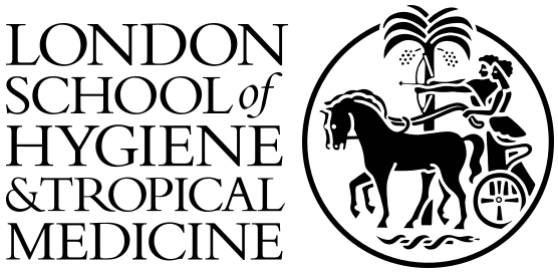

The Influence of Context on Healthcare Worker Responses to Public Health Interventions

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Declaration

I, Shari Nicole Krishnaratne, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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This PhD has been a decade in the making and I have a lot of people to thank.

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This thesis is for my grandfather, Dr. Terence Amerasinghe. How proud you would have been of what I have achieved.

Abstract

This thesis is composed of four peer-reviewed publications on which I was first author and a commentary on those publications. In the commentary, I critique and comment on these four papers. I present the commentary in two parts. In the first part, I reflect on the strengths, weaknesses, and research contributions of each paper and I reflect on how each paper has contributed to the overarching research theme of healthcare worker reactions and responses to public health interventions and if and how context might influence these reactions. In the second part, I reflect on the importance of understanding healthcare worker reactions to public health interventions and if and how this has been explored in the literature. I suggest a new approach to examining the influence of context on healthcare worker reactions and responses to public health interventions, supported by findings from my papers.

In part 1 of the commentary, I 1) explain the research concepts and approaches for each paper and why the research choices were made; 2) discuss the impact and relevance of each paper in its field at the time of publication; 3) critique the methods of each paper and discuss how they could have been improved upon to better understand the research questions that they addressed at the time; and 4) briefly discuss the relevance of the paper now, and comment on how the same research questions could be addressed now. I then comment on how the included papers have influenced my personal research interests, highlighting how the papers illustrate my journey in understanding healthcare workers, their reactions to the interventions they are asked to implement, and the role of context in influencing these reactions.

In Part 2 of the commentary, I expand on the contributions of each paper to my personal research interest by reflecting on findings from my papers as well as the current evidence on this topic. I discuss the different domains of healthcare worker reactions demonstrated in my papers and link these to the literature on healthcare workers, specifically describing the gaps in evidence about the impacts on healthcare workers in intervention evaluation. In this section, I draw on learnings from other frameworks that have sought to understand effective health intervention delivery, as well as those that describe context. I suggest a framework for

understanding how different layers of context work together to influence healthcare workers and conclude with a suggestion for next steps and for the wider applicability of the findings from my studies. I also include a reflection on my positionality and how this has shaped my interpretations within the papers in this thesis and throughout the commentary.

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Table of abbreviations

ART –Antiretroviral therapy

BMGF – Bill and Melinda Gates Foundation

CHW – Community health worker

CMO – Context-Mechanism-Outcome

HIV – Human Immunodeficiency Virus

MCM – Modern contraceptive methods

MSM – Men who have sex with men

PLHIV – People living with HIV

PopART – Population Effects of Antiretroviral Therapy to Reduce HIV Transmission

QLR – Qualitative longitudinal research

UTT – Universal test and treat

WFP – World Food Programme

Section 1: Analytic Commentary

Introduction

This thesis is comprised of a critical review of four papers on which I was first author and a reflection on what I have learned from these papers, and from my skills development during the research from which these papers were produced, with a view to how I can take these learnings and apply them in future research. Upon reviewing the four papers, I reflected that these papers and their findings are connected by a common thread of exploring if and how context influences healthcare workers and their reactions and responses to public health interventions. I did not set out to write any of these papers with this common thread in mind, and as such, this thesis alone cannot and does not draw major conclusions about influences on healthcare workers. However, it does use findings from the four papers to develop a framework of interacting spheres of contextual influence which demonstrates how multiple contexts can be layered to influence healthcare worker reactions to public health interventions. This framework views context as interactive between domains, fluid, and multi-layered. I am using the framework developed in this thesis in my current research to understand the implementation of malaria control interventions through a variety of delivery models and am finding the framework to be useful for understanding these increasingly complex interventions and their implementation with multiple different stakeholders, disciplines, and interests at play.

Part 1

This section presents an overview of each of the four papers presented in this thesis by describing the rationale for the research choices made in each paper, a discussion of the overall relevance and impact of each paper at the time of publication and now, and an assessment of the strengths and weaknesses of each paper. For each paper, I also discuss how it contributed to my overarching research interest of if and how context influences healthcare worker responses and reactions to public health interventions.

Paper 1

The first paper included in this portfolio is a systematic review of reviews of interventions to strengthen the HIV prevention cascade (1).

Explanation of research concepts and approaches

This paper began as a small scoping review to describe the evidence on structural interventions to prevent HIV, commissioned by the Bill and Melinda Gates Foundation (BMGF). After I initially conducted this smaller scoping review, I was asked to lead a much larger review to assess the current state of the evidence on HIV prevention interventions. The goal of this review was to contribute evidence to the development of the HIV Prevention Cascade, an approach to understanding HIV prevention interventions and when and how they should be implemented to achieve the best coverage. The cascade suggests that high intervention coverage can be achieved by focusing on three key domains of interventions: supply-side interventions that make prevention technologies accessible and available; demand-side interventions that increase awareness and acceptability; and adherence interventions that promote the adoption of prevention behaviours (2, 3). Given the short timeline and limited human resources available to carry out this work, my approach was to conduct a systematic review of reviews and to apply systematic review methodology to search for and summarise the evidence on HIV prevention. This paper used modified approaches for screening reviews, quality appraising review findings, and extracting data from studies included in those reviews. Using these modified approaches allowed for the

quick identification of a wide body of literature that had been published on HIV prevention. Studies within reviews were classified using the HIV prevention cascade typology developed in collaboration with BMGF and other colleagues involved in the larger project. Using this classification system was helpful and allowed for the mapping of studies across the prevention cascade, which in turn informed the wider work to develop the BMGF's HIV prevention platform.

In lieu of a formal critical appraisal process, the type and direction of the evidence, including outcomes, were assessed and reported on using an adapted framework from another similar review (4). This approach is not dissimilar to the standard GRADE assessment that is a recommended standard for systematic reviews, and given the limited timescale for this review, it was a useful system for assessing the strength of the evidence (5).

Impact and Relevance of paper at the time of publication

This paper was conceived and written in response to a call from the BMGF in order to inform their HIV prevention platform, and to inform the wider HIV Prevention 2020 Framework (2). It was presented alongside a series of other papers describing the HIV prevention cascade, and the financing of HIV prevention interventions, in a special issue of the Lancet HIV which was launched at a satellite session at the bi-annual conference of the International AIDS Society in 2016. At the time, this review was an essential component for informing BMGF's HIV prevention programming and funding. Also at the time, a review of the literature on HIV, presented alongside the HIV prevention cascade, had not previously been undertaken. The findings from the review were therefore very useful and widely cited. By mapping evidence across the HIV prevention cascade, findings were presented in a way that was useful for programme designers and developers as well as implementers and could inform research that would ultimately influence HIV prevention policy. The review informed a book chapter on the cost effectiveness of HIV prevention interventions in Disease Control Priorities, a publication by the World Bank (6). The review was also cited by a key paper describing the utility of the HIV Prevention Cascade, which was in turn cited by several primary studies describing HIV prevention interventions (7-11). The review highlighted the fact that many effective HIV prevention interventions used a combination of strategies which address structural and behavioural barriers to the uptake and use of HIV prevention technologies. It

also highlighted the relative lack of strong evidence on interventions to promote adherence to biomedical HIV prevention technologies. These findings were also important and relevant for the HIV prevention 2020 framework which set ambitious goals of reducing new HIV infections below 500 000 by 2020 by increasing coverage of the direct mechanisms of HIV prevention. This review mapped the relevant evidence that was needed to inform programming to increase demand for HIV prevention technologies, improve supply of prevention tools, and support adherence to safe practices, all of which are components of the HIV Prevention cascade (2).

Critique of methods

At the time of publication, a review of reviews of HIV prevention interventions of this scale had not previously been undertaken, and in using this method, I was able to summarise evidence from dozens of primary studies in a short timeframe. Using this review of reviews approach was helpful because there were multiple systematic reviews on the topic, and because a new syntheses from these existing systematic reviews was needed in order to inform new research questions (12). This review built on published methods for reviews of reviews by selecting subsets of studies contained in the included reviews and using modified methods for quality appraising included studies.

While this review produced detailed results to describe the existing evidence on HIV prevention interventions, there are limitations to its method and approach. Firstly, the use of the HIV prevention cascade to map findings was useful because it allowed for a clear division of studies into three categories, which aided understanding of where intervention impact was most likely to be made. However, in using the cascade to determine the types of studies that could be included, namely only studies assessing four key outcomes (HIV incidence, HIV prevalence, condom use, and uptake of testing), the review was unable to describe evidence about other related outcomes, such as uptake/use of other prevention services, including other biomedical technologies (i.e. pre-exposure prophylaxis, microbicides), but also behavioural outcomes which may have served as proximal outcomes (i.e. intention to use condoms or intention to access testing). Further, the review rating approach that we used meant that studies that used randomised control methods were automatically rated as being the highest quality and carrying the most weight. Given the nature of HIV prevention

research, this approach made sense when assessing biomedical interventions which were very often described in included reviews. However, for studies assessing behavioural interventions, or interventions providing knowledge and information to populations, randomized trials were often not used, and other types of observational studies were more common. These studies were given lower ratings and assessed as being of lower quality. The importance of looking at evidence from non-randomized methods to evaluate these types of interventions was not accounted for in the review, even though it has been acknowledged that randomised trials may not always be the most feasible or useful study method for understanding HIV prevention outcomes (13, 14).

Using the prevention cascade also limited the way that studies could be categorised and described. Primary studies contained within the reviews were allocated into one category only based on what was judged to be the most prominent component of the study, despite the fact that many interventions included components targeting more than one of the three cascade domains of supply, demand, and adherence.

Current relevance of paper and addressing methodological limitations

Evidence on HIV prevention described using the HIV prevention cascade has reduced over time and current literature suggests a shift from looking at individual interventions to recognizing that no single prevention method or approach is enough to prevent HIV. While this review was clearly an important contribution to the evidence base on HIV prevention at the time of its publication, and although it informed the use of the HIV prevention cascade for HIV prevention programming, its narrow focus, and the fact that the landscape of HIV prevention has developed so rapidly, means the utility of the review *per se* is lower now than it was when published. That said, the synthesis of findings from the review continues to be relevant, in HIV and other literature owing in part to the scale of the review and the number of studies included, and therefore the size of the overall body of evidence presented. Reviews and commentaries discussing access to HIV services among men, and adolescents have referenced the review's finding that the most impactful HIV prevention strategies are those that use a combination of interventions that are effective, acceptable, scalable and address multiple key risk factors for HIV transmission (15), and that targeted interventions are often useful for inducing behaviour change (8, 11, 16). The review has also been cited in

recent literature about Covid-19. A recent commentary on multidisciplinary approaches to the Covid-19 pandemic cited the review's findings that a combination of structured community mobilisation, targeted social protection, and differentiated health-care delivery were elements of successful behaviour change interventions (17). Another commentary discussing refugee health during the Covid-19 pandemic cited evidence from the review which highlighted the need to prioritize vulnerable populations in community engagement activities in order to ensure inclusivity (18).

To reach current targets to diagnose 95% of all HIV-positive individuals, provide antiretroviral therapy (ART) for 95% of those diagnosed and achieve viral suppression for 95% of those treated by 2030, the '95-95-95' targets (19), stronger evidence is needed about not only what works but for whom, and under what circumstances. As written, the review only provides insight into one part of this question and cannot inform decision making about how interventions should best be implemented to reach different target populations. A landscaping review of reviews such as this one, done today, would need to be broader, searching for and including reviews and studies that assess outcomes beyond the four included in the review, and that also focus on process and implementation outcomes. Using this approach, the review would capture studies that describe contextual factors that might influence intervention delivery and uptake. Indeed, the cascade does describe the need to include interventions to support adherence to HIV prevention technologies which are often best understood using a range of different methods (20).

How does this study contribute to my research interest

This review described studies across the HIV prevention cascade, including supply-side, demand-side, and adherence focused interventions.

What was evident from many of the included studies that described effective interventions, was that healthcare workers were usually key to implementing these interventions, particularly interventions focussed on counselling and testing (21-24). An example of an intervention where this was evident is the MEMA Kwa Vijana study in Tanzania which assessed an intervention that provided primary school students with sexual health education through a participatory programme combined with training for healthcare workers (25).

Other successful interventions focused on the use of counselling services to influence behaviours and relied on the use of healthcare workers and community-based health educators (26). Counselling interventions were most often delivered via health facilities through interactions between healthcare workers and patients or in community settings by providing either individual, couple-based, or group-based behavioural strategies to reduce HIV risk behaviours (27-29).

Recognising that healthcare workers were key to intervention success, I developed a research interest in understanding what factors influenced them and the way that they reacted to interventions, either positively or negatively. In HIV care, there remain lofty targets for scaling up treatment and reducing transmission drastically (19, 30). To reach current 95-95-95 targets by 2030 (19), it is clear that trained, mobilised, and motivated healthcare workers are needed to implement interventions. Recognizing also that many of the interventions described in the included studies relied on healthcare workers in a range of contexts, drew me to the idea of trying to understand the factors that influence the way that healthcare workers react to the interventions they are being asked to implement. This research theme has developed over time and throughout my academic career.

