile data collection and monitoring [21 22], and training of community health workers [23] and midwives to deliver MNCH interventions at the community level [24 25]. There have also been recent studies examining service usage, links between aspects of the healthcare system and the West African Ebola outbreak [26-29]. There thus remains much to be understood about implementation of MNCH interventions and services and progress in reducing under-five mortality. While case studies from other countries making significant gains in child survival such as Niger, Uganda, Malawi, Ethiopia, Rwanda, and Tanzania [30-34] have evaluated system-level factors contributing to their success, only Tanzania included qualitative information from individuals attempting to access services for themselves or their children.

To contribute to the growing literature on how progress in reducing under-five mortality can be achieved in resource-limited countries, we conducted an in-depth case study from Liberia as part of a larger study seeking to understand the factors influencing progress in child survival in the Africa region among countries that were on-track (Liberia and Zambia) and not on-track (Kenya and Zimbabwe) to meet MDG#4.[35-38] The period of interest was from the beginning of the MDG movement in 2000 through 2013 when the study was initiated. Our primary objective in the Liberia case study was to examine in-

depth the specific factors influencing child survival and attainment of MDG#4 in a post-conflict setting in sub-Saharan Africa. By evaluating national policies and strategies, qualitative data, and quantitative indicator data we identified several overarching factors consistently reported to have improved access and utilization of care for children under-five, and reduced under-five mortality in Liberia.

METHODS

Our case study utilized country-level indicator data for the years closest to 2000, 2005, and 2013 (details below), a review of national policies and strategies issued between 2007 and 2013, following the civil conflict, and key informant interviews and focus groups with community women conducted in 2013.

MNCH indicator data

Prior to 2000, country-level data for core MNCH indicators monitored by Countdown to 2015 were not reliably available from many African countries, including Liberia. Most of Liberia's indicator data reported here were obtained from the World Bank Data Catalogue [39], a repository of national, regional, and global indicator data compiled from officially-recognized sources, including national Demographic and Health Surveys (DHS) and other national surveys. Data for indicators not readily available from the World Bank Data Catalogue were obtained from the 2007 and 2013 Liberian DHS [40 41].

We included indicator data most closely corresponding to the beginning and end of the study period to enable description of trends during the period. No DHS was conducted in Liberia between 1986 and 2007 due to the civil war, resulting in substantial missing data for the time period around 2000. We therefore also included 2007 DHS data to better visualize changes over time. Estimates were not always available for exact years 2000, 2007, and 2013, but we used data that were available within a one to two-year window (see Fig 2).

Review of MNCH policies and strategies

An information abstraction guide based on relevant global strategies related to child survival [42-47] was developed to guide the document procurement and review process according to the following eight content areas: 1) Health care system (including leadership, structure, human resources for health, access & utilization, monitoring & evaluation, and accountability), 2) National health strategies and policies (and regulations and laws, when applicable), 3) MNCH interventions, 4) Clinical standards and guidelines, 5) Commodities and essential medicines, 6) Financial flows and resources, 7) Effective partnerships, and 8) Other contextual factors (e.g., conflict, political environment, sanitation and hygiene, nutrition and food security, education, and human rights). When reviewing documents for information pertaining to the eight content areas, answers to the four overarching questions presented in Table 1 were sought from each document.

Policies and strategies pertaining to overall national health, MNCH, and those from other sectors related to MNCH (e.g., education, water and sanitation, and agriculture and nutrition) were obtained from the WHO African Region office, the WHO country focal points for Liberia, and Liberia's Ministry of Health (MOH; formerly Ministry of Health and Social Welfare). These documents were reviewed and any additional documents referenced and deemed important for the review (according to the abstraction guide) were obtained from WHO or MOH. The final list of reviewed documents can be found in Table S1.

Table 1. Overarching questions to explore the eight content areas as related to child survival during the review of national health policies and strategies, key informant interview, and focus groups with community women.

Overarching questions for review of national policies and strategies	**Overarching questions explored with key informants**	**Overarching questions explored with community women**
What policies and strategies related to child health were in place between 2000 and 2013 (including changes during this period)? What challenges were stated as hindering progress towards MDG#4? What facilitators were stated as enabling progress towards MDG#4? What plans for change or improvements were either implemented after 2013 or were proposed as a measure to improve child survival?	What issues (positive or negative) exist related to program evaluation, access and utilization, coverage, impact, and sustainability, as appropriate? What is your knowledge of and experiences with MNCH across the *health care continuum* (prenatal care through age 5 years)? What is your knowledge of and experiences with MNCH across the *health system continuum* (community to tertiary hospitals)?	What are the barriers and facilitators to accessing and utilizing MNCH services, including cultural and community factors? What have been your experiences with MNCH across the *health care continuum*? What have been your experiences with MNCH across the *health system continuum?*

Each document was reviewed by two authors (MAB, CAH) and information was recorded and summarized according to the abstraction guide. To avoid biased interpretation of the information documented, the abstracted information was reported as it was stated in the original source, and efforts were made not to overstate or minimize the original information or add commentary not contained in the source.

