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Eliminating Preventable HIV-Related Maternal Mortality in Sub-Saharan Africa: What Do We Need to Know?

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Introduction: HIV makes a significant contribution to maternal mortality, and women living in sub-Saharan Africa are most affected. International commitments to eliminate preventable maternal mortality and reduce HIV-related deaths among pregnant and postpartum women by 50% will not be achieved without a better understanding of the links between HIV and poor maternal health outcomes and improved health services for the care of women living with HIV (WLWH) during pregnancy, childbirth, and postpartum.

Methods: This article summarizes priorities for research and evaluation identified through consultation with 30 international researchers and policymakers with experience in maternal health and HIV in sub-Saharan Africa and a review of the published literature.

Results: Priorities for improving the evidence about effective interventions to reduce maternal mortality and improve maternal health among WLWH include better quality data about causes of maternal death among WLWH, enhanced and harmonized program monitoring, and research and evaluation that contributes to improving: (1) clinical management of pregnant and postpartum WLWH, including assessment of the impact of expanded antiretroviral therapy on maternal mortality and morbidity, (2) integrated service delivery models, and (3) interventions to create an enabling social environment for women to begin and remain in care.

Conclusions: As the global community evaluates progress and prepares for new maternal mortality and HIV targets, addressing the needs of WLWH must be a priority now and after 2015. Research and evaluation on maternal health and HIV can increase collaboration on these 2 global priorities, strengthen political constituencies and communities of practice, and accelerate progress toward achievement of goals in both areas.

Key Words: HIV, maternal health, maternal mortality, research priorities, women's health, pregnancy

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INTRODUCTION

Nearly 18 million women are living with HIV worldwide, and more than 90% of pregnant women living with HIV (WLWH) reside in sub-Saharan Africa.[1,2] Globally, HIV and complications related to pregnancy remain the 2 leading causes of death for women of reproductive age.[3] Global maternal mortality has been reduced from an estimated 543,000 deaths in 1990 to 287,000 deaths in 2010. However, in the same period, maternal mortality seems to have increased in 8 sub-Saharan African countries with high HIV prevalence.[4] Without timely antiretroviral therapy (ART), WLWH in sub-Saharan Africa are approximately 8 times as likely to die during pregnancy or the postpartum period as HIV-negative women.[5–7] Before wider availability of ART, about 1 quarter of pregnancy-related deaths in the region were attributable to HIV.[6] International commitments to eliminate preventable maternal mortality[8] and reduce HIV-related deaths among pregnant and postpartum women by 50%[9] will not be achieved without a better understanding of the links between HIV and poor maternal health outcomes and improved health services for the care of WLWH during pregnancy, childbirth, and postpartum.

Research, monitoring, and evaluation are needed to understand the relationships between HIV and increased

maternal morbidity and mortality, track progress, motivate adoption of and sustained support for interventions that work, and generate solutions that address persistent barriers to the maternal health of WLWH. The context for the questions identified in this research and evaluation agenda includes impressive but uneven progress on providing antenatal HIV testing and ART to prevent vertical (mother-to-child) HIV transmission in sub-Saharan Africa.[10] Additionally, new treatment guidelines recommend earlier initiation of ART for all adults, and a growing number of countries are moving towards initiation of lifelong treatment for all pregnant and breastfeeding WLWH, regardless of CD4 count (Option B+).[11] The impact of these treatment changes on maternal mortality and morbidity is still unclear. At the same time, significant numbers of treatment-eligible women who learn they are living with HIV during pregnancy in sub-Saharan Africa do not begin ART,[12,13] and for those who do, retention in care[14,15] and postpartum ART adherence[16] are suboptimal. The current situation suggests that services better aligned to women's needs and enabling social environments are critical for more women to begin and remain in care.