Paper 2

The second paper included in this portfolio assessed HIV-related stigma and judgement among healthcare workers involved in the delivery of a Universal Testing and Treatment intervention for HIV (31).

Explanation of research concepts and approaches

This paper describes findings from the baseline analysis of data collected from a cohort study of healthcare workers on their attitudes towards delivering services to people living with HIV (PLHIV) and three key populations within communities taking part in the HPTN 071 (PopART) trial. PopART was a three-arm cluster randomised trial comparing universal testing and treatment (UTT) for HIV and referral to prevention and treatment services in Zambia and South Africa. The 'Stigma Ancillary Study' included integrated quantitative and qualitative data collection and analysis in all trial sites. Quantitative data on indicators of HIV-related stigma were collected from large probability samples of community members, healthcare workers and people living with HIV in parallel, along with qualitative data, from members of these same groups sampled purposively.

There were three hypotheses for the Ancillary study: 1) that the PopART intervention might change the levels of HIV-related stigma in the community by normalizing HIV testing and treatment, and relieving the burden on healthcare workers involved in delivering targeted interventions, which may exacerbate stigma in the community; 2) that HIV-related stigma may undermine the PopART intervention and reduce its impact; 3) that the intervention may change the types and forms of HIV-related stigma in the community.

At the time of data collection, I was the study coordinator and lead statistician for the Ancillary study. I worked closely with the study co-Investigators to develop the study protocol and healthcare worker survey, and to finalise an analysis plan for this component of the work. As this Ancillary study was situated within a large trial, we were presented with the unique opportunity to collect the same data from several different participant groups. This parallel

approach to data collection meant that we were able to understand if and how stigma affected the delivery and uptake of the intervention using multiple perspectives and to triangulate findings across populations (32). Validated scales for assessing HIV stigma and discrimination in health facilities were utilised to understand different domains of stigma (33). Healthcare workers were asked the same questions about PLHIV and key population groups allowing for comparability of responses towards populations. Healthcare workers included health facility-based healthcare workers, as well as community-based healthcare workers, and a cadre of community healthcare workers that were recruited and trained specifically for the PopART intervention. This was a large and robust study on stigma in the healthcare setting and was a fundamental component of the larger PopART trial.

Impact and Relevance of paper at the time of publication

The hypotheses driving this study were based on available evidence at the time which suggested that HIV-related stigma had acted as a barrier to HIV testing, status disclosure, and uptake of treatment (34-37). At the time of this study's conception, while there was a growing body of literature discussing if and how stigma influenced HIV prevention interventions, a quantitative survey using validated measures to assess stigma from large population samples of healthcare workers, community members, and PLHIV across multiple countries, had not been done, so this was a unique study at the time of publication. While this paper alone was unable to fully describe the impact of HIV-related stigma and judgement among healthcare workers involved in the PopART trial, the analyses in this paper formed the basis for other papers and analyses from the trial that went on to describe if and how healthcare worker stigma and judgement influenced trial outcomes (38, 39). Collectively, these papers formed an evidence base that described stigma among healthcare workers involved in PopART, and whether this stigma influenced delivery and uptake of the intervention.

At the time of publication, few studies that measured HIV-related stigma among healthcare workers in the context of an ongoing intervention existed where data on experienced stigma, and treatment uptake were also being collected. I reviewed the literature in 2017 and identified several studies that attempted to measure or describe HIV-related stigma among

healthcare workers; the majority of studies used one-time cross-sectional study designs to capture healthcare workers responses to questions about their attitudes towards providing HIV care, and towards PLHIV (40-43). They did not simultaneously measure experienced stigma among PLHIV or key populations, nor did they measure HIV-related outcomes. As such, this paper and analysis was unique in its contribution to the literature and was cited by other studies based on PopART data and published at the same time describing the impact of stigma and judgment among healthcare workers on uptake of HIV services (44, 45).

Critique of methods

The objective of this paper was to compare levels of stigma and judgment toward different population groups, and between different cadres of health workers, and to identify risk factors for stigmatizing attitudes among healthcare workers involved in the PopART trial. The study succeeded in achieving its aims and was able to describe the levels of stigma reported by included healthcare workers, and to describe risk factors for stigmatizing behaviours, however, there were some limitations. First, the study assessed stigmatising attitudes and beliefs against knowledge about HIV and key populations, co-worker attitudes, and training on providing care. It did not ask about broader societal factors such as awareness campaigns in the community about HIV, national policies about HIV or key populations, or about myths or rumours about HIV in the community. It also did not ask about broader work-related factors such as workload, or employment conditions. There may therefore have been other risk factors that were not assessed but that may have influenced healthcare worker attitudes. Further, while the questionnaire asked healthcare workers about their experience of job stress, responses to those questions were not included in the published analysis. This assessment was conducted in subsequent publications using data from this study in longitudinal analyses of the PopART intervention, but these papers were not focused on healthcare workers or stigma and the findings may have been diluted by other findings presented in that paper (45, 46). A baseline analysis of job stress among healthcare workers would have strengthened the findings of this study and allowed for a more holistic picture of the key risk factors for stigmatising attitudes among healthcare workers.

Second, while the use of scales can be useful when trying to quickly assess attitude-related questions (47) and such scales have been developed and used to measure HIV related stigma in a range of different settings (48), the scales used in this study (4 responses on a scale of strongly disagree, disagree, agree, strongly agree) were narrow, and did not give participants the option of 'agreeing somewhat' with any of the statements nor did they allow participants to select a neutral response. There were strengths and weaknesses to having a neutral option when using this scale. The absence of a neutral option meant that participants were forced to either choose a 'side' or to abstain from answering the question. Participants not wanting to choose an option may have abstained from responding to the questions. In our analyses, we only used data from participants who answered all of the questions for each stigma domain. Participants may have felt that the narrow scale options did not represent their views and chosen to abstain, and these people were excluded from our analyses meaning that our sample may not have been representative of the participants. There was rationale for not including a midpoint and there is some evidence to suggest that neutral response options can reduce the validity of scales (47). Participants may have chosen a 'neither agree nor disagree' option if it was available even if their opinion was not truly neutral and simply because they felt that the other responses were not representative of their opinion. Participants might have also chosen a neutral option if they felt unfamiliar with the questions and did not know how to answer, rather than abstaining from answering (47). There is also some evidence to suggest that participants might choose neutral options to avoid what they think of as socially undesirable attitudes or opinions (49).

Current relevance of paper and addressing methodological limitations

With 38.4 million people living with HIV globally and 1.5 million new infections globally in 2021 (50), the need for understanding potential barriers to HIV treatment and prevention remains high. The usefulness of data on healthcare worker stigma towards PLHIV and key populations is clear, and this paper has formed an important base for several other publications on this topic using data from the PopART trial (38, 39, 44, 45, 51).

The findings from this paper challenged conclusions from several studies that sought to understand the role that stigma plays in the delivery and uptake of HIV services in healthcare settings (35, 52-55). There was little evidence, from this paper, that HIV-related stigma

influenced the way that healthcare workers delivered care; these findings were in contrast to studies describing the perceptions of PLHIV about the sigma they experienced when accessing care in health settings. It is important to note that healthcare worker perceptions of the way they deliver care might not always align with patient's perceptions of their experiences of care and this may explain some of the conflicting evidence. Contextual factors and differences in geographies may also provide an explanation for the conflicting evidence. Again, while this study alone was unable to describe the impact of healthcare worker stigma towards PLHIV and key populations, it was a key component of a wider analysis that described the association between healthcare worker stigma and HIV outcomes within the PopART trial. Further analyses using data from this cohort at baseline and in subsequent rounds of data collection, and citing this paper, found no evidence of any association between HIV-related stigma within the PopART trial and risk of HIV infection (39).

An updated approach to this study might expand on the risk factors for reported stigma and include data on broader societal or political factors that potentially drive or influence stigma. A study that builds on these findings and goes deeper into understanding how these different levels of risk factors influence healthcare workers would be helpful and may highlight different areas where anti-stigma interventions could be effective.

How does this study contribute to my research interest

This paper described the levels of, and risk factors for, HIV-related stigma and judgment among healthcare workers involved in the PopART trial. It has been well documented that anticipated and experienced stigma may act as a barrier to uptake of and adherence to HIV services (37, 56) but, as a junior researcher, I questioned the working hypotheses of much of the literature that healthcare worker stigma and judgmental attitudes would translate into their poor delivery of care. The findings from this analysis clearly show that even if healthcare workers do agree with statements describing stigma and judgement, they do not believe stigma and judgement, as measured in this paper, affects the way that they deliver services. Findings from subsequent analyses of data from the same study reinforce these findings and demonstrate that there were few, if any, associations between stigma experienced in health settings and HIV outcomes (39, 44, 45).

Ultimately this paper provided insight into how important healthcare workers were in the delivery of HIV services in a context where UTT was being implemented. It also showed that healthcare worker attitudes were influenced by their education levels and their perceptions of the attitudes of their co-workers, suggesting that key contextual factors including social networks may heavily influence healthcare workers' feelings about the interventions they are delivering, which might influence the way they think about or treat clients. If healthcare workers believed that their co-workers held stigmatising beliefs towards PLHIV and the key populations studied in this paper, then they were more likely to hold stigmatising attitudes and beliefs themselves. Healthcare workers who perceived that their co-workers either talked badly about their clients living with HIV or treated them poorly were more likely to hold stigmatising attitudes, with healthcare workers who strongly agreed with the statement that their co-workers treated PHLIV poorly or talked badly about them being more likely to believe that ''other people deserve access to health services more than PLHIV'' or that they would ''prefer not to provide services to PLHIV."

There is compelling evidence from this study that context influenced the healthcare workers who were interviewed for this study. These healthcare workers were influenced by the views and behaviours of their co-workers – which influenced their own personal levels of stigma and judgement, as measured by the study. However, it is not possible, from this study, to say that stigma influenced the way they delivered services, or the way that they reacted to the intervention. Moreover, the experience of studying healthcare workers and their reactions, motivations, and perceptions in this study was influential to me as a researcher, and I took the learnings and experiences from this study into my subsequent research to explore this topic in more detail.

Paper 3

The third paper included in this portfolio describes findings from a realist evaluation implemented in Ethiopia (57).

Explanation of research concepts and approaches

This study was conceived in response to a request from the funder to conduct an evaluation of an intervention of integrated family planning and immunisation services in Benin, Ethiopia, Kenya, Malawi, and Uganda and this paper describes the findings from Ethiopia. As implementation of the intervention was nearing the end when the funder requested the evaluation, and in the absence of any strong monitoring data to demonstrate any process or impact outcomes, the study Principal Investigator (PI) made the decision to undertake a realist evaluation in order to describe how implementation happened, and particularly, to interrogate if and how the intervention worked for whom and under what circumstances.

A meeting with intervention implementers took place in order to develop an initial programme theory that described the way the intervention worked. This programme theory was used to map stakeholders involved in the delivery and uptake of the intervention and to guide the development of interview questions to ask these stakeholders. This initial mapping exercise was a key component of the study, particularly as the intervention had been implemented for 18 months before the evaluation took place, and programme implementers had good knowledge about how implementation was happening. I worked directly with implementing partners in Ethiopia to conduct and facilitate semi-structured interviews and focus group discussions with stakeholders.

The use of realist methods for this evaluation was logical given the fact that the intervention had been implemented for several months and was nearing completion as well as due to the complexity of the intervention. Realist evaluation is useful when seeking to understand complex social interventions whose outcomes are dependent on context and implementation (58). While the implementing partners provided monitoring data, this data was not adequate,

(mainly due to the lack of denominators) to quantify any changes in uptake of family planning or immunisation services. Using a realist approach allowed us to understand implementation processes, and key factors that drove, or hindered, implementation. The approach to analysis was to determine key mechanisms that were triggered by contextual factors and to test the initial programme theory. These mechanisms were mapped against three published theoretical frameworks, the Theoretical Framework of Acceptability, the Diffusion of Innovations Framework, and the Access Framework (59-61). A revised programme theory comprised of context-mechanism-outcome (CMO) configurations was developed.

Impact and Relevance of paper at the time of publication

While several studies had used realist evaluation methods to evaluate a range of different public health interventions, to our knowledge, few, if any, realist evaluations of a family planning intervention had been done at the time of publication. Given the relative newness of using this approach to study this topic, I presented the study protocol and proposed methods at a protocol workshop for the Centre for Evaluation at LSHTM.

This study analysed and described findings taking a slightly different approach to that of published realist evaluations at the time, by mapping identified mechanisms against published theoretical frameworks. By linking the study findings to these frameworks, we aimed to present findings that would encourage cumulation of evidence from other studies to contribute to understanding and determining transferability across geographic sites, together with the role of context within this transfer. The theoretical frameworks that were used to map findings were chosen because they were focused on implementation and therefore had the potential to aid our understanding of the mechanisms driving intervention implementation. Linking mechanisms to published frameworks increased the utility of findings and increased the potential of findings to contribute to improved programming for family planning, immunisations, and integrated health services. In taking an implementation science approach, the findings from this study went beyond understanding outcomes at the end-user level, understanding outcomes at the level of healthcare workers, programme implementers, and programme designers (62).