Qualitative study procedures

Study location and participants

Because major differences in MNCH often exist between urban and rural areas, participants for the qualitative study were included from both urban and rural areas. The design of the parent study (consisting of four country case-studies) used country DHS to compare region-specific under-five mortality rates and declines in mortality over the study period. Urban and rural sites for the qualitative study were to be selected from the region or county whose annual rate of reduction in under-five mortality most closely matched that of the nation as a whole. In the case of Liberia, the 1986 DHS only reported mortality for three counties, while the 2007 DHS reported mortality rates for Monrovia and six regions comprised of three counties each [41 48]. As such, specific locations representative of Liberia's progress as a nation could not be conclusively identified. Following discussions with the in-country Primary Investigator (SBK) Monrovia (Montserrado County) was selected as the urban location with focus groups conducted in the Paynesville and New Kru Town areas, and the areas in and around Gbarnga (Bong County, North Central region) were chosen as the rural location with focus groups conducted in Gbarnga and Totota. While we cannot ensure these locations experienced declines in under-five mortality similar to Liberia as a whole, the other three country case studies were also largely conducted in the capital (urban site) and a nearby rural region[35 36 38]. Bong County was selected because

it was reasonably accessible for conducting the study in a timely manner and was not markedly different from other areas of the country in terms of demographics and health infrastructure.

Data were obtained from semi-structured, key informant interviews with Ministry of Health (MOH) officials (N=11 individuals interviewed), donor organizations (N=8), community-based organizations (CBO) involved in MNCH (N=14), and health care workers (HCW) (N=14). Data were also obtained from four focus group discussions, two in Monrovia (N=16 total participants) and two in Bong County (N=21), with women who have experience accessing MNCH services. Interviews and focus groups were conducted between October 30 and December 19, 2013.

Eligibility criteria and identification of study participants

All participants, whether key informants or focus group women, were eligible for the study if they met the following criteria: 1) being 18 years of age or older, 2) having adequate knowledge or experiences related to childhood survival specified for each participant group below, 3) speaking English or Liberian English, and 4) being able to provide written informed consent. Specific inclusion criteria for each key informant group included the following: national or provincial-level officials working in government-level health care system administration, policy-making, program development, leadership, or any aspect of MNCH (MOH officials); directors, managers, or other leaders of entities providing financial or other aid for MNCH services, or international or national organizations focusing on MNCH or having MNCH as one component of their mission (Donor organizations); directors, leaders, or managers working for a CBO involved in or providing referrals to MNCH services; and professionally trained physicians, nurses, clinical officers, or other health-related staff working in a health facility providing MNCH care (HCPs).

Similar numbers of participants from each key informant group were enrolled, and a range of ages, work experiences, and positions/roles within each group was sought using department registers

when available. Additionally, efforts were made to balance the number of urban and rural participants among the HCWs and CBO workers. Lists of potential key informants from each group were developed by the in-country research team with assistance, as needed, from the WHO National Professional Officer for Family Health and the MOH Deputy Programme Manager for the Expanded Program on Immunizations. A letter signed by an official from the MOH was sent to each potential key informant participant informing them of the purpose of the study, risks and benefits of participation, and describing the interview process. These were followed-up with a phone call or email to those interested. The final number of key informant interviews conducted was arrived at through a combination of approaches. Due to study logistics, we set a minimum number of six interviews to be conducted with both MOH and donor organization representatives and a minimum of twelve interviews (have urban, half rural) to be conducted with both HCWs and CBO representatives. In an effort to achieve saturation, we prioritized diversity in the types of key informants we reached (Table S2). The in-country PI and research assistants monitored data collection and saturation.

Women were recruited to participate in focus groups using informational flyers or advertisements posted in different health centers and surrounding communities. As with the key informants, a balance was sought in the level of education and participants with live and deceased children, as well as a diversity of experiences and opinions regarding access and utilization of MNCH services. The number of focus groups was determined at the outset of the study, and constrained by study logistics. Written informed consent was obtained from all enrolled participants. Community women (Table S3) were provided a small monetary compensation for their participation.

Interview and discussion guides

Interview guides for key informants and discussion guides for focus groups with community women were developed, pilot tested through cognitive interviewing [49], and revised as needed. The guides focused on experiences with MNCH services and barriers to and facilitators for improving child survival (Table 1), pertaining to the eight content areas evaluated during the review of national health policies and strategies. Not all content areas were appropriate for each key informant group, but each topic was asked of at least two of the four groups. The content areas and overarching questions were developed to provide structure across the four country case studies of the parent study. However, they were intentionally broad to provide sufficient flexibility for participants within and across countries to discuss the issues most relevant to them. Focus group discussions with community women focused only on the health care system, MNCH interventions, medicines, and contextual factors content areas. While participants could discuss the entire period from 2000 forward, most participants recalled more recent information and experiences.

Data collection

Prior to conducting interviews and focus group discussions, participants completed a brief survey to obtain basic demographic information, MNCH-related work experience (key informants only), socioeconomic information (focus group women only), and/or information on births and under-five deaths in the household (focus group women only).

Key informant interviews were conducted in English by one research assistant using the appropriate interview guide and were audio recorded. Key informants were encouraged to provide their perspectives openly and discuss a range of barriers and facilitators to child survival. Interviews typically lasted 60-90 minutes. The focus group discussions were conducted in Liberian English and were audio recorded. Two Liberian research assistants (one male and one female) were present at each focus group to facilitate discussion and note-taking. Focus group participants were encouraged to provide their

opinions openly, and research assistants were trained in techniques to promote open discussion. Focus groups typically lasted between 1 ½ to 2 hours.

The researchers on this study included individuals with knowledge and experience of MNCH at the national and international levels, and who had prior experience with health research in Liberia. Key research team members had prior experience with qualitative and quantitative research methods and research ethics. An in-person methods training was held to ensure high quality data across sites. Ongoing remote training and trouble-shooting was provided to the research team during the piloting and data collection stages of the study. To promote reflexivity, preliminary results were discussed at a workshop held after data collection and preliminary analysis was completed.