Beyond ART, coverage of interventions necessary to improve the maternal health of all women, but which are particularly crucial for WLWH, such as screening and treatment for tuberculosis[17] and malaria[18] and provision of contraceptive information and services,[19] is insufficient. Pregnancy and HIV both increase women's susceptibility to acquiring malaria and to developing active tuberculosis disease.[20–22] Coinfection with HIV and either malaria or tuberculosis are also associated with increased risk of maternal death compared with women who have tuberculosis or malaria but are not living with HIV.[23,24] Reducing unintended pregnancies among WLWH constitutes primary prevention of vertical transmission and maternal mortality and morbidity, but although 66%–92% of WLWH in sub-Saharan Africa report not wanting another child (now or ever), only 20%–43% are using contraception.[25] Finally, although the efficacy of ART for preventing sexual[26] and vertical HIV transmission[27] holds promise for safer reproductive opportunities for WLWH, limited attention has been focused on strategies to support safer conception among HIV-serodiscordant couples in resource-constrained settings.[28,29]

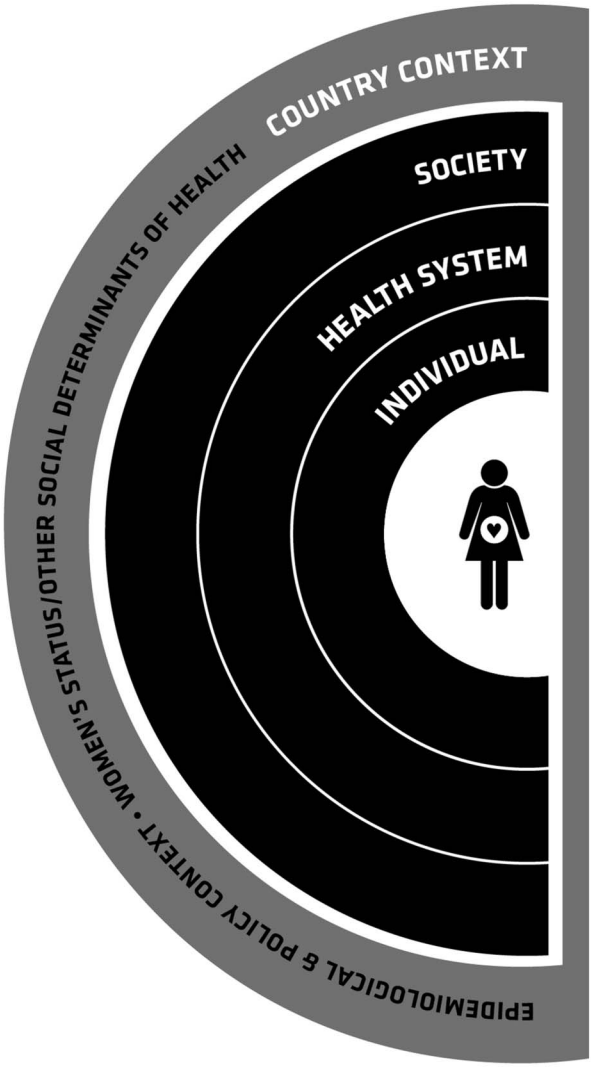
Identification of the Research and Evaluation Priorities