While the use of this approach was novel at the time of publication, the evaluation of an intervention that integrated family planning and immunisation services was also unique. Few evaluations of integrated family planning and immunisation services had been conducted at the time, with many looking at the integration of either one of these services with another service, but often not these two services together (63-70). This study contributed to a growing body of literature, supported by other papers led by colleagues analysing data from other countries involved in the same intervention, that sought to describe and understand the uptake of integrated family planning and immunisation services (71-75).

Critique of methods

The objective of this paper was to describe how, why and for whom, the process of intervention implementation worked. Given the fact that implementation had been ongoing for several months, and the lack of strong monitoring data, the use of realist methods was a practical option for evaluation. The stakeholder mapping and programme theory development that took place prior to data collection was helpful as it ensured that the interview guide was asking appropriate questions and that the opinions of the most pertinent stakeholders were being sought.

One key limitation was the small sample size which was due to time constraints. This paper describes findings from one out of five countries where intervention implementation took place, and data were collected from all five countries within a short time span. In Ethiopia, semi-structured interviews were conducted with 23 participants, and while all pre-identified stakeholders were included, a larger sample size of the same stakeholders would have contributed information on variability within stakeholder groups, which would ultimately have strengthened the overall findings of the study. The CMO configurations that were developed using the available data were well-informed and supported by findings, but more may have been uncovered with more data. In particular, only one woman was interviewed specifically as a user of family planning. While other women were interviewed, they were considered members of other stakeholder groups and were asked questions specific to those groups. More data from women using and not using family planning would have strengthened the findings.

Current relevance of paper and addressing methodological limitations

The utility of the findings from this paper has remained high since its publication and there is a continued need for data evaluating and describing family planning interventions. Estimates on the unmet need for family planning globally suggest that more than 160 million women and adolescents who wanted to avoid pregnancy were not using contraceptives in 2019 (76). Addressing this unmet need is a key component of the Sustainable Development Goal of universal access to family planning (77). There remains a need for information to inform decision making around programming for family planning and, because this paper interrogates the mechanisms that drove, or hindered, intervention implementation, it provides invaluable insight into what interventions might work, for whom, and under what circumstances when trying to improve family planning outcomes.

The findings from this paper have been cited in recent literature, and the mapping of findings against published theories has proved to be particularly useful. For example, the perceived reduced work burden of delivering family planning and immunisation through household visits increased the acceptability of the intervention for healthcare workers because it triggered mechanisms of self-efficacy. These findings contributed to literature on healthcare worker burden and workload and were cited by literature exploring healthcare worker agency and empowerment (78, 79). My key finding that religious leaders needed to see that family planning was compatible with their religious beliefs in order to accept and promote it in the community, has important implications for programmes that seek to engage religious leaders in public health interventions including family planning and beyond and has been cited in the literature exploring the influence of religious leaders on the implementation of a family planning intervention in Burkina Faso (80).

In addition to evaluating the intervention, this paper added to research that explores the use of context and mechanisms to explain integrated interventions and the use of published theories to map mechanisms and aid cumulation and abstraction of findings (73). Findings from this study were featured in a paper led by the study PI that describes the development of context-acceptability-theories (CATs) to summarise the mechanisms of acceptability that were triggered for specific stakeholders in specific contexts. These CATs are transferable

theories that could be generalised to other geographies or settings and describe what mechanisms need to be triggered in order to achieve outcomes (73).

How does this study contribute to my research interest

This paper presents evidence that contextual factors influenced the way that healthcare workers involved in the intervention reacted and responded to the intervention. In Ethiopia, the cadre of healthcare workers involved in intervention delivery were Health Extension Workers. Health extension workers play a key role in health service delivery by providing primary health services at health posts in rural communities and filling gaps in healthcare coverage in more remote areas of the country (81). The study findings showed that health extension workers perceived a decrease in their workload with the introduction of the intervention, and therefore a reduced work burden given the integration of family planning with immunisations. This meant that they viewed the intervention positively and felt that providing both services together had more impact than providing them alone. These positive feelings towards the intervention meant that these health extension workers wanted to implement the intervention. Further, training on intervention provision was viewed positively, with practical exercises and clinical coaching considered particularly helpful. This meant that health extension workers were confident in their ability to provide family planning services to women in the community and that integrated services were provided effectively. The intervention did not provide training to health extension workers on all aspects of family planning and this left health extension workers feeling limited in their ability to provide services. This is explored in more detail in Part 2 of this commentary and in the paper. Linking study findings to previously published theories was insightful and uncovered key mechanisms helped describe how health extension workers felt about the intervention, and by observing where and when these mechanisms occurred, the influence of context on the way that health extension workers reacted or responded to the intervention is clear.

Paper 4

The final paper in this thesis describes data from a realist evaluation that took place over two time points in Uganda (82).

Explanation of research concepts and approaches

This paper describes an evaluation which expanded on that described in Paper 3. As in Paper 3, this study was originally conceived in response to a request from the funder to conduct an evaluation of an intervention of integrated family planning and immunisation services in Benin, Ethiopia, Kenya, Malawi, and Uganda. Due, in part, to the success of the study team, the funder decided to extend the implementation of the intervention and evaluation in four of the five countries, of which Uganda was one. This presented the study team with the opportunity to implement a process evaluation with quantitative and qualitative elements, in order to understand implementation of the intervention. This paper describes data from the qualitative component of this process evaluation which used realist methods to understand the uptake and delivery of the intervention, as well as data from the first, smaller, realist evaluation described in Paper 3.

The overall objective of this paper was to understand if and how prevailing contextual factors influenced acceptability and use of modern contraceptive methods (MCMs) in a pastoral community in Karamoja, Uganda and what mechanisms were triggered by these contextual factors. This paper made the distinction between family planning and MCMs as there was a heavy reliance on natural family planning methods within the study community, and the goal of the intervention was to increase the use of modern, non-natural methods.

The opportunity to conduct a second round of data collection allowed the study team to explore changes over time in the implementation and delivery of the MCM intervention. As in Paper 3, we used qualitative methods and realist evaluation concepts to understand the mechanisms that drove implementation and uptake of the MCM intervention. This involved in-depth interviews with key stakeholders based on an initial programme theory that was developed with implementing partners. Findings from the first round of data collection

informed the development of interview guides for the second round of data collection, and, in the second round of data collection, participants were presented with relevant CMO configurations and asked to confirm whether they believed the statement was true at the time of round 1 data collection, whether it was true during the second round of data collection, and why or why not in each case. This allowed for an understanding of if and how implementation had changed over time.

As in Paper 2, the approach to analysis was to determine key mechanisms that were triggered by contextual factors and to map these against published theories, the Theoretical Framework of Acceptability and the Diffusion of Innovations framework, and in doing so, to present findings that could be transferable to other geographic sites (60, 61).

Impact and Relevance of paper at the time of publication

Like with Paper 3, this paper was published alongside multiple other papers describing data from this same project and together, they form a strong evidence base describing not only the integration of immunisations and family planning, but the use of realist concepts to understand and describe implementation (57, 71-74, 83). While these studies described similar data and explored implementation of the same intervention in different countries, this paper was the only one that conducted an analysis of data across two time points. The process of refining and testing an initial programme theory was unique to this paper and allowed the opportunity to show changes over time in prevailing contextual factors and how these changes influenced the acceptability of an intervention. The paper highlighted several contextual factors that triggered mechanisms of acceptability of the intervention. In doing this, this paper contributed to the evidence base of studies describing delivery and uptake of family planning services, including other studies on this specific intervention (57, 71-74, 83-85).

By describing key contextual factors that ultimately influenced outcomes, the paper also described the influence of social and cultural norms, and of broader contextual factors, on the acceptability of MCMs. Further, the paper also explored how acceptability of interventions can shift over time due to shifts in contextual factors, and also how interventions themselves can influence and change contextual factors.

As with Paper 3, this paper provided important findings that were relevant for the Sustainable Development Goals, particularly Goal 3.7, *to ensure universal access to sexual and reproductive health-care services, including…family planning*, and Goal 5.6 to *ensure universal access to sexual and reproductive health and reproductive rights (77, 86)*. In order to achieve these targets, evidence that describes factors that influence the effectiveness of family planning interventions is crucial.

Critique of methods

Building on the methods used to understand the same intervention in Ethiopia, this paper used qualitative methods and realist evaluation concepts to analyse data collected at two time points to understand contextual factors that influenced the implementation of the intervention. There is limited literature that describes the use realist methods over time and, to our knowledge, ours was a novel approach (87, 88). While not a longitudinal study in that it did not collect data from the same participants at both time points, this study was nonetheless able to draw conclusions about changes over time by asking similar questions of participants, and also by asking participants to confirm or refute findings drawn from data from the first round.

There were some limitations to the methods and approach of this paper. A longitudinal approach would have ensured that the study accurately captured changes over time, because it would have asked the same participants to confirm or refute CMO configurations from the first round of data collection. Qualitative longitudinal research (QLR) can be used to understand how and why processes affect different populations in different ways over time. It can be useful for understanding how things change and evolve over time and this approach might have strengthened the utility of this paper (89). Such an approach was not possible because this evaluation was initially commissioned as a standalone piece of work. It was not until after the first round of data had been collected that the funder extended implementation of the intervention, and therefore, the scope of the evaluation.

Second, the second round of data collection was embedded in a larger process evaluation that took place in all intervention countries except Uganda. This meant that even though

quantitative data on MCM and family planning uptake were captured and analysed in the other countries, these data were not available for this paper and analysis. A full process evaluation would have allowed for the triangulation of findings across methods and could have demonstrated if and how uptake of MCMs was actually taking place, adding depth to the qualitative findings. It could have shown if perceived barriers and facilitators to MCM uptake were actually affecting MCM uptake and might have better described how the intervention was being implemented. A full process evaluation in Uganda not possible due to logistical issues beyond the control of the funders and the researchers. In lieu of this, monitoring data that demonstrated the uptake and delivery of MCMs would have been useful. The minimal monitoring data that was collected and shared by programme implementers suggested a very slight increase in uptake of MCMs as can be seen in the paper.

Current relevance of paper and addressing methodological limitations

This paper was published within the past year and its findings remain relevant as the need for evidence on effective family planning interventions remains high. This paper highlighted a number of key contextual factors that continue to be explored in the literature on family planning.

A major theme from this paper was the role that the pastoralist lifestyle within the study community played on beliefs about family planning. The first round of data indicated that men typically spent several months away from the home and in the fields, doing pastoral work. In the first round of data collection, it appeared that there were relatively low levels of acceptability of MCMs among men. Over the two time points of data collection, this changed, and men were perceived to be spending more time at home than previously. This meant that couples could no longer rely on the natural birth spacing that would take place when men were away for long periods of time. There was also a shift in the perceived lack of male support for MCMs that was seen in round 1, and men were more supportive of MCMs in round 2. This was because, participants said, men could see that there were negative impacts of not being able to manage or take care of a large family, and they could therefore see the

utility and importance of MCMs. These findings have recently been cited by a study exploring gender norms and family planning among pastoralist communities in Kenya (90).

Another key theme was the long standing and deeply held fears of side effects of MCMs in the study community. This fear of side effects was a barrier to uptake of MCMs during the first round of data collection. Participants acknowledged that rumours perpetuated in the community added to these fears. However, over time these fears were reported to have subsided, and as programme implementation continued, qualitative data suggested that uptake and acceptability of MCMs increased. The second round of data indicated that, among women interviewed, fear of side effects was reducing. These findings have contributed to literature exploring the role that cultural norms and values have on the uptake of health services (91).

These and other findings from this paper remain relevant and important as targets to reduce the unmet need for family planning and to achieve universal access to family planning services persist. An evaluation that builds on the findings from this one might include additional rounds of data collection to consistently assess changes over time in communities where family planning interventions are being implemented, supplemented by quantitative data that measures delivery and uptake of services. Using these approaches, the study could contribute findings to improve implementation while interventions are being implemented, and measure whether targeted intervention changes led to increased uptake of services.

How does this study contribute to my research interest

This study described changes over time in the acceptability of an integrated family planning and immunisation intervention in Uganda, and described the contextual factors that triggered mechanisms of acceptability and if and how these changed over time.

It was clear from the data that healthcare workers were essential for the delivery of the intervention, and that the way that they responded to the intervention was influenced by the contextual factors described in this paper. In terms of fears of side effects, healthcare workers played a crucial role in ensuring the success of the intervention by educating and counselling community members about family planning and MCMs. Fears of side effects were

mitigated by healthcare workers who showed women in the community that side effects could be managed. In this example, healthcare workers responded directly to contextual factors in the community and showed how they were in terms of their reaction and response to the MCM intervention.

In terms of changes to the pastoralist lifestyle in the community, healthcare workers reported responding by emphasizing the need for, and encouraging the use of, MCMs. Again, the way that healthcare workers reacted to or responded to the intervention, in this case focusing their messaging to encourage couples and families to use MCMs, rather than just focusing on counselling women, was influenced by the context of changes to the pastoralist lifestyle in Karamoja. Healthcare workers responded by focusing on educating and sensitising couples about the challenges of having large families and the benefits of using family planning services.

My research journey

The four research papers included in this thesis were largely written independently of each other, and they describe different health topics and use different methods. However, each of the papers contributed to my belief that understanding the way that healthcare workers react and respond to public health interventions is essential for ensuring that the interventions are implemented effectively. Further, the four papers included in this thesis present an opportunity to interrogate if and how context might influence the way that healthcare workers react to public health interventions by providing evidence on a range of different health issues, cadres of health workers, geographies, and methods. As these papers were largely written before I began my in-depth research into understanding context and its role in influencing healthcare workers, I will discuss the role that context played in each of the four papers further in Part 2 of this commentary. Below I present a reflection on how each of the four papers illustrate the journey I have made in understanding health worker reactions to interventions.