Following completion of the interviews and focus groups, audio recordings were transcribed by the research assistants and field notes incorporated into the transcript. Transcripts were coded and analyzed using the software Atlas.ti (Atlas.ti Scientific Software Development GmbH, Berlin, Germany) [50]. In keeping with a framework approach often used for qualitative, multidisciplinary health research,[51-53] deductive themes were determined *a priori* based on our conceptual framework of overarching questions. Additional inductive themes were also identified upon review of the transcripts. Deductive codes provided a useful way of comparing themes and concepts within and across countries. Text was coded and reviewed for patterns of consistency, variation, relationships between themes and exemplary cases or quotations [54 55]. Ethical approval was obtained from the Vanderbilt University Medical Center and the University of Liberia-Pacific Institute for Research and Evaluation.

Patient involvement

Patients were not involved in the design of this study. Results were disseminated to Ministry of Health and WHO representatives from Liberia, and a presentation and report detailing results were made available to these representatives to aid further dissemination to other stakeholders.

RESULTS

MNCH coverage Indicators

Indicator coverage data from 2000 were not available for six of the thirteen core indicators (Fig 2). Liberia has improved coverage of nine of these indicators during the study period. Highest current indicator coverage is seen for pregnant women receiving antenatal care (ANC) (96%), vitamin A supplementation (88%), pregnant women receiving at least four ANC visits (78%), and improved water sources (75%; Fig 2). Coverage was below 50% for improved sanitation (17%), postnatal visits within two days for deliveries (35%), use of insecticide-treated bednets (38%), and diarrhea treatment (46%; Fig 2).

Figure 2 here. **National document review and qualitative study**

National Prioritization of MNCH

Both national documents and key informants at nearly all levels highlighted the strong commitment the Liberian government made to re-build the health care system soon after the civil war ended. Key informants and national documents also described how MNCH was prioritized, not just within the MOH, but also by top leadership throughout all sectors of the government. As an example of Liberia's high level commitment to MNCH, key informants described how maternal and neonatal deaths were reported directly to Liberia's president. Routine audits of maternal and neonatal deaths were undertaken by county health boards to identify problems with care, and improve accountability and oversight. Community women rarely specifically commented on the government's prioritization of MNCH, but some did express appreciation for the government's role in rebuilding services after the conflict. This prioritization of MNCH by multiple levels in the government is illustrated in the quotations below:

"I mean it has been a painfully slow process…to get government to that level of commitment but a lot of progress, a lot of gain has been made and I can tell you for instance now the President of Liberia is the president of the commission for women health in Africa and that's under the WHO-AFRO, I can tell you that the government…had made maternal and newborn health one of the conditions that will undergo surveillance, meaning that…maternal and newborn death should be reported." (49 year old, male donor partner)

"…I think all the things we do medication and everything government has been involved [in]…if you have anybody dying from giving birth they have this audit in this particular team that reports directly to the President of Liberia, so they are even involved in it…" (35 year old, female from CBO partner)

"[NGOs and the government] are giving us knowledge [on] how to take care of ourselves and what to do when you are pregnant, where to go and where not to go and what for you to eat…things have improved, because we having NGOs, we having government, we having UN, many people coming in they helping us too. So things have improved bit by bit." (39 year old, rural woman with 4 children)

Although child health has been recognized as an important priority by both the Liberian government and donor partners, national health documents and key informant interviews all indicated consistent concern that Liberia's high dependence on donor aid is unsustainable. Many key informants felt that the Liberian government's relationship with donors had evolved such that donors no longer drove the agenda, but rather accepted guidance from the government on priority areas and needs that the donors could assist with. However, there were also some who felt that donors continued to have too much involvement because of the high levels of funding they provided. Due to strong donor funding and some government funding, most MNCH services were free during much of the study period, which key

informants and community women felt contributed to increased access and utilization. However, key informants and national documents indicated that the government of Liberia needs to institutionalize services currently provided by external partners and take more financial responsibility for the health sector. The government was praised by a few participants for taking on a greater share of responsibilities, such as vaccine procurement, but many acknowledged that the government needed to sustain their involvement and investment to ensure gains were sustainable.

> "…we are donor dependent; the sources of funding either from the donor or the GOL [Government of Liberia] but what comes into the ministry for maternal and child health issue is very small but the input that partners are making if you count it, it's very huge. So we think that for sustainability the government needs to play more roles because if these partners leave, the gains that we are making, to sustain it might be difficult..." (46 year old, female MOH official)

The Development and Implementation of Integrated Packages of Services

Key informants indicated that the MOH did a good job of implementing extensive reforms of the health system soon after the civil war, and continuous attempts to evaluate and update policies and strategies to make gradual improvements. An often-cited example by key informants of this process was the implementation of integrated packages of services, detailed in the quotations below:

> "…I think there is an enabling environment from the government through the Ministry of Health that is in place through the development of the ten years plan and the expanded program which is the EPHS [Expanded Package of Health Services], which addresses child health and maternal health, so first there is a will on the part of the government to address child health and maternal health…" (49 year old, female donor partner)

"…the Ministry of Health, from the beginning a postwar country had a policy first that was guiding the process; the BPHS [Basic Packages of Health Services]…So it had bases on how people should implement the policy and also as time went by, maternal services improved over time based on evaluation from the Ministry of Health and Social Welfare through their annual accreditation looking at service delivery." (35 year old, male donor partner)

Liberia's National Health Policy and Plan [56] first focused on establishing the Basic Package of Health Services (BPHS). National documents and key informants attributed rapid scale-up of MNCH interventions immediately following the civil war to the effective framework set forth by the BPHS. According to national documents, the BPHS also aimed to improve distribution and supervision of healthcare providers through establishment of a salary scale, standardized job descriptions, and supervision tools for all cadres. Although the BPHS is credited with restoring MNCH service delivery across Liberia, several key informants stated that the BPHS did not adequately integrate services across different sectors of MNCH, which they felt hindered delivery of maternal health and family planning, nutrition and PMTCT. Additionally, components of the BPHS intended to improve human resources for health were not fully implemented or did not appear to have the intended impact, as many key informants and community women cited a lack of qualified and quality providers.