In June 2013, 56 international maternal health and HIV researchers and policy implementers were convened by the Maternal Health Task Force, the United States Agency for International Development, and the United States Centers for Disease Control and Prevention to share emerging evidence and identify priority knowledge gaps for improving programmatic responses to maternal health in contexts of high HIV prevalence. After this 2-day meeting, 30 researchers and policy implementers participated in a day-long meeting dedicated to reaching consensus on research and evaluation priorities for HIV and maternal health in sub-Saharan Africa. In addition to experience and technical expertise in HIV and maternal health, criteria for selecting the invited experts included representation of institutions from sub-Saharan Africa, North America, and Europe and a range of disciplinary backgrounds. Please see www.mhtf.org to consult the meeting agenda, presentations, and participant list. After a facilitated discussion of research and evaluation priorities, the experts divided into 3 groups tasked with reaching consensus on 4 priority areas for research and evaluation. Repetition of identified priorities allowed clustering in 3 broad areas for research and evaluation that were agreed on by consensus: (1) clinical management of pregnant and postpartum WLWH to address the leading causes of maternal death and evaluate the impact of expanded ART on maternal mortality and morbidity, (2) integrated service delivery models that simultaneously provide HIV screening and/or treatment and address malaria, tuberculosis, and/or the reproductive health of WLWH to optimize maternal health outcomes, and (3) an enabling social environment for women to begin and remain in care. The international working group that authored this article was formed to further develop the research and evaluation agenda and a conceptual framework (Fig. 1). Subsequently, narrative reviews of the peer-reviewed literature, relevant international guidelines and selected documents from the gray literature were conducted for each of the identified subtopics to summarize the existing evidence and knowledge gaps and generate additional specific research questions. The full working paper provides a comprehensive review of the literature and a detailed discussion of the proposed research and evaluation agenda.[30] This article synthesizes broad research and evaluation questions that should be addressed to improve the maternal health of WLWH and provides illustrative examples. Table 1 outlines additional research questions.

The 3 thematic areas focus on different levels of the social and programmatic context relevant for HIV and maternal health (Fig. 1) as follows: (1) the "individual" level is focused on the clinical management and maternal health outcomes of WLWH; (2) the "health system" level considers how multiple priority health needs can best be addressed in resource-constrained health systems; and (3) at the "society" level, the intent is to assess how interventions that address gender and HIV-related discrimination and create a supportive social environment affect women's linkage to and retention in health services. Evidence-based interventions will resonate positively across all 3 levels. For instance, better information about the causes of maternal death among WLWH can inform clinical management and health system resource allocation. Subsequent reductions in maternal deaths can create more community demand for services, creating a positive cycle. Similarly, when the social context enables women to access and continue HIV care and adhere to ART, individual morbidity and mortality, sexual and vertical HIV transmission, and development of antiretroviral resistance will be reduced. Individual and community health outcomes and the sustainability of ART programs will be improved.

IMPROVING DATA AVAILABILITY AND QUALITY

Three overarching issues were identified regarding data availability and quality: the lack of good quality data on the causes of maternal death, the need for enhanced program



INDIVIDUAL
Cause of maternal death & clinical management of pregnant and postpartum WLWH
► KEY OUTCOMES AND VARIABLES
HIV status, pregnancy/postpartum status, ART status, gestational age (or trimester) at initiation/on ART at conception, time on ART, ART regimen, CD4 and viral load (most recent and at treatment initiation), WHO disease stage, causes of maternal death or maternal morbidity, type of delivery (vaginal or cesarean), perinatal outcome (live or stillbirth), cost-benefit and cost-effectiveness

HEALTH SYSTEM
Integrated Health Service Delivery
► KEY OUTCOMES AND VARIABLES
HEALTH OUTCOMES: maternal morbidity and mortality, pediatric HIV cases, sexual HIV transmission, and clinical effectiveness of different interventions in integrated settings.

HEALTH SYSTEMS: national policies and budget allocation, process indicators to assess coverage and quality of care (including uptake of MCH and HIV services), satisfaction and retention of healthcare workers and service users, human resources needed to deliver interventions (ratio and cadre of providers to service users, skill level), cost-benefit and cost-effectiveness.

SOCIETY
Create an enabling environment for pregnant and postpartum WLWH to begin and remain in care/treatment
► KEY OUTCOMES AND VARIABLES
Uptake of HIV and MCH services, linkage from HIV diagnosis to treatment, retention in care, antiretroviral adherence, postpartum depression, disclosure of HIV status, disrespect & abuse in maternity and HIV care (including physical and psychological violence), HIV-related stigma & discrimination, intimate partner violence, other human rights violations, maternal morbidity and mortality, other health-related quality of life measures, cost-benefit and cost-effectiveness.