Figure 1 below presents a timeline of when my four papers were written and published, along with the focus of my research at the time each paper was written.

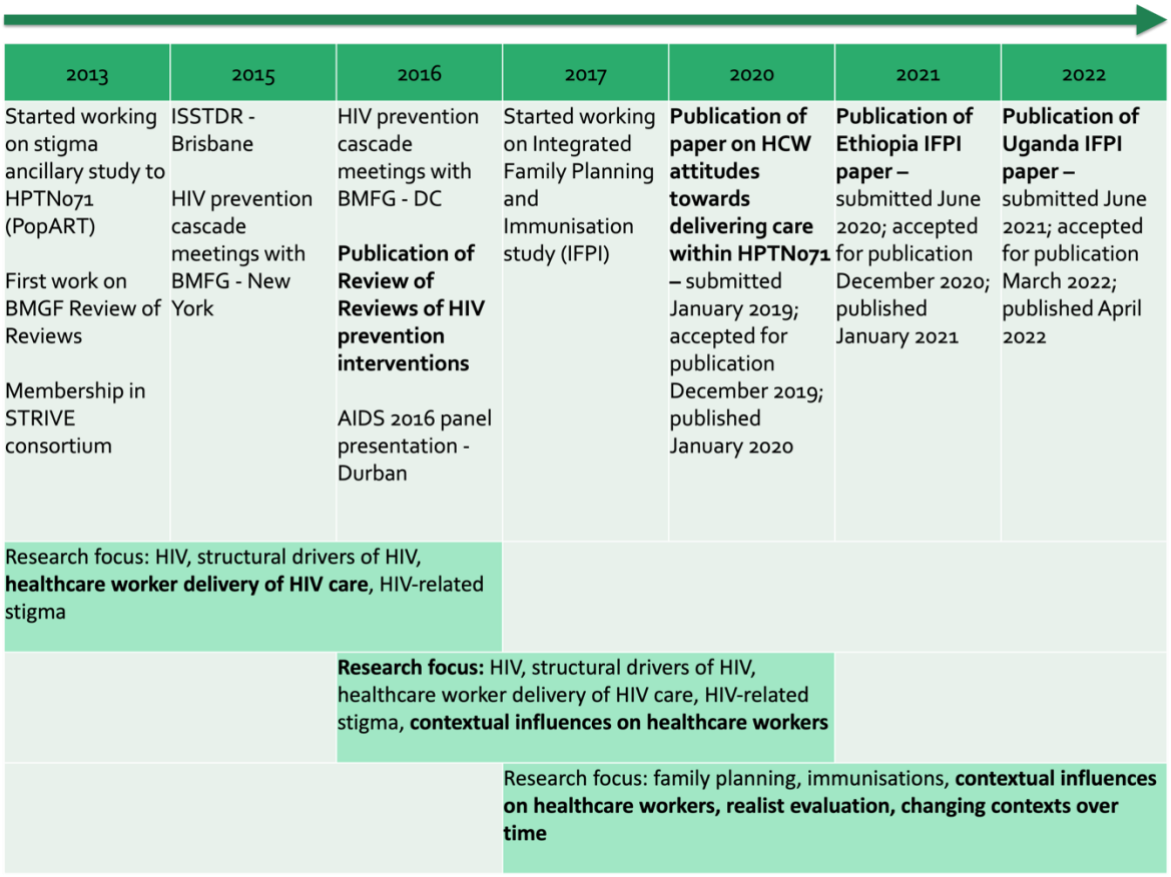

Figure 1. Timeline of Publications and research focus

*BMGF: Bill and Melinda Gates Foundation; ISSTDR: International Society for Sexually Transmitted Disease Research; HCW: healthcare worker; STRIVE: Structural Drivers of HIV,

I began the work that contributed to Paper 1 in 2013. While this paper was not directly focussed on healthcare workers and their reactions to interventions, it gave me insight into the role that healthcare workers played in the delivery of HIV prevention interventions which shaped both my interest in healthcare workers and my future approach to research. It also coincided with my work on the STRIVE (Structural Drivers of HIV) consortium at LSHTM which looked at the structural drivers of HIV in India, South Africa, and Tanzania. This consortium produced research and publications that often focused on healthcare workers and the role that they played in healthcare delivery. Being part of this consortium was instrumental to my career because it exposed me to research that focused on healthcare workers and the wider health system. I co-authored several publications during my time in this consortium, and I had the opportunity to present this research at multiple international meetings and conferences where research on healthcare workers was often at the forefront (32, 92, 93). Moreover, I engaged with colleagues and stakeholders whose research focused on

healthcare workers, and stigma, and the role that stigma might play in influencing the way that those healthcare workers approached HIV prevention interventions.

At the time this paper was written, I did not have an appreciation for the wider literature about healthcare worker reactions to the interventions they were implementing, nor had I begun to study realist evaluation, or context. However, what was evident from many of the included studies that described effective interventions, was that healthcare workers were usually key to implementing these interventions, particularly interventions focussed on counselling and testing (21-24). An example of an intervention where this was evident is the MEMA Kwa Vijana study in Tanzania which assessed an intervention that provided primary school students with sexual health education through a participatory programme combined with training for healthcare workers (25). Other successful interventions focused on the use of counselling services to influence behaviours and relied on the use of healthcare workers and community-based health educators (26). Counselling interventions were most often delivered via health facilities through interactions between healthcare workers and patients or in community settings by providing either individual, couple-based, or group-based behavioural strategies to reduce HIV risk behaviours (27-29).

Recognising that healthcare workers were key to intervention success, I developed a research interest in understanding the factors that influenced them and the way that they reacted to interventions, either positively or negatively. The interventions described in this thesis involved different cadres of healthcare workers including facility and community-based healthcare workers and it is important to acknowledge that that these cadres are likely exposed to different contextual factors, and also may be influenced differently by identical factors. In HIV care, there remain lofty targets for scaling up treatment and reducing transmission drastically (19, 30). To reach current 95-95-95 targets by 2030 (19), it is clear that trained, mobilised, and motivated healthcare workers are needed to implement interventions. Recognizing also that many of the interventions described in the included studies relied on healthcare workers in a range of contexts, drew me to trying to understand the factors that influence the way that healthcare workers react to the interventions they are being asked to implement.

Paper 2, based on a study that I was working on at the time of writing Paper 1, provided an opportunity to explore this further by examining the role that stigma among healthcare workers might have in influencing their attitudes towards providing HIV care. This work introduced me to the literature that suggests that healthcare worker knowledge about HIV treatment and their attitudes towards PLHIV may influence the way that they provide services to PLHIV (36, 94, 95).

My work on the HPTN 071 (PopART) trial and my exposure to the literature exploring healthcare worker stigma towards PLHIV (34, 43, 92, 94, 96) encouraged my interest in how context influences healthcare worker reactions, and my time conducting fieldwork to collect the data presented in this paper provided useful insight into how different contexts might lead to different reactions among healthcare workers. This paper described the levels of, and risk factors for, HIV-related stigma and judgment among healthcare workers involved in the PopART trial, and my work on this study played a key role in shaping my interest in understanding healthcare workers and the factors that influence them when they are delivering care. As part of this work, I conducted in-depth interviews with healthcare workers and liaised with different cadres of healthcare workers, all providing unique insight into how the context they were working in influenced the way they approached and delivered the intervention. This was fundamental to me as a researcher.

It has been well documented that anticipated and experienced stigma may act as a barrier to uptake of and adherence to HIV services (37, 56) but, as a junior researcher, I questioned the working hypotheses of much of the literature that healthcare worker stigma and judgmental attitudes would translate into their poor delivery of care. Learning that there was a widely held belief or assumption that healthcare workers would allow their personal stigma to negatively influence the way that they provided care was eye-opening for me as a junior researcher and I was determined to prove this hypothesis wrong. I was pleased that the findings from this paper clearly show that even if healthcare workers do agree with statements describing stigma and judgement, they do not believe stigma and judgement, as measured in this paper, affects the way that they deliver services. Findings from subsequent analyses of data from the same study reinforce these findings and demonstrate that there were few, if any, associations between stigma experienced in health settings and HIV

outcomes (39, 44, 45). Nonetheless, being involved in this study and the writing of this paper drove my interest healthcare workers further, and, given the focus on stigma in this paper, I developed a clearer interest in understanding the role that contextual factors played in influencing healthcare workers.

Ultimately this paper provided insight into how important healthcare workers were in the delivery of HIV services in a context where UTT was being implemented. The findings in the paper also showed that healthcare worker attitudes were influenced by their education levels and their perceptions of the attitudes of their co-workers, suggesting that key contextual factors including social networks may heavily influence healthcare workers' feelings about the interventions they are delivering, and subsequently might influence the way they think about or treat clients. If healthcare workers believed that their co-workers held stigmatising beliefs towards PLHIV and the key populations studied in this paper, then they were more likely to hold stigmatising attitudes and beliefs themselves. Healthcare workers who perceived that their co-workers either talked badly about their clients living with HIV or treated them poorly were more likely to hold stigmatising attitudes. Healthcare workers who strongly agreed with the statement that their co-workers treated PHLIV poorly or talked badly about them were more likely to believe that ''other people deserve access to health services more than PLHIV'' or that they would ''prefer not to provide services to PLHIV."

There is evidence from this study that context influenced the healthcare workers who were interviewed for this study and this solidified my interest in context and how it influences healthcare workers. These healthcare workers were influenced by the views and behaviours of their co-workers – which influenced their own personal levels of stigma and judgement, as measured by the study. This was clearly shown in the data. However, it is not possible, from this study, to say that stigma influenced ?how healthcare workers delivered services, or how they reacted to the intervention. Moreover, the experience of studying healthcare workers and their reactions, motivations, and perceptions in this study was influential to me as a researcher, and I took the learnings and experiences from this study into my subsequent research to explore this topic in more detail. This study included both facility and community-based healthcare workers but in my analyses, both cadres of healthcare workers were grouped together and if I were to conduct the same analyses now, I would do this separately

for each cadre of healthcare worker, recognising that context might influence different cadres of healthcare workers differently.

Papers 3 and 4 represent the further development of my interest in context and how this influences healthcare workers. Through writing these papers and working on the IFPI study, I developed my skills in realist evaluation, and the understanding of the role of context-mechanism-outcome configurations. This was a natural progression for my research, and it allowed me to dive deeper into the reactions that healthcare workers have to the interventions they are asked to implement. The use of a realist evaluation for the IFPI study meant that I could interrogate if and how context influenced outcomes within the study setting.

Paper 3 presented evidence that contextual factors influenced the way that healthcare workers involved in the integrated family planning and immunisation intervention reacted and responded to the intervention. In Ethiopia, the cadre of healthcare workers involved in intervention delivery were Health Extension Workers. Health extension workers play a key role in health service delivery by providing primary health services at health posts in rural communities and filling gaps in healthcare coverage in more remote areas of the country (81). The study findings showed that health extension workers perceived a decrease in their workload with the introduction of the intervention, and therefore a reduced work burden given the integration of family planning with immunisations. This meant that these healthcare workers felt happy to provide the intervention and that they did not see the intervention as adding to their workload. These positive feelings towards the intervention motivated the health extension workers to implement the intervention. Further, training on intervention provision was viewed positively, with practical exercises and clinical coaching considered particularly helpful. This meant that health extension workers were confident in their ability to provide family planning services to women in the community and that integrated services were provided effectively. The intervention did not provide training to health extension workers on all aspects of family planning and this left health extension workers feeling limited in their ability to provide services. Linking study findings to previously published theories was insightful and uncovered key mechanisms that helped describe how health extension workers felt about the intervention, and by observing where and when

these mechanisms occurred, the influence of context on the way that health extension workers reacted or responded to the intervention was clear. This approach moved beyond the standard CMO configuration to also include the interventions and actors involved in reaching intervention outcomes. This allowed me to focus on healthcare workers specifically to understand the contextual factors they influenced them; linking findings to published theoretical frameworks allowed me to understand exactly how the individual mechanisms fit within a bigger picture of the programme theory.

Paper 4 expanded my research further and provided the opportunity to understand and describe changes over time in the acceptability of an integrated family planning and immunisation intervention in Uganda. It described the contextual factors that triggered mechanisms of acceptability and if and how these changed over time and allowed me to explore context fluidity and the ability of context to change and shift. This was a fascinating opportunity to understand context, as a researcher, and to reflect on if and how changes in the prevailing context might influence intervention delivery, and further, if and how the intervention itself might change the prevailing context. I explore this further in this thesis.

In Paper 4, it was clear from the data that healthcare workers were essential for the delivery of the intervention, and that the way that they responded to the intervention was influenced by the contextual factors described in this paper. In terms of fears of side effects, healthcare workers played a crucial role in ensuring the success of the intervention by educating and counselling community members about family planning and MCMs. Fears of side effects were mitigated by healthcare workers who showed women in the community that side effects could be managed. In terms of changes to the pastoralist lifestyle in the community, healthcare workers reported responding by emphasizing the need for, and encouraging the use of, MCMs. Again, the way that healthcare workers reacted to or responded to the intervention, in this case focusing their messaging to encourage couples and families to use MCMs, rather than just focusing on counselling women, was influenced by the context of changes to the pastoralist lifestyle in Karamoja. Healthcare workers responded by focusing on educating and sensitising couples about the challenges of having large families and the benefits of using family planning services.