Recognizing the shortcomings of the BPHS, the National Health and Social Welfare Policy and Plan [57] was developed and established the Essential Package of Health Services (EPHS) which aimed to scale-up interventions (especially MNCH interventions), reduce inequities, improve collaboration across different sectors, and improve quality at secondary and tertiary healthcare centers. The EPHS also sought to increase the number of skilled workers available for labor and delivery to ensure that emergency obstetric and neonatal care (EmONC) is available at all facilities. Key informants were quite positive about the EPHS, feeling that it had improved collaboration between sectors and had improved quality of

care in some areas. Some key informants also felt that the clearer language in the policy documents enabled the government to better establish expectations and hold partners accountable when implementation goals were not met.

> "…from the BPHS to EPHS, it was EPHS they were able to strengthen that MCH part to include in addition to nutrition, adolescence, reproductive health care and all of that sexual health but in the past, those were very weak and gray areas; as long as the policy did not address them, they became difficult for anyone to hold a partner accountable for any implementation. Uh, now, the ministry has included that and there are more services." (47 year old, male CBO partner)

However, some key informants felt that the EPHS had not been completely implemented at all levels, particularly the primary care level, due to lack of resources, both human and financial. The incomplete implementation limits not only delivery of MNCH interventions, but also the collaboration and coordination the EPHS was intended to promote. In addition, both key informants and some community women described continued shortages of healthcare providers, especially those trained in delivery-related interventions, certified midwives, and pediatric specialists outside the capital of Monrovia. As illustrated below, community women and key informants noted that limited availability of MNCH providers and poor attitudes of providers remained a barrier to utilizing and accessing care.

> "…When I gave birth, the girl that attended to me because she left, her shift was over…that night I could die because I started bleeding right after giving birth. But because my friend was a nurse she went there and attended to me that night. Those that were on shift that night… never had time for me because nothing was there for me to tip in, so they just acted careless on [with] me." (38 year old, urban woman with 4 children)

> "Clinics are…not running 24/7 services, we have heard these challenges from them, people go

overnight with complaints and the health care provider says I am not paid for overnight services so you have to wait until tomorrow; so lack of motivation at the service provider end is also impeding the process." (37 year old, male CBO partner)

Although key informants were concerned about incomplete implementation of the EPHS, they attributed improvements in malaria, PMTCT services, nutrition and reproductive health to the enhanced integration between sectors that the EPHS provided, as illustrated below. Community women did not specifically describe implementation of the EPHS or differentiate between levels of the healthcare system, but did discuss the quality of care they received. Specifically, women felt very positive about the care received during pregnancy and delivery, as well as educational and preventive services.

"…I think it has changed…in the past we had the BPHS that provided minimum service at the health facility where when the pregnant woman comes, they only check them and when they have malaria, they treat them and they go home. But this time around, the BPHS has been modified to EPHS and where, we look at a full package, the standards have improved, the services have improved and they receive a whole package and deliver it to the mother… [including] PMTCT services, immunization, nutrition, and other laboratory findings so as to reduce the number of visits, she has to do at the health facility." (33 year old, male MOH official)

"…the nurses and the doctors especially at the hospital here, whenever they carry pregnant woman there, they always cater to the person and talk [to] the person in a polite manner, try to help the person…They always treat us free and at time [delivery] they give baby's clothes free of charge." (43 year old, rural woman with 6 children)

"…when you give birth and the baby is growing up, you don't have to wait for the child to fall sick before you carry the child to hospital. You can take the child to hospital so the child will get drugs [anti-malaria prophylaxis]..." (35 year old, urban woman with 4 children)

Community outreach and service delivery

Liberia's use of community outreach and service delivery was a third overarching factor identified as facilitating achievement of MDG#4. The national Community Health Services Policy first issued in 2008 and revised in 2011 [58] outlined a standard set of outreach, health promotion and referral services. This policy also specified the roles and responsibilities of community-based staff including general community health volunteers (GCHVs) and Trained Traditional Midwives (TTMs). It further outlined how they should be distributed geographically, supervised, evaluated, and that TTMs are to be compensated with monthly salaries while GCHVs work as volunteers but receive an incentive package. Both key informants and community women were positive about their efforts at the community level, recognizing how these cadres enhance referrals from the community to healthcare facilities and follow-up with mothers and children in the community after they return home. GCHVs and TTMs were also highly valued by community women for their assistance with the outreach campaigns--"Reach Every District" (RED) and "Reach Every Pregnancy" (REP)-- to improve immunization coverage and maternal health, respectively. Both key informants and community women further described that GCHVs and TTMs had likely increased coverage of antenatal and post-natal care by connecting women with the healthcare system earlier in pregnancy and increased immunization coverage through mobile vaccination sites, and improved community-based education and communication.