FIGURE 1. Conceptualization of research and evaluation priorities for eliminating HIV-related maternal mortality.

monitoring to better track coverage and effects of programmatic interventions for pregnant and postpartum WLWH, and the need for program evaluation to report on health outcomes in addition to process indicators. To improve availability and quality of maternal death data, recording all maternal deaths that occur in facilities and improving the quality of death certificates is a priority.[31] Implementing maternal death surveillance and response, which links facility- and community-based notification and investigation to national health information systems and includes a multidisciplinary process for making recommendations, is strongly advised.[32] The existence of significant errors in descriptions of cause of maternal death (even at tertiary level facilities) indicates the need for more autopsy studies. In addition, the large numbers of women who deliver outside of facilities in most countries in sub-Saharan Africa points to the need for further development of minimally invasive autopsies and improvement of verbal autopsy tools for use in the community.

Harmonized monitoring that identifies whether women are (1) living with HIV and (2) pregnant or postpartum would permit evaluation of the effects of programs on the maternal health of WLWH. Tuberculosis provides an example of the value of this approach. Ensuring that people living with HIV are screened for tuberculosis and given prophylactic treatment is a core activity for HIV treatment and tuberculosis control programs. Pregnant WLWH have an elevated risk of developing tuberculosis disease and of maternal death, but many information systems for monitoring tuberculosis prevention and treatment among people with HIV do not identify pregnant and postpartum women.

Finally, evaluation research tends to report on process outcomes, such as coverage, rather than health outcomes, and in general, does not report on relatively rare events, such as maternal mortality. The expert meeting and literature review identified the need to increase reporting of maternal health outcomes as part of program evaluation. Indeed, many of the interventions identified as priorities for evaluation have had

TABLE 1. Priority Research and Evaluation Questions to Improve the Maternal Health of WLWH