Reflecting on my journey as a researcher through these papers, it is evident that my interest in understanding if and how context influences the way that healthcare workers react to public health intervention has grown over time and has been influenced by the research I have been involved in, and the experiences I have had as a researcher. While Paper 1 focused my interests on healthcare workers, paper 2 expanded on it, and also drew me to want to understand context and if and how it influences healthcare workers. Papers 3 and 4 provided the opportunity to bring both of these interests together, and to build on realist evaluation methods that with their CIAMO configurations provide a vehicle to formally link context, interventions, actors, mechanisms and outcomes, and to understand changes over time.

Summary

In this section, I have critically reviewed four papers on which I was first author, and I have described my journey of writing these four papers and how the cumulation of experience in writing these papers has led me to my interest in understanding how context influences healthcare workers. These four papers were not all written with the theme of context and its influence on healthcare workers in mind, however, they have all contributed to my interest in this topic, and have influenced my belief that understanding the contextual factors that influence the way that healthcare workers react to, engage with, and deliver health services is important for designing and evaluating public health interventions. I will now present a discussion on the current state of the evidence on how context influences healthcare workers, and how my four papers contribute to this literature.

Part 2

In the second section of this commentary, I begin by reflecting on the different domains of healthcare worker reactions as described in my papers, and why understanding the contextual factors that influence the way that healthcare workers react to, engage with, and deliver health services is important for designing and evaluating public health interventions. I also reflect on how healthcare workers reactions and responses are included in the literature before discussing if and how context influences healthcare worker reactions and responses.

Domains of healthcare worker reactions

Part 1 of this thesis demonstrates the evolution in my research and reflecting on these papers, I see how the reactions of healthcare workers explored in these papers span several different broad domains, or themes including **motivation**, **emotional and mental well-being**, and **acceptability**. I did not conduct the research for my four papers with the goal of understanding domains of healthcare worker reactions, nor did I discover these domains during my data analyses on these papers. These are domains that I have determined to be present in my papers upon reflecting on them.

In paper 1, given the limited data on healthcare worker reactions and indeed context, I am unable to say exactly what domains of healthcare worker reactions would be present across all included papers in the review, but given the empirical findings from papers 3 and 4 that healthcare worker acceptability of the intervention was critical for ensuring that healthcare workers delivered the intervention effectively, it is likely that healthcare worker **acceptability** of the interventions described in paper 1 was a key domain (57, 82). Papers 3 and 4 both draw upon Sekhon's Theoretical Framework of Acceptability and Sekhon's definition that acceptability is "*a multi-faceted construct that reflects the extent to which people delivering or receiving a healthcare intervention consider it to be appropriate, based on anticipated or experienced cognitive and emotional responses to the intervention*" (61). Again, as the goal of this paper was not focused on understanding healthcare workers, it is not possible to say for sure that this domain would be seen throughout all of the studies included in the review. In paper 2, where healthcare workers were clearly influenced by what they believed their co-workers believed, it was ultimately their **acceptability** of the intervention that influenced how

they felt about delivering the intervention. Healthcare workers being influenced by what they believed their co-workers believed also suggests the potential for **emotional and mental well-being** impacts on the healthcare workers involved in delivering the intervention. However, the data from this paper, and the analyses conducted, do not allow for these conclusions to be drawn.

Papers 3 and 4 interrogate the domains of **motivation**, and **acceptability** in more detail with study findings mapped across published theories. The findings in Paper 3 were clear in that the perceived reduced work burden of delivering family planning and immunisation through household visits increased the **acceptability** of the intervention for healthcare workers because it triggered mechanisms of self-efficacy, and that healthcare workers felt **motivated** to deliver the intervention when they engaged positively with the training they received, and were happy to implement the intervention when they felt that they could share their workload with their co-workers. In Paper 4, healthcare workers reported that they felt confident about being able to provide services to women who sought care for side effects of MCMs. Again, because the goal of these papers was not to determine which domains of healthcare worker reactions were influenced, it is not possible to draw strong conclusions on exactly how these domains manifested within the study populations.

These domains of motivation, emotional and mental well-being, and acceptability can be seen throughout the published literature that explores healthcare workers and their role within health systems. Healthcare workers are the driving force of many public health interventions, and the success and sustainability of these interventions is dependent on how healthcare workers engage with the intervention, and if and how, they decide to deliver the intervention. There is extensive literature that describes healthcare workers feeling motivated and happy to implement interventions as key to effective implementation (97-102). This literature suggests that if healthcare workers feel that the interventions they are asked to implement are high burden, in terms of workload, job stress, or emotional stress, they may choose to not deliver them, or they may deliver them imperfectly (100, 103) or they may choose to still deliver the intervention to the detriment of their own mental and emotional well-being, with eventual negative impact the delivery of the intervention (104, 105). Below, I explore the current evidence base on if and how context influences healthcare

workers and highlight the extent to which motivation, mental and emotional well-being, and acceptability are featured in the current literature.

Current evidence base

Several studies have explored how context influences the design and implementation of public health interventions, including papers presented in this thesis (57, 71, 73, 74, 82, 106) but few look specifically at how context influences healthcare workers despite the fact that many public health interventions rely on the use of healthcare workers to support intervention implementation. Theories have been developed to understand how context might influence the delivery of public health interventions by looking at health systems and wider structures within them but have often failed to describe the importance of healthcare workers (107, 108). When studies do seek to understand if and how context influences healthcare workers, they often only look at one element that might be influenced, such as healthcare worker motivation, or healthcare worker performance, or they only look at one cadre of healthcare worker (109-111). Other studies look more broadly at determinants of healthcare worker performance, or levels of healthcare worker job stress without specifically exploring context (103, 112).

There are some important learnings that can be taken from studies that seek to understand if and how context influences healthcare workers. A systematic review by Kok et al (2015) identified several contextual factors that influenced the performance of community health workers (CHWs), though the authors were careful to note that few studies included an exploration of contextual factors as their primary research focus (109). The review identified contextual factors, including those related to the economy, environment, and health system policy as influencing CHWs performance. They also noted socio-cultural factors (including social norms and stigma), education, and knowledge as key contextual factors that could influence the performance of CHWs (109). The authors also acknowledged that contextual factors sometimes interact and intersect. Other studies that seek to understand how CHWs can be utilised in health systems also acknowledge that interventions need to be context specific in order to be effective (113, 114). Studies looking at facility based healthcare

workers have drawn similar conclusions. In their examination of policy initiatives for training medical students in rural settings, Strasser and colleagues (2010) found that using education approaches that were context-driven led to skilled and motivated healthcare workers (115).

Some studies have described contextual factors to include those that have been referred to in health systems literature as health systems 'hardware' including things like finances, medical resources, information systems, and organisational structures (116). In their analysis of the influence of contextual factors on healthcare worker motivations in Kenya, Mbindyo et al (2009) found that the setting, or context in which interventions are implemented can heavily influence healthcare worker motivations and approaches to interventions, particularly in relation to the work environment including management practices, supportive supervision and leadership, and human resource management (111). The provision of encouragement and motivation, either through local incentives and handling healthcare worker expectations in terms of promotions, performance appraisal processes, and good communication, were also influencing factors. Studies that have explored increased workload and training among community healthcare workers have found that manageable workload, organisation of tasks, supportive supervision, adequate supplies and equipment, and respect from the community and the health system are key drivers of successful intervention delivery because they make healthcare workers feel motivated, engaged, and happy (117, 118). Other studies have concluded that healthcare worker productivity is influenced by working conditions and that providing 'enabling' work environments encourage healthcare workers. Such conditions can ensure that healthcare workers are productive and that they provide services effectively (119). A recent study by Mayhew *et al* concluded that structural factors at the health facility level, including issues of staffing and workload in integrated interventions can often be managed by healthcare workers themselves and highlight that when healthcare workers feel agency or power over their own decision- making in the workplace, they responded positively to the intervention (120).

In contrast, studies that have explored barriers to successful intervention delivery have highlighted high levels of job stress and a lack of motivation among healthcare workers and noted that these are often influenced by contextual factors (121-123). In another study on integrated healthcare interventions, Mutemwa and colleagues determined that successful

integration of services is dependent on the performance of service providers, or healthcare workers, and that this performance is influenced by the work environment. Understanding healthcare worker roles in intervention delivery is important in any case where increased workload for healthcare workers is a consequence of the intervention, which is very often the case in interventions where multiple services are integrated. A recent Cochrane review of integrated interventions found that healthcare workers may become overloaded or deskilled in integration interventions leading to negative impacts on service provision and health outcomes (124). Another recent study from Tanzania found that when healthcare workers did not feel valued, or when they felt like they were working within an unsupportive system, one that was not motivating and did not allow for professional development or skills building, it negatively affected their ability to provide quality services (125).

As reflected above, the papers included in this thesis describe findings that fall into three domains of healthcare worker reactions – motivation, emotional and mental well-being, and acceptability – and the findings from these papers resonate with what has been referred to as health systems 'software,' broader concepts that describe the values, ideas, and norms that influence actors within health systems (116). The literature described above mostly pertains to motivation and job stress, and it is fairly limited in its ability to describe how context might influence these domains. This is an important reflection when considering the broader health system and how healthcare workers fit within this system, and contribute to its success. Frameworks for describing health systems do not often place healthcare workers at the forefront, if they are included at all, but healthcare workers are vital for intervention implementation and understanding healthcare worker reactions are missing from key implementation research frameworks (126, 127). As discussed previously, healthcare workers are often seen as a component of a health intervention or a health system rather than as the conduit or channel through which interventions are delivered. Anand and Bärnighausen (2012) conducted a literature review of health system frameworks and the role they assign to health workers and found that healthcare workers are rarely at the core of these frameworks. The authors argue that health systems frameworks must focus on healthcare workers in order to ensure success and present a framework which places healthcare workers at its core (107). The framework falls short of acknowledging the motivations and well-being of healthcare workers however, and instead focuses on the size and capacity of

the health workforce. This strong focus on healthcare workers and their motivation and well-being is often lost in broader health system frameworks such as PRISM (108). The World Health Organization's Strengthening Health Systems to Improve Health Outcomes framework includes the Health Workforce as one of its key building blocks, but its focus is on the density or quantity of staff, with only a minor focus on training (128). This lack of focus on healthcare workers aligns with what was presented earlier when describing the literature on healthcare worker reactions to public health interventions. By failing to focus on healthcare workers within health systems, these frameworks fail to acknowledge if and how context might influence healthcare workers and are therefore limited in their ability to accurately describe if and how interventions might work.

Few studies have assessed if and how context influences healthcare worker intentions to implement interventions directly. Herzog and colleagues conducted a systematic review on the relationship between healthcare worker knowledge, beliefs and attitudes about vaccines and their intentions to vaccinate (129). While the authors do not specifically discuss contextual factors, they describe studies assessing healthcare worker beliefs about vaccines concluding that healthcare worker knowledge, beliefs, and attitudes about vaccines are associated with their willingness to vaccinate. Rajaraman and Palmer (2008) discuss the importance of understanding healthcare worker attitudes and responses to HIV care interventions. While they do not describe healthcare worker attitudes and beliefs as contextual factors, they argue that a barrier to the scale up and sustainability of successful HIV interventions is a shortage of trained workers, and that it is essential to understand healthcare worker responses to HIV care interventions to guarantee intervention success (130).

Focusing on context

The studies highlighted above describe context in a narrow sense, mainly as the characteristics of the conditions in which healthcare workers are working. This is also how context is described in papers 3 and 4 in this thesis, as well as in Webster et al (2021), which describes Context-Acceptability-Theories as mentioned in Section 1 of this thesis (73). Greenhalugh et al (2022) assert that when context is described in such a way, it is possible to

"*identify and then reproduce these contextual features in order to optimise the implementation of the intervention as intended" (131)*. There are benefits to this conceptualisation, as it suggests that contextual features in one geography can be reproduced in another geography to achieve the same outcome. Wong et al (2012) describe context as the 'prevailing beliefs, social and cultural norms, regulations and economic factors' within which interventions are implemented (132). Other authors define context as the 'features of the conditions' or the characteristics of the setting or environment in which interventions are implemented (133, 134), with some going further to describe context as having have underlying or intrinsic features that help describe and explain how they influence interventions (135). Together, contexts and mechanisms can be used to develop theories on how interventions work and for whom (133). Mechanisms are factors that drive or lead to decision making among different actors, or the decisions that actors make in response to an intervention, and they may be triggered by contextual factors and/or interventions. Mechanisms encompass the decisions that actors make, or the reactions that they have, in response to interventions and realist evaluation theory posits that interventions work via mechanisms that are triggered in some contexts and not in others (136). In other words, context triggers mechanisms that drive healthcare workers decision-making in response or reaction to public health interventions. While the understanding of which mechanisms are triggered in which contexts is a cornerstone to realist evaluation, recent literature has suggested that much of the published realist evaluation evidence does not interrogate this thoroughly (137, 138).