"…the vaccine team most of the time come around to give our children vaccine and deworm them with the medicine. At time we can see some people with the megaphone educating…pregnant women on how to take care of your children and even how to take care of

your community. As for the health campaign we can see them and we can benefit from them." (38 year old, urban woman with 3 children)

"Number one thing that is trying to work well is the TTMs and GCHVs, they are trying their best with the referrals. They get any patient in the community, they bring them here… we have family planning, we have EPI under MCH, we have PMTCT, ANC, labor and delivery, post-partum care provided…The only problem we have with our GCHVs is that they are saying they are not been compensated so we don't expect them to work full time." (43 year old, female health care worker)

While attributing success at the community level to the efforts of GCHVs and TTMs, study participants also felt these staff needed better compensation beyond what is currently provided to enable them to work more often. The insufficient number of GCHVs and TTMs was also cited as a challenge affecting availability of health services. Key informants and national documents noted that due to limited human and financial resources, local health clinics were not always staffed and community-based interventions such as the RED and REP campaigns had not been implemented or adequately supported in all areas.

"…I remember some time ago they were trying to integrate the…reach every pregnant women; reach every district…but for the reach every pregnant woman actually it is not working 100%. If I will have to grade it may be it is working around 40 to 45% because of may be some supplies that supposed to be given or put into place it is not into place…" (34 year old, female CBO partner)

DISCUSSION

This case study identifies three components that have likely contributed to Liberia's rapid post-conflict decline in under-five mortality and attainment of MDG#4. First, the Liberian government made re-establishment and funding of MNCH a top priority as it rebuilt its health system after the civil war. Second, the development and implementation of integrated packages of services, first the BPHS followed by the EPHS, enabled Liberia to restore basic MNCH services and scale-up interventions at all levels of the healthcare system. The development and implementation of the BPHS and EPHS also demonstrated Liberia's ability to evaluate and re-work policies and strategies. The EPHS fostered further integration and collaboration across multiple sectors, which allowed for expansion of PMTCT, nutrition, and other MNCH services. The EPHS also sought to improve the availability of trained health workers and fully functional health units, although challenges persisted despite these efforts. Third, provision of services at the community level, such as outreach campaigns and use of GHCVs and TTMs to deliver basic MNCH interventions, contributed to improved coverage of ANC, post-natal care, and immunizations, and also improved access and continuity of care in post-conflict Liberia by strengthening referrals between the community and healthcare facilities.

Liberia utilized a healthcare system recovery approach that has shown promise in other post-conflict or conflict-affected settings. Specifically, Kruk, et al. (2010) emphasize the need for strong national leadership and governance that makes restoration of basic health services a top national priority. They also documented that, when a national government makes a strong commitment to providing healthcare to the most vulnerable populations (such as women and children), this commitment can contribute to the country's long-term stability and recovery efforts. A basic package of health services enabling rapid roll-out and scale-up of MNCH and other primary health services has also been deployed with some success in Afghanistan, South Sudan, Rwanda, and Bosnia and Herzegovina [59-63], and is specifically recommended for conflict-affected settings [4 12]. These packages of services typically include key MNCH interventions, nutrition, and treatment for communicable diseases (such as TB and HIV) [59-65].

Afghanistan, like Liberia, revised their basic package to also include additional services (for disability and mental health), recognizing the specific needs of their population and the gaps in their original package. Researchers have suggested that integrated packages of services may help in initial scale-up and improvements, but require additional inputs and adjustments to sustain these improvements [59 60 62 66].

Community-level education, empowerment, and outreach are also recommended to improve utilization and access to basic interventions and improve referrals from the community to the facility levels [4 67-70]. Expanding cadres of traditional birth attendants and community health workers has been found to be particularly key in restoring maternal and neonatal services in conflict-affected settings [59 71-75]. Community health workers and community-level outreach and service delivery has also been a key factor in the successes of other countries successfully reducing child mortality [30-34 38 76]. Although many conflict-affected settings have difficulties with referrals [67 77 78], this is one area where Liberia appears to have made great progress through their use of GCHVs and TTMs, as described by key informants and community women.

Although Liberia has made significant progress in MNCH, national documents and study participants noted a number of challenges that persist and need to be addressed as Liberia moves forward to achieve their post-2015 goals [79]. This includes their severe shortage of healthcare providers, particularly community-based midwives and child health providers in rural areas. The lack of healthcare providers and challenges associated with training and retaining general and MNCH providers is well-documented in the literature from other conflict-affected countries where brain-drain is common during and after conflict [4 12 59 67 69 80-83]. Another weakness described in the study is Liberia's high dependence on donor aid to provide many of the MNCH services. Although heavy reliance on donor aid is consistent with other conflict-affected countries, there is little consensus on how donors can best support post-conflict countries and few recommendations as to how and when post-conflict settings should make the transition from donor-provided services to government-provided services [84-86]. An emphasis on

increased government stewardship of the healthcare system, particularly with respect to the government taking a key role in determining partner expectations and roles and contracting directly with partners comprises one set of recommendations.[87-89] Liberia's relationships with donors appears to have evolved in line with this recommendation, however additional progress is still needed. The literature also cautions that the time horizon for moving away from donor dependence in conflict-affected states may be lengthy and is not necessarily linear as a state's stability may not always follow a linear trajectory.[85 87]

This study provides one of the few country-case studies to assess progress towards achieving MDG#4. Perhaps more importantly, it provides much needed insight into MNCH infrastructure and experiences from an understudied, post-conflict, yet highly successful African country. This case-study utilized a number of data sources, including national indicator data, country-authored health policies and strategies, and qualitative data from key informants with different roles in MNCH and four focus group discussions with women from urban and rural areas. By bringing together diverse sources of data, this study was able to assess the national-level measures used to enhance child survival and the facilitators and challenges that affected full implementation and impact.