Individual: Cause of Maternal Death and Clinical Management of Pregnant and Postpartum WLWH
How will rates and causes of morbidity and mortality during pregnancy and the postpartum period be affected by increased availability of ART for WLWH?
What is the impact of ART on maternal morbidity and mortality caused by or associated with sepsis, obstetric hemorrhage, hypertension, anemia, malaria, pneumonia, and tuberculosis? What are the safest and the most effective clinical protocols to address these conditions among pregnant and postpartum WLWH? Are they as effective for WLWH as HIV-negative women?
Are ART-related adverse events more common or severe during pregnancy? Are side effects associated with reduced adherence among pregnant women?
How does long-term ART affect maternal micronutrient status, particularly as it relates to preconceptional health for future pregnancies?
What antibiotic protocols are most effective for preventing puerperal sepsis among WLWH, including for emergency cesarean sections? What policies and provider training prevent unnecessary elective cesarean sections among WLWH?
Is hemorrhage more severe among WLWH than HIV-negative women after controlling for the presence of anemia?
Will timely diagnosis and treatment of malaria and tuberculosis reduce prevalence and severity of anemia among pregnant and postpartum WLWH?
Is routine iron supplementation without verifying the presence of anemia warranted for pregnant women in areas where there is a high prevalence of both malaria and HIV? Does ART modify effects of iron supplementation on HIV and malarial replication? Is nutritional supplementation of pregnant and lactating WLWH in resource-limited settings necessary, particularly if they are receiving ART?
What are the microbiological causes of pneumonia in pregnant WLWH?
Is cotrimoxazole as effective as sulfadoxine–pyrimethamine for Intermittent Preventive Treatment of Malaria in Pregnancy in WLWH? What are the best prophylactic regimens for malaria among WLWH? What are the optimal clinical protocols for treating pregnant WLWH who are taking ART and who also have severe malaria or multidrug resistant tuberculosis?
Health System: Integrated Health Service Delivery
What are the most effective models for providing integrated services and how will integrated services affect the maternal health of WLWH?
What are the most effective models for harmonizing policy and programmatic guidelines to integrate crucial services (ART, contraceptive information and provision, safer conception, malaria, and tuberculosis screening and treatment)?
What are the advantages and disadvantages of integrated service delivery for quality of care, clinical effectiveness, and coverage of core maternal health and HIV services and the additional intervention?
What is the effect of task shifting on uptake and quality of care?
What is the effect of integrated service delivery on client and provider satisfaction and retention?
What are the best screening questions and diagnostic methods for improving detection of tuberculosis among pregnant WLWH?
How do educational programs for health care providers and counseling for pregnant women to inform them about the safety of prophylactic treatment for tuberculosis affect coverage?
Does training providers working in prenatal care to identify and manage Immune Reconstitution Inflammatory Syndrome improve clinical outcomes?
What models of counseling and service delivery increase access to and uptake of contraceptive methods, including long-acting reversible contraceptives and dual protection, while ensuring respect for reproductive rights? What is the role of community and community–facility collaborations in expanding access and uptake among WLWH and their partners?
Are postpartum immunization visits an optimal time for providing contraception information and services to WLWH?
How safe, effective, and acceptable to WLWH, their male partners, and health care providers are biomedical interventions (including "treatment as prevention," pre-exposure prophylaxis and medical male circumcision for an HIV-negative male partner) and behavioral interventions (including manual insemination and timing intercourse to peak fertility) to support safer conception?
Society: Create an enabling Environment for Women to Begin and Continue in MCH and HIV Care
Do programs designed to reduce disrespect and abuse in maternity care, HIV-related stigma and discrimination, IPV, and increase supportive involvement of male partners improve maternal health outcomes?
What additional rights-promoting interventions and programs to address social determinants of health are needed to promote equitable access and improved maternal health outcomes for heterogeneous groups of WLWH?
How will programs that seek to create an enabling environment affect uptake and retention in MCH and HIV care among WLWH who are disproportionately affected by the HIV epidemic, such as sex workers and drug users?

Bold indicates heading.

a positive impact on proximate outcomes, such as use of contraceptives or reduction of intimate partner violence (IPV), but have not been evaluated for their effects on maternal morbidity and mortality among WLWH.

INDIVIDUAL: CAUSE OF MATERNAL DEATH AND CLINICAL MANAGEMENT OF PREGNANT AND POSTPARTUM WLWH

How Will Rates and Causes of Morbidity and Mortality During Pregnancy and the Postpartum Period be Affected by Increased Availability of ART for WLWH?

Tracking maternal health outcomes to assess the impact of ART on excess maternal morbidity and mortality is a priority as millions of WLWH begin and remain on treatment. Evidence from sub-Saharan Africa indicates that earlier initiation and longer duration of ART reduces the risk of maternal death among WLWH. When South Africa began initiating ART at a $CD4^+$ cell count of $\leq$350 cells per microliter rather than at $\leq$200 cells per microliter, an 18% reduction in the institutional maternal mortality ratio for WLWH was observed during the first year.[33] In Mozambique and Malawi, more than 30 days of ART before delivery has been associated with reduced risk of death during childbirth and postpartum.[34] However, data from South Africa indicate higher maternal mortality rates among WLWH compared with HIV-negative women even when they are receiving ART,[35]

and results from a prospective cohort study of women initiating ART in Uganda found elevated risk of pregnancy-related mortality when pregnancy and the 1-year postpartum period were treated as a time-dependent risk factor.[36] Data from the United States also indicate a persistently elevated risk of maternal morbidity and mortality among WLWH in the ART era.[37] More studies, including cohort studies that allow valid comparisons by controlling for the health status of different groups of WLWH and that allow adjusted comparisons with HIV-negative women, are needed to tease out the relationships between HIV, pregnancy, time on ART, immune status, and maternal morbidity and mortality. As more countries offer lifelong ART for all pregnant and breastfeeding WLWH, it is critical to develop surveillance systems to track potential negative and positive effects of ART on women and infants.