This framing of context and the current evidence provides some insight into how context can influence healthcare workers, but it often falls short of describing how different contextual factors might influence each other, or work together, to influence healthcare workers. In this sense, it is important to consider context as something that is dynamic, fluid, and relational. Greenhalgh and Manzano (2022) describe context as falling into two key narratives, one where context is an 'observable feature' that can trigger or hinder an intervention, and one where it is dynamic and emergent, happening over time and at multiple different levels within a social system (131). In their development of an integrated framework to describe and understand how to account for context in the implementation of complex interventions, Pfadenhauer and colleagues expand on these definitions to say that context 'reflects a set of

characteristics and circumstances that consist of active and unique factors, within which the implementation is embedded' (139). They further describe how context is not simply a backdrop for interventions, but something that interacts with interventions and that can modify or influence them, and present seven unique domains of context: geographical, epidemiological, socio-cultural, socio-economic, ethical, legal, and political (139).

Contextual factors can overlap and interact to influence healthcare worker reactions and responses to interventions and can influence the way that interventions are delivered and taken up. This is important when designing and implementing health interventions and also when developing evaluations and programme theories of how interventions work. Understanding the different factors that might influence healthcare worker reactions to interventions can help to determine points at which interventions can be strengthened or improved upon, but it can also ensure that healthcare workers are protected and that their views and experiences are heard and understood which will ultimately lead to intervention success. This commentary provides an opportunity to explore the different contextual factors that were present across my three primary studies, and systematic review and specifically, to understand indications from them on how context influenced the way that healthcare workers reacted to the interventions described in the papers. Beyond this, these papers allow for reflection of if and how these factors intersected and interacted with each other and how this might have changed the way that healthcare workers were influenced. Below, I explore this in more detail by first describing how context is presented in each paper, then second, suggesting a framework for how the influence of context on healthcare workers can be understood.

Summary of findings

For each paper presented in Section 1, I describe the cadre of healthcare worker(s) involved in the delivery of the intervention, the intervention, the contextual factors as described in the paper, the domain of healthcare worker reactions seen in the paper, the country the intervention took place in, the study methods, and provide a brief description of the key outcomes (Table 1).

Table 1. Summary of findings across included studies

Paper	Healthcare worker cadres	Intervention	Context	Domain of healthcare worker reactions	Country	Study methods
Paper 1 (1)	Facility-based healthcare workers, community health workers (CHWs)	HIV prevention interventions	Social norms Healthcare worker training	Acceptability	Global	Systematic review of reviews
	Outcomes: Primary studies of direct prevention mechanisms showed strong evidence for the efficacy of some prevention technologies. Evidence suggested that interventions to increase supply of prevention technologies can be effective. Evidence from demand-side interventions and interventions to promote use of or adherence to prevention tools was mixed, with some strategies likely to be effective and others showing no effect. The quality of the evidence varied across categories.					
Paper 2 (31)	Facility-based healthcare workers CHWs CHiPs (intervention-specific CHWs)	Universal testing and treatment including counselling for PLHIV	Stigma and judgement towards PLHIV and key populations in the community and workplace	Acceptability Mental and emotional well-being	South Africa and Zambia	Cross-sectional survey
	Outcomes: Healthcare workers agreed with statements indicating judgemental attitudes towards all populations, and agreement was highest in relation to women who sell sex and men who have sex with men, especially in Zambia. There was general disagreement with statements that clients should be denied services, but disagreement was higher among CHWs. Higher education levels were associated with lower judgmental beliefs but there were strong associations between perceived co-worker stigma and holding judgmental beliefs. There were limited associations between training and reported judgmental attitudes.					
Paper 3 (57)	Health extension workers	Integrated family planning and immunization services	Community level reluctance to use MCMs without religious leader and male partner support Lack of training for health extension	Motivation Mental and emotional well-being	Ethiopia	Semi-structured interviews with realist analysis

			workers on implant removals			
	Outcomes: Several key contextual factors were identified including the use of trained health extension workers to deliver family planning services; a strong belief in values that challenged family planning among religious leaders and community members; and a lack of support for family planning from male partners based on religious values.					
Paper 4 (82)	healthcare workers, CHWs (known as village health team [VHT] members)	Integrated family planning and immunization services	Food insecurity/climate change Fear of side effects and myths about MCMs in the community Changes to the role of men in the household Preference for natural family planning	Motivation Acceptability	Uganda	In-depth interviews with realist analysis
	Outcomes: Four key themes were identified that encompassed themes, as described in the paper, that influenced the acceptability of MCMs. These were: fear of side effects of MCMs; preference for natural family planning methods; pastoral lifestyles in the community; and food insecurity. The nature of the context represented by these themes changed over time leading to the triggering of mechanisms with an overall increase in acceptability of MCMs over time.					

As shown in this table, each paper describes a different context, or contexts, within which the study, or studies, were implemented. In this commentary I will now expand on what was presented in each paper and describe a framework for categorizing these contextual factors and understanding how they may have interacted to influence healthcare worker reactions or responses to each intervention. Below, I use both context and contextual factor, the former meaning the overarching type of context (i.e. physical context), later described as the contextual sphere of influence, and the later meaning the specific factor within that context (i.e. food insecurity).

Analytical Framework

Interventions have been described as being products of their context, often influenced by layers of social reality, with broad contextual factors like the infrastructure and policy in the outer layers, and more specific contextual factors such as interpersonal relationships and social norms in the inner layers (140). Pawso*n et al* (2004) expand on this with their Four I's framework to describe context as the *individual capacities* of key actors, the *interpersonal relationships* needed to support the intervention, the *institutional setting* in which the intervention is implemented, and the wider *infrastructural environment* (141). Maben *et al* use this description and expand on it somewhat in their review of Rounds in UK hospitals (142). The authors describe multiple, interconnected contextual layers that affect and explain how Rounds are implemented. The authors acknowledge that there is interaction between contextual layers and explain that these layers work together to trigger mechanisms which drive decision making or responses by actors involved in the intervention.

While using a framework of contextual layers is a useful way of looking at context and understanding the different levels of contextual influence, it falls short of being able to describe how those layers interact with each other. Looking across contextual spheres of influence builds on this and provides a more useful framework for understanding the interaction between different levels or layers of context and allows for the synthesis of findings across my four papers. George *et al* developed a conceptual framework to represent contextual spheres and how these spheres intersect and interact dynamically to influence health committees (143). The framework demonstrates that different spheres of influence

each play different roles in a health system and that there are several cross-cutting issues within these spheres meaning that they intersect and overlap. This observation is important for this commentary as each of my papers describes different contextual factors which overlap to influence the way in which healthcare workers interact with health interventions. In each case where healthcare workers are influenced by one contextual factor within one sphere, there is also another sphere (or several spheres) of influence, and other contextual factors at play simultaneously. This means that healthcare workers are being influenced by multiple contextual factors at once, and interaction between these contextual factors may influence the way that healthcare workers are influenced.

The literature describes levels and layers of context in various ways (140, 142-144). For this commentary, I define 5 key spheres of contextual influence within which specific contextual factors sit. Figure 2 depicts these spheres of influence, including very broad, macro level factors such as the physical environment, as well as micro-level factors such as the social environment, with examples of what is included in each sphere. This figure aligns somewhat with the domains of context presented in Pfadenhauer's framework for understanding complex interventions, but differs in its description of the influence of physical setting or environment and the legal or political environment (139).

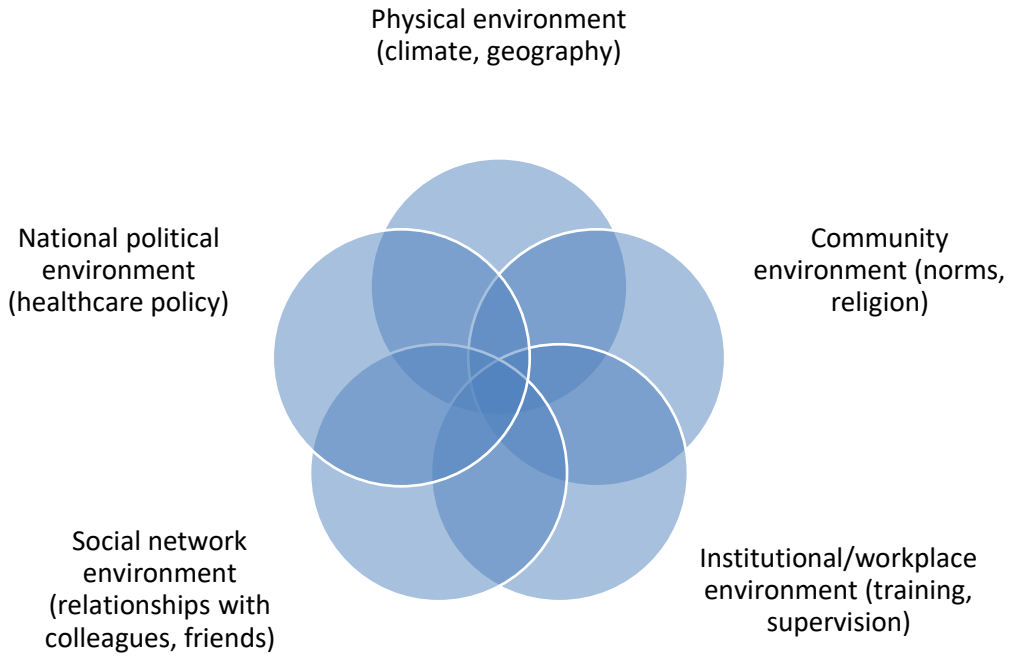

Figure 2. Spheres of influence over healthcare worker responses to public health interventions

This initial depiction of how contextual spheres of influence overlap and intersect is helpful but while several different spheres can overlap to influence outcomes, they do not always influence each other and sometimes the influence happens in one direction and not the other, for example, the physical environment might influence social networks, but social networks will not influence the environment. However, in this example, social networks might influence the way that the environment influences healthcare workers; in other words, contextual factors do not always influence each other, but they can influence the way that other contextual factors influence healthcare workers. The contextual spheres of influence presented in Figure 1 are defined as follows:

Physical environment context: The natural and built surroundings within which populations live. This can include the physical terrain and climate but also man-made things like buildings, roads, and infrastructure.

National political context: The national political environment in which interventions are implemented. This can include things such as national policies on service provision, or accessibility of services based on economic or social determinants.

Institutional context: The workplace environment, including training, supervision, and workload.

Community context: The prevailing social norms and cultural beliefs, within the communities in which interventions are implemented. This can include religious beliefs, myths, and rumours.

Social network context: The relationships and interactions between healthcare workers and their friends and colleagues. This can include the influence of the behaviours, attitudes, and beliefs of friends and colleagues.

Table 2 presents data on where these contextual spheres are seen in the four papers included in this commentary. For each contextual sphere of influence, I state the paper where it is seen, and the contextual factors included in that sphere. Importantly, this table and these findings only describe the influence of context on healthcare workers in each of

the papers. There may have been other ways in which context influenced intervention outcomes in each paper, but those findings are not presented here.

Table 2. Spheres of influence and included contextual factors across included papers

Contextual sphere of influence	Paper where this sphere of influence is seen	Included contextual factors
Physical environment	Paper 4	Food insecurity/climate change
National political environment	Paper 2	Legislation against homosexuality
	Paper 3	National policy restricting training for health extension workers
Institutional/workplace environment	Paper 1	Healthcare worker training on intervention components
	Paper 2	Healthcare worker training on working with PLHIV, working with key populations, stigma, safety
	Paper 3	Healthcare worker training on family planning, supervision, training, shared workload
	Paper 4	Healthcare worker training on family planning, supervision, training, shared workload
Community environment	Paper 1	Social norms about gender roles, HIV transmission and prevention
	Paper 3	Community level reluctance to use MCMs without religious leader and male partner support
	Paper 4	Fear of side effects of MCMs in the community; changes to the role of men in the household; preference for natural family planning
Social network environment	Paper 1	Positive relationships with colleagues
	Paper 2	Co-worker beliefs and attitudes
	Paper 3	Positive relationships with colleagues

Figure 2. Interactions between contextual spheres of influence.

What these papers add to the realist evaluation literature

Papers 1 and 2 do not contribute to the realist evaluation literature as they did not use a realist evaluation approach, nor was I familiar with realist evaluation methods when I wrote those papers. Papers 3 and 4 directly sought to understand why and how an intervention worked, for whom, and under what circumstances. As such they contribute to the realist evaluation literature by moving beyond the understanding of CMO configurations to simply describe why and how intervention outcomes were achieved, by mapping findings against published theoretical frameworks and as such, allowing for the cumulation of evidence. In

doing this mapping against frameworks, my co-authors and I were able to increase our understanding of the mechanisms driving intervention implementation, and why different mechanisms might be triggered in different contexts. Rather than developing CMOs, we developed CIAMOs which allowed us to clearly see the intervention components that were involved in triggering mechanisms which lead to outcomes. Using an example from Ethiopia, Paper 3 demonstrated that health extension workers received ongoing training as part of the intervention that demonstrated the benefits of integrating FP and immunisation services. They could see the benefits of providing a combined package of services and therefore felt positively about providing the intervention. By mapping our findings across published theoretical frameworks, we were able to demonstrate that constructs such as observability, compatibility, and relative advantage drove implementation decisions by the health extension workers. By demonstrating the framework constructs that equated with empirically identified mechanisms, we were able to provide a way in which findings could be mapped across further sites to contribute to a cumulation of evidence . Paper 4 expanded on the methods in Paper 3 by looking at changes over time, and looking at context as a fluid, changeable phenomenon, one that might influence the way an intervention is implemented, or that might itself be influenced by an intervention. Beyond this, these papers contributed to the literature on family planning. As mentioned in Section 1, when these papers were written, few evaluations of integrated family planning and immunisation services had been conducted, and these studies contributed to a growing evidence base on uptake of integrated family planning and immunisation services (71-75).