There are limitations in our study. For the review of national MNCH policies and strategies, new policies and strategies were not issued until after 2007 due to the civil war. While these documents contained a retrospective assessment of the preceding period, assessments of the impact of more recent policies or strategies were not yet available. Moreover, country policies and strategies covered different and sometimes overlapping time periods, making it difficult to distinguish current from outdated information, and whether a stated plan had been implemented unless stated. Input from co-authors affiliated with the WHO and the MOH helped to clarify uncertainty.

With regards to the interviews and focus groups, this study was limited to a non-random sample of participants and conducted in two counties (one urban, one rural). Changes in under-five mortality in these areas may not reflect changes at the national level and local views and experiences may not reflect

those from other areas. However, participants were selected to represent five different cadres of individuals who could share a diversity of MNCH experiences, including some key informants with national-level responsibilities and 37 women from the community. Most of the participants recalled their current experiences and opinions on MNCH, and we gained less insight as to long-term changes.

Our study contributes to the growing literature on effective approaches to scaling-up availability and use of MNCH services in conflict-affected settings. The factors identified as contributing to Liberia's success in reducing under-five mortality can be applied in the many other countries recovering from conflict, and is relevant to Liberia's recovery from the 2014-2015 Ebola epidemic. To further improve the delivery of essential health services and reduce under-five mortality in the post-2015 era, Liberia must maintain the health and welfare of pregnant women and children as a top priority, conduct comprehensive evaluation and enhancement of programs and interventions, increase government responsibility for service delivery to reduce donor dependence, and ensure that sufficient human and financial resources enable MNCH service delivery close to the population.

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Authors' contributions

Brault: Involved in conceptualization of research, development of methodology, data collection, data analysis, data management, and manuscript development.

Kennedy: Involved in development of methodology, data collection, data management, and manuscript development.

Haley: Involved in conceptualization of research, development of methodology, data collection, data analysis, data management, and manuscript development.

Clarke: Involved in development of methodology, provision of study resources, and manuscript development.

Duworko: Involved in development of methodology, provision of study resources, and manuscript development.

Habimana: Involved in conceptualization of research, development of methodology, funding acquisition, and manuscript development.

Vermund: Involved in conceptualization of research, development of methodology, funding acquisition, and manuscript development.

Kipp: Involved in conceptualization of research, project administration, development of methodology, funding acquisition, data collection, data analysis, data management, and manuscript development.

Mwinga: Involved in conceptualization of research, project administration, development of methodology, funding acquisition, provision of study resources, and manuscript development.

Data sharing statement

Annual mortality estimates used in Figure 1 are publicly available, without restriction, from http://www.childmortality.org/index.php?r=site/graph#ID=LBR_Liberia. Indicator data used for Figure 2 are publicly available, without restriction, from the World Development Index, Africa Development Index, and Health Nutrition & Population Statistics databases of the World Bank Data Catalog (http://data.worldbank.org/data-catalog/) or Liberia Demographic and Health Survey reports available at http://dhsprogram.com/Where-We-Work/Country-Main.cfm?ctry_id=22&c=Liberia&r=1. A detailed description of each indicator's source can be found in the supplemental material from a previously published study (Kipp et al. BMJ Open. 2016. http://dx.doi.org/10.1136/bmjopen-2015-007675).

Supplemental table S1 lists the national documents reviewed for the study. These were obtained with the permission and assistance of the Liberian co-authors and do not belong to any of the individual study authors. As such, they cannot be made available as they belong to the Ministry of Health or other agencies and some are still in draft form. Links to publicly available documents are provided in Supplemental table S1. For investigators wishing to obtain other policy documents used in this study, please contact Mr. Luke Bawo, Coordinator for Research and Health Management Information System, Ministry of Health, email: lukebawo@gmail.com; or Hon. C. Sanford Wesseh, Assistant Minister for Vital Statistics, Ministry of Health, email: cswesseh@yahoo.com.

Under the Agreement for Performance of Work with the World Health Organization (sponsor) that was used for this study, all rights to the data collected from key informants and community women belong to

the WHO. The WHO will entertain any reasonable proposal for use of the data. Researchers who are qualified to manage and analyze qualitative data may request these data from Dr. Phanuel Habimana, Team Leader, Child and Adolescent Health and Nutrition, WHO Regional Office for Africa, Brazzaville, Congo; email: habimanap@who.int.

Interview, focus group discussion, and national document abstraction guides are available upon request from the corresponding author; email: aaron.kipp@vanderbilt.edu. These data are not considered part of the underlying data necessary to replicate the study.

Figure legends

Fig 1. Under-five, infant, and neonatal mortality rates for Liberia in 1990, 2000, 2010, and 2015 (solid circles) with annual rates of reduction (ARR) for each period (solid and dashed lines).

Source: Levels and Trends in Child Mortality: Report 2015 - Estimates Developed by the United Nations Inter-agency Group for Child Mortality Estimation [1]. Report and data accessed July 2015 from www.childmortality.org.

Fig 2. Changes in child survival indicator coverage in Liberia, 2000, 2007, and 2013*.

*Estimates were not always available for years 2000, 2007, and 2013, in which case the nearest estimate between 1999 and 2000, 2005 and 2007, or 2012 and 2013 was used; data were not available for the six indicators showing an asterisk (*) during the 2000 time period.