What Are the Safest and Most Effective Clinical Protocols to Address the Leading Causes of Maternal Morbidity and Mortality Among WLWH?

Tuberculosis, malaria, pneumonia, and sepsis are the leading causes of maternal death among WLWH.[38–40] Prevalence of anemia among pregnant WLWH is high and contributes to poor maternal and infant health outcomes.[41–43] Data about greater incidence of hypertension or obstetric hemorrhage and outcomes for pregnant WLWH are inconclusive.[44–49] Research to improve the prevention and clinical management of the leading causes of maternal morbidity and mortality among WLWH is needed. To exemplify, WLWH have 3 times the risk of puerperal sepsis as compared with HIV-negative women and a 6-fold greater risk when delivery is by caesarean.[44] Maternal death audits in South Africa have identified an institutional maternal mortality ratio due to sepsis of 24.2 among WLWH as compared with 4.1 per 100,000 live births for HIV-negative women.[50] Results from studies that examined provision of prophylactic antibiotics to WLWH before or during delivery have been mixed.[51,52] Additional research is needed to inform sepsis prevention for WLWH during labor and delivery and as part of postpartum and postabortion care, as well as to elucidate the relationships between puerperal sepsis, immune status, and ART. Similar questions exist for other causes of maternal morbidity and mortality among WLWH (Table 1).

HEALTH SYSTEM: INTEGRATED HEALTH SERVICE DELIVERY

What Are the Most Effective Models for Providing Integrated Services and How Will Integrated Services Affect the Maternal Health of WLWH?

The promise of integrated service delivery is that meeting women's multiple health needs at a single point-of-care, possibly during a single visit and potentially by the same providers, can optimize women's contact with the health system and more effectively use scarce human and financial resources. Providing ART within maternal health services and eliminating barriers to ART initiation, for example by offering point-of-care CD4 testing[53] or eliminating CD4 testing before initiation of ART,[54] has been shown to dramatically increase uptake of ART among pregnant and breastfeeding women.[55,56] Reviews of integration of interventions needed to prevent vertical HIV transmission with other maternal and child health (MCH) services have identified generally positive results in terms of coverage, but few studies provide information on health outcomes.[57,58] Similarly, provision of contraceptives in HIV services and as a routine part of postnatal care has shown increased uptake by WLWH,[59–61] but information about how these interventions affect unintended pregnancies or other health outcomes is lacking.[62] Despite the overall positive impact, individual studies that identify negative effects in some settings, for instance, drops in child immunization rates in rural clinics when offer of HIV testing was added to immunization visits,[63] deserve attention. There are also outstanding questions about the point on the MCH and HIV care continuum at which to provide services. For example, if WLWH begin ART in MCH services, when and how is the transition to chronic HIV care most successfully accomplished? Research and evaluation priorities include monitoring to ensure that service integration does not compromise the quality and coverage of core MCH and HIV services and medium-term assessment of health outcomes. Studies that evaluate the impact of adding other care components to MCH and HIV services, such as safer conception and contraceptive services, and malaria and tuberculosis prevention and treatment are also needed.

Increasing the quality of services and the number of interventions provided requires strengthening MCH and HIV services and ensuring adequate human resources. This strengthening is particularly important in the context of increased demands for ART provision to greater numbers of pregnant and breastfeeding WLWH and guidelines recommending earlier initiation of treatment for all people living with HIV. In addition, the skills required to deliver different services, for instance, HIV treatment adherence counseling or diagnosis and management of tuberculosis may differ from the skills required to deliver high-quality antenatal and obstetric care. As task shifting is implemented, evaluation is needed to assess health care staffing needs and skill level and optimal provider mix to deliver interventions safely and effectively while retaining health care providers on the job and pregnant and postpartum women in care.