Limitations

As discussed at the beginning of Section 2, and outlined in Table 1, the domains of healthcare worker reactions described in the included papers were motivation, emotional and mental well-being, and acceptability. Given the fact that these papers were not written with the influence of context on these domains in mind, it is not possible to draw conclusions about which domains were affected by which contextual sphere of influence in detail, and speculating about what these relationships might be would not be useful. However, reflecting on these four papers has allowed for the development of a framework that could be applied

to future research where multiple contextual spheres of influence are present. There are, therefore, limitations to the papers presented in this paper in being able to interrogate the topic of how context influences the way that healthcare workers approach and deliver public health interventions.

The first paper, being a systematic review of reviews on HIV prevention, does not have a primary focus on healthcare workers, it provides a broad overview of the literature on HIV prevention and does not interrogate the factors that influenced the delivery of the interventions. The conclusions that I was able to draw from this paper in terms of healthcare workers and their experiences were therefore limited, and based primarily on what I theorised to be the case based on further research and learning I have completed since the publication of that paper. Similarly, paper two was limited in its ability to describe how healthcare workers felt about the intervention they were delivering or the populations they were delivering it to. My interpretation of how context influenced the healthcare workers was drawn from strong quantitative data and supported by findings presented in subsequent papers on the same topic, but the paper itself did not describe how context influenced healthcare workers. There was strong evidence that healthcare workers were influenced by what they thought their co-workers believed. There is a wide body of literature that explores how social norms interventions, such as those that aim to influence the behaviour of health workers by exposing them to the beliefs and attitudes of their co-workers can lead to change in healthcare worker behaviour and ultimately, positive health outcomes for patients, but in this case, healthcare worker acceptability of the intervention is what ultimately influenced their attitudes towards providing services (145, 146).

Next steps and conclusions

This thesis presented a critical review of four papers on which I was first author, and a suggested framework for analysing and understanding if and how context influences healthcare workers and their reactions and responses to public health interventions based on findings from these papers. It examined the research approaches taken for each paper, the relevance and impact of each paper at the time it was published, the methodological strengths and weaknesses of each paper, the current relevance of each paper, and how these papers contributed to the development of my current research interest on the overarching theme of how context influences healthcare worker responses and reactions to public health interventions. It also presented a suggested framework of interacting spheres for understanding this overarching theme. This framework, which views context as fluid phenomenon that can influence and be influenced by other contexts, will be useful for understanding increasingly complex interventions with multiple different stakeholders, disciplines, and interests at play.

In this thesis I have presented four papers that I wrote at very different timepoints in my academic career and have reflected on how I believe they have driven my pathway and decisions as a researcher. As such, this thesis is limited in its ability to draw conclusions about exactly how and why healthcare workers are influenced by contextual factors. It describes context as it was examined and discussed in the included papers and so, when reflecting on the included papers, the discussion on context remains limited. I have used the opportunity of this thesis as a tool for both reflection and consideration of my future direction in studying and understanding how context influences the reactions of healthcare workers to interventions. Alongside this forward thinking, I have presented a body of peer reviewed papers that showcase the breadth of methods that I have used in my research training over the last several years, and which will serve me well for moving forward. Other explorations of context, including those describing context as a much more dynamic, fluid phenomenon, present a way forward from this thesis and I hope to use this in future analyses of what works, for whom, and under what circumstances.

This thesis represents not only my journey as an academic researcher and the research skills I have gained along the way, but also a journey of collecting evidence to inform the hypothesis that context influences healthcare workers, and that understanding why and how this happens is important for designing good public health interventions and evaluations. Importantly, I did not set out to understand this topic when I started my career, but the fact that this topic has come through very clearly in all of these publications is compelling, and suggests that this is a key theme that should be explored in any research that seeks to understand why and how interventions work, which is essential for designing successful interventions. The use of a framework to help unpack and examine the influence of context on healthcare workers and their reactions and responses to public health interventions is increasingly important as public health interventions continue to grow in complexity and scope. The framework presented in this commentary is a first step, and I am hopeful that findings from my current research will allow me to test the validity of this framework, and to apply it to different health topics.

Positionality statement

While the conclusions I have reached in this thesis reflect my journey and growth as a researcher over my career in public health research, my own personal experiences have shaped the way that I approach learning and research, and it is important that I acknowledge these experiences and how they may influence or bias my research. When I started working on PopART, I was struck by the hypotheses of my colleagues on the research team that healthcare worker stigma might influence the way that they deliver HIV care. I challenged the notion that a healthcare worker might allow personal beliefs to negatively impact their duty of care, and in my research on this study, and on subsequent studies I have worked on, I have felt protective of the healthcare workers within our participant groups. This is something that has stood out to me throughout my career in academia, particularly when I have conducted fieldwork and have had the chance to interact and engage with healthcare workers. The studies that I have worked on have often involved the introduction of new tools and technologies that healthcare workers must learn and use to deliver the interventions. Further, the health topics that the studies I have worked on have often been subject to stigma, and healthcare workers, as they are associated with those health topics, have expressed experiencing stigma as a result. These realities have led me, throughout my career, to question the impact that the increased workload, or the associated stigma, has on the motivations of these healthcare workers, their mental and emotional well-being, and the acceptability of and willingness to deliver the interventions they are asked to deliver. This was evident during fieldwork I conducted in Zambia, where healthcare workers delivered care to PLHIV, and a healthcare worker who was living with HIV herself told me that her involvement in the intervention brought back painful memories of when her co-workers stigmatised her for having HIV, and she expressed fear that patients would not want to receive treatment from her if they knew she was living with HIV. A healthcare worker in Uganda that I conducted an in-depth interview with told me of her strong religious beliefs and that she did not know what the moral consequences of providing family planning services to other women would be. I felt deeply concerned for these healthcare workers and worried about the emotional toll their involvement in these interventions would have on them. These experiences were formative for me as a researcher, and have driven me to want to

understand not only how healthcare workers react to the interventions that they are asked to implement, but also the factors that influence these reactions.

I do not believe that my feelings of protectiveness over healthcare workers have influenced the lens through which I have conducted my research. This is of course more straightforward in papers 1 and 2 where systematic review and quantitative data analyses were conducted and less interpretation was required. In papers 3 and 4, which used realist evaluation methods, the research was conducted within a team, and initial and final programme theories were developed iteratively after significant reflection on the research findings. This ensured the trustworthiness of findings and that my own positionality did not bias the conclusions of the papers.

Section 2: Research Papers

Paper 1: Interventions to strengthen the HIV prevention cascade: a systematic review of reviews

Interventions to strengthen the HIV prevention cascade: a systematic review of reviews

Shari Krishnaratne, Bernadette eHensen, Jillian Cordes, Joanne Enstone, James R Hargreaves

Summary

Background Much progress has been made in interventions to prevent HIV infection. However, development of evidence-informed prevention programmes that translate the efficacy of these strategies into population effect remain a challenge. In this systematic review, we map current evidence for HIV prevention against a new classification system, the HIV prevention cascade.

Methods We searched for systematic reviews on the effectiveness of HIV prevention interventions published in English from Jan 1, 1995, to July, 2015. From eligible reviews, we identified primary studies that assessed at least one of: HIV incidence, HIV prevalence, condom use, and uptake of HIV testing. We categorised interventions as those seeking to increase demand for HIV prevention, improve supply of HIV prevention methods, support adherence to prevention behaviours, or directly prevent HIV. For each specific intervention, we assigned a rating based on the number of randomised trials and the strength of evidence.

Findings From 88 eligible reviews, we identified 1964 primary studies, of which 292 were eligible for inclusion. Primary studies of direct prevention mechanisms showed strong evidence for the efficacy of pre-exposure prophylaxis (PrEP) and voluntary medical male circumcision. Evidence suggests that interventions to increase supply of prevention methods such as condoms or clean needles can be effective. Evidence arising from demand-side interventions and interventions to promote use of or adherence to prevention tools was less clear, with some strategies likely to be effective and others showing no effect. The quality of the evidence varied across categories.

Interpretation There is growing evidence to support a number of efficacious HIV prevention behaviours, products, and procedures. Translating this evidence into population impact will require interventions that strengthen demand for HIV prevention, supply of HIV prevention technologies, and use of and adherence to HIV prevention methods.

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See Comment pages e284 and e286

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Introduction

Despite progress in development and delivery of efficacious HIV prevention interventions, more than 1 million people are newly infected with HIV every year.[1] UNAIDS have called for a reinvigoration of HIV prevention methods and suggest that 25% of global HIV spending should be allocated to prevention activities.[2] There is growing interest in the use of HIV prevention cascades to support the development and implementation of interventions and to facilitate resource allocation. In this issue, Hargreaves and colleagues[3] suggest a reframing of HIV prevention interventions organised around an HIV prevention cascade that can both integrate evidence from different disciplines and be more helpful for programmers. Garnett and colleagues[4] use observational data from Zimbabwe to operationalise the idea of an HIV prevention cascade as a monitoring tool. In this paper, we review the available evidence for HIV prevention as reflected in systematic reviews of HIV prevention interventions published during the past 20 years. We map the evidence base in line with the HIV prevention cascade, describe characteristics of interventions relevant to each area of the cascade, assess the type of evidence available on these interventions, and identify gaps and areas for future research.

Methods

Search strategy and selection of reviews

We did three independent systematic searches to identify systematic reviews of HIV prevention interventions published in English from Jan 1, 1995. Search terms included HIV/AIDS MeSH terms, "behav*" (behavioural review), "struct*" (structural review), "prevent*" and "intervention", and terms specific to each included biomedical intervention.

To identify systematic reviews of biomedical HIV prevention interventions, on Aug 15, 2014, we searched the Cochrane Library, MEDLINE, ISI Web of Knowledge, and ClinicalTrials.gov. The search findings were updated on July 20, 2015, when we extended the search to include Embase and no longer limited it to systematic reviews so that we could identify primary studies from 2012 that might not have been incorporated into reviews. To identify systematic reviews of behavioural interventions, on May 12–15, 2015, we searched the Cochrane Library, Embase, Health-Evidence.org, MEDLINE, and PsycNET

Research in context

Evidence before this study

We did a systematic review of reviews for domains across the HIV prevention cascade. Because we restricted our search to review articles, we are confident that we would have identified any additional reviews of reviews on a similar scale to this work. Our search identified several overviews of the literature on HIV prevention, but few systematic reviews of reviews. One review published in 2013 searched for and described evidence for HIV prevention interventions as they pertain specifically to young people and adolescents. We refer to the methods used in this review in our work, and we have based the appraisal and rating of the evidence in our review on that previous review.

Added value of this study

To our knowledge, this is the first review of reviews on HIV prevention of this size and scope. We map the evidence across the HIV prevention cascade and show strong evidence for the efficacy of biomedical tools such as of pre-exposure prophylaxis (PrEP) and voluntary medical male circumcision and for increasing supply of biomedical tools such as condoms or clean needles. By mapping the published work in this way, we present evidence in a format that we hope will be useful to programme developers and implementers and that will provide an evidence base to inform policy on HIV prevention.

Implications of all the available evidence

We highlight the importance of combination HIV prevention interventions that address structural and behavioural barriers to the uptake, use of, and adherence to strategies known to prevent HIV. Future research for biomedical tools with demonstrated efficacy should focus on population-level effectiveness. Research on increasing supply of these tools should use more rigorous study designs to measure impact in specific populations, including cluster randomised trials where feasible; if not feasible, a range of alternative impact designs are available. Although a range of interventions seek to address demand for HIV prevention, these have rarely been studied using experimental trials, and, where studied, have shown heterogeneous effectiveness. Similarly, studies of interventions to support use or adherence to HIV prevention need further adaptation and study aligned with the new HIV prevention cascade.

and for papers that described interventions implemented. To identify systematic reviews of structural interventions, we searched the Cochrane Library, MEDLINE, ISI Web of Knowledge, and Health-Evidence.org. We did the initial search for reviews about structural interventions on Aug 1–10, 2014, and updated the results on May 15, 2015.

Data were extracted from reviews with a data extraction tool (appendix 1) Reviews were eligible for inclusion if they systematically reviewed the evidence on the effectiveness of HIV prevention interventions. Reviews of experimental and observational studies were included. There were no restrictions on populations. We excluded broad overviews, scoping reviews, and unsystematic literature reviews.

See Online for appendix 1

See Online for appendix 2

We excluded reviews containing studies of behavioural interventions and structural interventions done only in high-income countries because we wanted to focus on areas in which HIV burden is highest and because the effectiveness of such interventions could be context specific and the heterogeneity of studies would present even greater challenges to data synthesis. We did not exclude any countries of implementation for reviews about the efficacy of biomedical products, because efficacy trials are not as heavily affected by contextual factors and so we considered the country-focus restriction less pertinent.

Primary study identification and data extraction

We extracted primary studies from reviews if they assessed at least one of the following outcomes: HIV incidence, HIV prevalence, reported condom use, and uptake of HIV testing. For studies of direct mechanisms only, HIV incidence had to be a primary outcome to qualify for inclusion. We included condom use and uptake of HIV testing as proximate outcomes of intervention effectiveness because these are two of the most commonly reported outcomes in studies that do not report biological HIV outcomes. Although prevention of mother-to-child-transmission interventions and outcomes were identified by some reviews, here we aimed to look specifically at sexual transmission or transmission through needle sharing.