†Among all births, both inside and outside a health facility

‡Children 12-23 months old who have received BCG, measles and three doses each of DPT and polio vaccine (excluding polio vaccine given at birth)

§Children under 5 receiving oral rehydration and continued feeding

Source: World Development Indicators Data Catalogue from the World Bank (http://datacatalog.worldbank.org; accessed August 2015) and Liberia DHS

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Supporting Information

S1 Table. Liberia policy, strategy, and other national documents reviewed

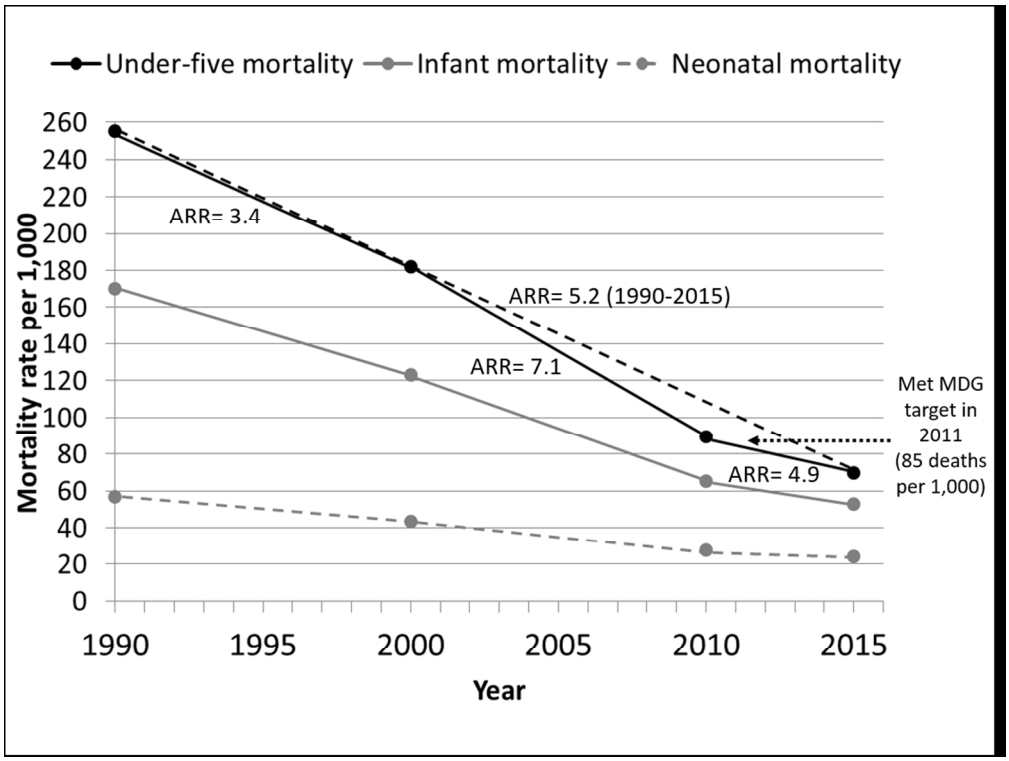

Figure 1: Under-five, infant, and neonatal mortality rates for Liberia in 1990, 2000, 2010, and 2015 (solid circles) with annual rates of reduction (ARR) for each period (solid and dashed lines).

98x74mm (300 x 300 DPI)

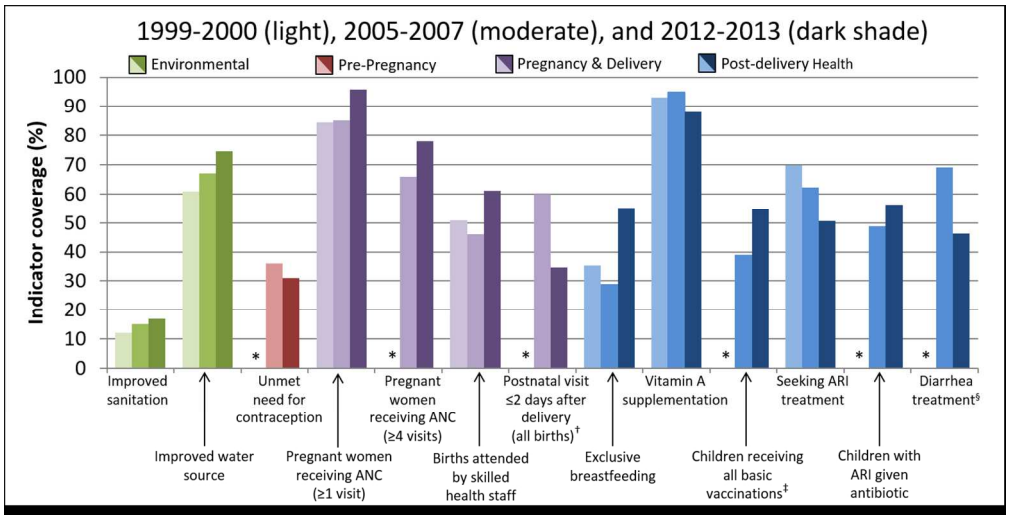

Figure 2: Changes in child survival indicator coverage in Liberia, 2000, 2007, and 2013*.