Preconception counseling and safer conception strategies for women affected by HIV provide examples of the type of research and evaluation needed to guide the integration of service delivery. When and where on the continuum of MCH and HIV services should information about biomedical and behavioral interventions and services to support safer conception be offered to WLWH and to serodiscordant couples? How prepared are different cadres of HIV and MCH health care providers and community members to provide safer conception strategies? What facility- and community-based models are feasible and what resources are needed to ensure quality and coverage? Implementation research is needed to answer these questions and to assess the impact of information and service provision on reproductive behaviors, vertical and sexual HIV transmission, and maternal health outcomes. Additional questions about

integrating interventions to support the reproductive choices of WLWH and to prevent, diagnose, and treat tuberculosis and malaria with MCH and HIV services are noted in Table 1.

SOCIETY: CREATE AN ENABLING ENVIRONMENT FOR WOMEN TO BEGIN AND CONTINUE IN MCH AND HIV CARE

Do Programs Designed to Reduce Disrespect and Abuse in Maternity Care, HIV-Related Stigma and Discrimination, IPV, and Increase Supportive Involvement of Male Partners Improve Maternal Health Outcomes?

Gender discrimination and HIV-related stigma violate human rights and contribute to poor health outcomes, in part by creating barriers to women's utilization of essential maternity and HIV services. Anticipation or experience of disrespect and abuse in maternity care and HIV-related stigma and discrimination, including internalized stigma, have been associated with avoidance of skilled delivery, refusal of antenatal HIV testing, and for WLWH, not enrolling in HIV services, and reduced adherence to ART for prevention of vertical HIV transmission.[64–66] One of the most egregious forms of gender discrimination, Intimate Partner Violence (IPV), is associated with increased likelihood of acquiring and living with HIV[66–68] and with poor reproductive health outcomes among all women.[69–72] Qualitative research indicates that experiencing IPV can be a barrier to accessing HIV care and ART adherence for women in Africa.[73] Studies from the United States and Canada associate IPV with reduced ART adherence, detectable viral load, and less engagement in HIV care.[74–76] There is an urgent need to evaluate if facility- and community-based interventions that reduce disrespect and abuse during childbirth, HIV-related stigma, and IPV result in improved uptake and retention in care and better maternal health outcomes.[64,77–81] Interventions, such as IMAGE and Stepping Stones, are particularly promising as they have been shown to simultaneously reduce IPV and HIV-related stigma and increase measures of women's empowerment,[80,81] indicating the potential to address multiple social determinants simultaneously.

Research and evaluation of male involvement in HIV and MCH care is a related priority. When men attend prenatal care visits with their female partners and choose to test for HIV or women disclose their HIV status to male partners during pregnancy, male involvement has been associated with improved implementation of interventions to prevent vertical HIV transmission.[82–84] Similarly, when women choose to disclose their HIV status, family-centered care has successfully engaged men and supported women to remain in care.[85] However, how best to involve men systematically is a knowledge gap. For example, while some models of promoting couple counseling and HIV testing during pregnancy show promise for engaging men and assisting women with safe disclosure,[86] others have resulted in half of the pregnant women asked to bring their male partner not returning for antenatal care.[87] Research is needed to develop and evaluate programs that involve male partners while safeguarding women's access to and retention in care, safety, and autonomy.

In addition, policymakers and programmers should seriously consider the evidence associating participatory women's groups with reduced maternal mortality,[88] and showing that community mobilization and peer support increase supply of, demand for, and implementation of interventions to prevent vertical HIV transmission, in addition to improving pregnant and postpartum WLWH's retention in care.[15,89–91] Existing evidence indicates that further investment in and evaluation of strategies that actively involve and engage community members, including people living with HIV, is warranted.

Interventions designed to create an enabling environment for women to begin and remain in care and treatment should be sensitive to the diversity of women's experiences and needs, including those of women who may face additional barriers because of age, civil status, ethnicity, drug use, involvement in sex work, or other factors. Evaluation should consider proximate measures, such as uptake of services, retention in care, disclosure of HIV status, postpartum depression, and adherence to ART, as well as maternal health outcomes.

CONCLUSIONS

Research and evaluation to guide clinical and programmatic practice are urgently needed to make significant progress towards reducing HIV-related maternal deaths and eliminating preventable maternal mortality in sub-Saharan Africa. Research priorities include evaluating the impact of scaled-up access to ART on maternal health outcomes and improving clinical protocols to prevent and treat the leading causes of maternal death among WLWH. To generate this information, causes of maternal death data must be improved, as must facility-based information on pregnancy-related outcomes including HIV status, ART use, and maternal morbidities. Additionally, improving the availability and accuracy of data from routine program monitoring that permits analysis of the outcomes of pregnant and postpartum WLWH is critical.

More evaluation of integrated models of care to understand how HIV testing, care, and treatment during antenatal, labor and delivery, and postpartum care can be better delivered is also important. A nuanced understanding of program models, including community support systems, which improve uptake and retention in care and their effects on maternal morbidity and mortality, is needed. Critical to this understanding is implementation research on how to incorporate screening and treatment for tuberculosis and malaria, preconception counseling, and contraception without sacrificing coverage or quality of other core MCH and HIV services. Disease burden, causes of maternal deaths at the community and country level, and the national policy context need to be considered when identifying which interventions to prioritize. Successful delivery of integrated MCH and HIV services requires further health system strengthening, including implementation research to generate a better understanding of the optimal mix of skills, staffing, and supportive supervision.

There is an increasing body of compelling evidence about the social, structural, and psychosocial barriers WLWH face when deciding to seek and remain in MCH and HIV care. Less information is available about how to overcome

these barriers. Reducing IPV, HIV-related stigma, and disrespect and abuse in maternity care, and engaging men hold promise for supporting women to access services and remain in care and should be evaluated for their effects on the maternal health of WLWH.

The expert consultation and literature review described here capture key priorities for research and evaluation to (1) improve identification of and response to leading causes of maternal death among WLWH and evaluate the effects of increasing availability of ART on maternal health outcomes, (2) enhance integrated models for delivery of critical health interventions to WLWH, and (3) identify interventions that contribute to an enabling environment for WLWH to begin and remain in care. Although we endeavored to be comprehensive by addressing different factors that influence maternal health outcomes (clinical care, models of health service delivery, and social context) and by including experts with a broad range of relevant disciplinary backgrounds and institutional affiliations, the scope of the expert consultation and literature review do not preclude the possibility that additional critical areas for research and evaluation have been omitted.

In conclusion, the availability, acceptability, and quality of maternal health care are life and death issues for pregnant women. The identified research and evaluation priorities focus on the maternal health of WLWH. However, improving the availability of data on maternal causes of death and evaluating how best to integrate service delivery to increase coverage of crucial services and creating an enabling environment for women to begin and remain in care are expected to contribute to the maternal health of all women. The Saving Mothers Giving Life project in Uganda and Zambia indicates how rapidly progress can be made on reducing maternal mortality when HIV is addressed as an integral component of maternal health and resources are pooled to strengthen existing MCH and HIV platforms to improve access to and quality of maternal health care.[92]

Research and evaluation on maternal health and HIV can increase collaboration on these 2 global priorities, strengthen political constituencies and communities of practice and accelerate progress toward achievement of goals in both areas. The investments made to reduce maternal mortality and increase access to HIV treatment in sub-Saharan Africa are significant. The scope of these investments should be reflected in support for research and evaluation that addresses priority knowledge gaps. As the global community evaluates progress and prepares for new maternal mortality and HIV targets, addressing the needs of WLWH must be a priority now and after 2015.

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