127x64mm (300 x 300 DPI)

Supplemental Table

Table S1. Liberia documents reviewed

Document title (dates if not otherwise specified in title)
Primary source documents* (Newest to oldest)
Republic of Liberia Agenda for Transformation: Steps towards Liberia Rising 2030 (2012)
Accelerated Action Plan to Reduce Maternal and Neonatal Mortality, 2012-2016
Situational Analysis of Newborn Health in Liberia (Parts A and B) (Drafts) (2012)
National Health and Social Welfare Policy and Plan, 2011-2021
Country Situational Analysis Report, 2011
Road Map for Accelerating the Reduction of Maternal and Newborn Morbidity and Mortality in Liberia, 2011-2015
Revised National Community Health Services Policy (2011)
Essential Package of Health Services: Primary Care, 2011-2021
Essential Package of Health Services: Secondary and Tertiary Care, 2011-2021
National Strategy for Child Survival in Liberia, 2008-2011
Other documents reviewed† (Newest to oldest)
Micronutrient Powder Supplementation of Young Children Linked with IYCF community promotion, 2012-2015
National Policy on Immunization, 2012
National EPI Strategic Plan, 2011-2015
National Sexual and Reproductive Health Policy (2010)
Integrated Guidelines of Prevention, Testing, Care and Treatment of HIV and AIDS in Liberia, 2010
Report on the Assessment of Infant and Young Child Feeding Practices, Policies and Programmes in Liberia 2009

*Primary documents extensively reviewed to obtain information on each content area identified in the abstraction guide

†Documents reviewed, but information on progress towards MDG#4 was sufficiently covered by the primary documents

Table S2. Characteristics of key informants in Liberia.

	Ministry of Health (N=11)		Donor organization (N=8)		Community Based Organization (N=14)		Health Care Worker (N=14)	
Sex, N (%)								
Male	8	(73)	5	(62.5)	10	(71)	5	(36)
Female	3	(27)	3	(37.5)	4	(29)	9	(64)
Age, M (IQR)	45	(38, 55)	40	(36, 49)	40	(36, 50)	45	(40, 54)
Ethnicity, N (%)								
Bassa	1	(9)	1	(12.5)	0	(0)	0	(0)
Grebo	2	(18)	1	(12.5)	1	(7)	2	(14)
Kissi	1	(9)	0	(0)	1	(7)	0	(0)
Kpelle	2	(18)	1	(12.5)	4	(29)	6	(43)
Lorma	2	(18)	0	(0)	0	(0)	1	(7)
Mano	2	(18)	1	(12.5)	4	(29)	1	(7)
Other*	1	(9)	4	(50)	4	(29)	4	(28)
Education, N (%)								
Secondary	1	(9)	0	(0)	0	(0)	0	(0)
Post-secondary	10	(91)	8	(100)	14	(100)	14	(100)
Median (IQR) years working for organization	7	(6, 9)	1	(1, 6)	5	(3, 13)	7	(2, 15)

* Other includes one each of Belleh, Dahn, Gbandi, Gola, and Kru; five foreign nationals (Ghana, Kenya, Nigeria, Sierra Leone, and Uganda); and 3 not reported

Table S3. Characteristics of female focus group participants in Liberia.

	Rural participants (N=16)		Urban participants (N=21)	
Age, M (IQR)	26	(22, 32.5)	28	(21, 38)
Ethnicity, N (%)				
Kpelle	12	(75)	1	(5)
Lorma	2	(13)	2	(10)
Bassa	0	(0)	9	(43)
Kru	0	(0)	7	(33)
Vai	0	(0)	2	(10)
Other*	2	(13)	0	(0)
Education, N (%)				
None	2	(14)	2	(10)
Primary	7	(50)	5	(24)
Secondary	3	(21)	13	(62)
Post-secondary	2	(14)	1	(5)
Travel time to health care (dry season), N (%)				
Less than one hour	15	(94)	19	(90)
One to two hours	0	(0)	2	(10)
More than two hours	1	(6)	0	(0)
Number of living children, M (IQR)	1	(1, 3)	2	(1, 4)
Age of youngest child, M (IQR)	2 yr	(11 mo, 4 yr)	2 yr	(1 yr, 3 yr)
Any children who died <5yrs old, N (%)				
No	12	(80)	12	(57)
Yes	3	(20)	9	(43)
Place of delivery for latest pregnancy, N (%)				

Health facility	16	(100)	17	(81)
Home	0	(0)	4	(19)
Birth attendant for latest pregnancy, N (%)				
Doctor	2	(13)	3	(14)
Nurse/midwife	14	(88)	17	(81)
Traditional birth attendant	0	(0)	1	(5)

* Other includes one each Kisii and Mandingo

Standards for Reporting Qualitative Research (SRQR)*

http://www.equator-network.org/reporting-guidelines/srqr/

	Page/line no(s).
Title and abstract	
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	Page 1, lines 1-2
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	Pages 2-3, lines 28-52
Introduction	
Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	Pages 4-6, lines 72-119
Purpose or research question - Purpose of the study and specific objectives or questions	Page 6, lines 120-128
Methods	
Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	Page 16, lines 279-283
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	Page 16, lines 267-275
Context - Setting/site and salient contextual factors; rationale**	Page 10-11, lines 174- 191
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	Pages 7-13
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	Page 16, lines 285-286
Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	Pages 7-10 and Pages 15-16

Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	Pages 7-10 and Pages 15-16
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	Pages 7-8 and Pages 11-12
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	Pages 15-16
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	Page 16
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	Page 16

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	Throughout results
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	Throughout results

Discussion

Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	Throughout discussion
Limitations - Trustworthiness and limitations of findings	Pages 28-29, lines 552-567

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	Page 29, lines 586-587
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	Pages 29-30, lines 586-593

*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

**The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

Reference:

O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014
DOI: 10.1097/ACM.0000000000000388