We developed an approach for minimal data extraction at the primary study level (appendix 2); data included the country of focus, target population, study design, reported outcomes, and overall findings of each study. We classified reviews and primary studies with the HIV prevention cascade typology described by Hargreaves and colleagues.[3] Many primary studies fit into more than one category, but we allocated each study into one category only based on what we judged the most prominent component seemed to be, despite recognising that some interventions include components targeting more than one of three domains: demand-side, supply-side, and adherence (table 1).

The demand-side domain contained studies in which we judged the main aim of intervention to be to influence behaviour by targeting risk perception or strengthening awareness of, and positive attitudes towards, HIV prevention behaviours and technologies. These interventions include those providing information, education, and communication and those intended to influence perceived norms through peer-based approaches. Interventions were delivered in a range of settings and to different target populations.

The supply-side domain contained studies in which we judged the main aim of intervention to be to influence

the supply of HIV prevention products and messages. Examples included mass condom distribution, needle exchange initiatives mainstreaming HIV prevention within other services, and treatment strategies for sexually transmitted infections (STIs). Some, but not all, of these interventions have been characterised as structural interventions in published work.

The adherence domain contained studies in which we judged the main aim of intervention to be to support adoption or maintenance of prevention behaviours, including, but not restricted to, the use of prevention technologies. These interventions often sought to influence behavioural self-efficacy or skills and included interventions such as longitudinal risk counselling. We also included within this group interventions that targeted social determinants of behaviour hypothesised to act as barriers to the ability of individuals to access or adhere to prevention, such as cash transfers or livelihood interventions. Again, some of these interventions have been identified as structural in the published work.

Studies in the direct mechanism domain were most often individually randomised trials of the efficacy of biomedical products or procedures (eg, pre-exposure prophylaxis [PrEP] or medical male circumcision).

Within each of these domains, we identified specific types of interventions. In describing each intervention type, we categorised the evidence according to the target population (table 1). We assessed the type and direction of the evidence for each of the four outcomes based on study design and reported findings (appendix 2). We used a framework created by Mavedzenge and colleagues[3] in their review of the evidence for interventions for young people and adolescents. We first described the study designs in each category with use of the ratings A, B, or C on the basis of how many randomised controlled trials were published for a specific outcome (table 2). We then assessed how many studies had findings that suggested intervention effectiveness or not, assigning a score of 1–4 (table 2). Two reviewers (SK and BH) assessed the evidence for structural and behavioural interventions. Disagreements, although rare, were resolved after consultation and detailed review of the studies in question. One reviewer (JE) assessed the evidence for biomedical interventions.

Role of the funding source

The funder of the study had no role in data collection, data analysis, data interpretation, or writing of the report; however, the decision to focus only on evidence from low-income and middle-income countries for the behavioural and structural reviews was made, in part, by the funder. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Findings

We identified 88 eligible reviews (figure 1A),[4–91] from which we extracted 292 primary studies (figure 1B). Of 194 primary studies of demand-side, supply-side, or adherence interventions, 137 (71%) used observational study designs (figure 2). 34 (38%) of 90 randomised controlled trials (RCTs) were trials of direct mechanisms to prevent HIV. 24 (12%) of the studies classified as demand-side, supply-side, or adherence included HIV incidence or prevalence or both as primary outcomes, whereas almost all (88%) reported condom use.

54 primary studies from 40 reviews contributed evidence for information, education, and communication interventions (table 3). The interventions included many different approaches to influence risk perception, awareness, and attitudes about preventive behaviours, including through multimedia, text messages, posters, and other forms of communication. For example, the Helping Each Other Act Responsibly Together (HEART) campaign in Zambia included a multimedia programme of television spots, public service announcements, radio advertisements, music videos, posters, and billboards to share messages about HIV and STI risk reduction.[34] A secondary-school-based programme in KwaZulu-Natal provided sexual health and HIV prevention messages through either drama performances or an information

	Intervention type	Subcategory (if applicable)
Demand-side interventions	IEC	Young people, men, women, people who use drugs, mass media
	Peer	Young people, men who have sex with men, female sex workers, people who use drugs or alcohol, general
Supply-side interventions	Integration of HIV services	..
	Needle or syringe programmes	..
	Condom distribution	..
	Community-level STI interventions	..
Adherence interventions	Counselling	Couples-based counselling, HIV testing and counselling, individual-level counselling, HIV-positive prevention
	Socioeconomic	Microfinance interventions, cash transfer interventions
Direct mechanisms of HIV prevention	Voluntary medical male circumcision	Male to female transmission, female to male transmission, men who have sex with men
	Condoms	..
	PrEP	..
	Microbicides	..
	STI treatment	..
	Vaccines	..

IEC=information, education, and communication. PrEP=pre-exposure prophylaxis. STI=sexually transmitted infections.

Table 1: Categorisation of evidence of HIV prevention interventions in line with the HIV prevention cascade

	3 or more RCTs (might also include observational studies)	1–2 RCTs (might also include observational studies)	No RCTS; only observational studies
Consistently showed effectiveness	A1	B1	C1
Largely, but not consistently, showed effectiveness	A2	B2	C2
Mixture of beneficial and ineffective or harmful results	A3	B3	C3
Consistent ineffective or harmful results	A4	B4	C4

RCT=randomised controlled trial.

Table 2: Assessment of strength of evidence of HIV prevention interventions across types of interventions

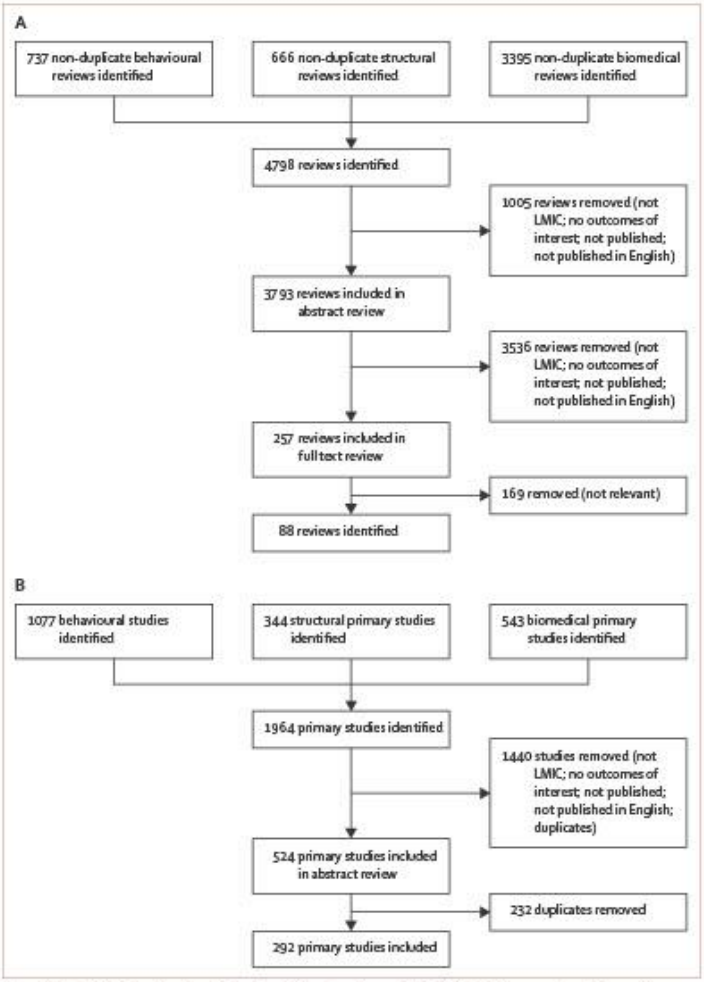

Figure 1: Identification of systematic reviews (A) and primary studies (B) of HIV prevention interventions
LMIC=low-income or middle-income country.

booklet, both delivered in classroom settings.[95] Slightly more than half (56%; n=30) of the information, education, and communication studies were of interventions focused on young people. An example is the MEMA Kwa Vijana cluster RCT of an intervention that provided primary school students with sexual health education through a participatory, teacher-led programme combined with training for health workers to provide sexual health services that are friendly to young people, as well as condom promotion and provision and community mobilisation.[96] Almost all studies of information, education, and communication interventions assessed condom use as a primary outcome (table 3).

31 reviews contributed 54 studies of peer-based interventions (table 3). Interventions in this category often combined peer-delivered sexual health education with either increased availability of direct mechanisms to prevent HIV, such as condoms, or community empowerment approaches. Studies of interventions targeted at female sex workers used peer-led community empowerment approaches to support mobilising female sex workers and developing a sense of community. An example is a peer-delivered education programme among establishment-based female sex workers in the Philippines, which combined venue-manager training with information on HIV and condom use.[97,98] Studies assessing the impact of these interventions on HIV incidence and prevalence among female sex workers used experimental and observational designs, but they showed little evidence to support their effectiveness on reducing HIV incidence or prevalence (table 3). 12 studies described peer-based interventions among young people. Examples include a project in Kenya that involved peer educators teaching students about HIV and life skills with songs, quizzes, competitions, and other methods; and Stepping Stones, an intensive community training programme designed for HIV-vulnerable communities in low-income countries. The participatory learning approach sought to empower men and women to take greater control over their sexual and emotional relationships.[99,100]

12 reviews contributed 35 studies on supply-side interventions (table 3). Approaches were often facilitated by policy changes, such as to increase access to free clean needles or subsidised condoms for populations most at risk (table 3). In Thailand, the 100% condom-use policy launched in 1989 promoted the practice of "no condom–no sex" in all types of sex work through collaborations between local authorities, sex business owners, and sex workers.[101] Similar approaches have been implemented in the Dominican Republic and Cameroon,[102,103] and adaptations for other population groups such as young people have also been attempted. Among the 20 primary studies describing the effectiveness of condom distribution interventions, three measured HIV prevalence, and all used observational study designs. Among six observational primary studies of exchange programmes for clean needles and syringes, three assessed HIV incidence as an outcome. Findings from one study supported effectiveness, whereas two did not (C3; table 3). Two observational studies measured HIV incidence and demonstrated findings in support of the intervention (C1). Three studies (all RCTs) described interventions aimed at STI control. These interventions aimed to increase access to STI testing and treatment. For example, in Rakai, Uganda, an intensive STI control programme via home-based mass antibiotic treatment was rolled out and studied in a cluster RCT design.[104]

16 reviews provided 51 studies of interventions to support the adoption and maintenance of prevention behaviours by influencing efficacy and skills through counselling-based interventions or interventions targeting

socioeconomic determinants. 26 primary studies described use of counselling alone or with HIV testing to promote HIV prevention. Seven reviews contributed evidence from studies describing couples-based counselling interventions (n=10). One observational study assessed the effect of couples-based counselling on HIV incidence with findings in support of the intervention (C1; table 3). Nine studies, including three RCTs, assessed self-reported condom use after couples counselling and findings from these studies were in support of the interventions (A1; table 3). Counselling interventions were most often delivered via health facilities through interactions between providers and patients or in community settings by providing either individual, couple-based, or group-based behavioural strategies to reduce HIV risk behaviours. 12 studies (seven RCTs) assessed individual-level counselling interventions. One example is a programme in South Africa that focused on people without HIV and delivered a 60-min risk-reduction counselling session led by health educators and delivered within a health-care setting.[105] Seven studies (four RCTs) assessed HIV-positive prevention counselling. For example, an RCT in South Africa studied an intervention that consisted of patient-centred discussions between counsellors and patients living with HIV during regular clinical visits focused on HIV risk reduction and tailored to specific patient needs.[106]

Interventions to address socioeconomic barriers to adherence to HIV prevention behaviours or other direct prevention mechanisms were based either on incentives or cash payments or on strengthening livelihoods through microfinance or related initiatives. Cash transfer interventions aimed to improve school attendance and educational outcomes and through this mechanism reduce HIV infection rates among young people.[107] Other interventions used a contingency management model, such as that in smoking cessation programmes, in which regular behaviour monitoring was combined with financial incentives when the desired behaviour was demonstrated.[108] Livelihood interventions involved training of participants in the development of products or services, access to markets, financial skills, and financial support or credit. The interventions sought to strengthen livelihoods among participants to alleviate poverty and increase self-efficacy. Microfinance interventions included the provision of small loans, assistance with the facilitation of income-generating activities, or provision of financial services.[61] In some cases, interventions were combined with life-skills interventions and condom distribution including in studies from Kenya and Zimbabwe.[109,110]

29 systematic reviews (in 28 publications) incorporated 98 primary studies of six direct mechanisms to prevent HIV (table 3). 38 studies, including three large RCTs, assessed the impact of medical male circumcision on HIV acquisition in heterosexual men (A1; table 3).[111] Cohort studies pre-dating the trials also indicated a protective effect for heterosexual men, including those at high risk.[67] A systematic review and meta-analysis covering seven primary studies, including one RCT, did not provide evidence of a protective effect of male circumcision for women (B3).[75] Four reviews provided 19 primary studies exploring whether circumcision protects men who have sex with men (MSM). No RCTs were found, but two subanalyses of observational data by partner role suggest, to varying extents, that circumcision might give a protective effect for MSM with a predominantly or exclusive insertive role.[76,77]

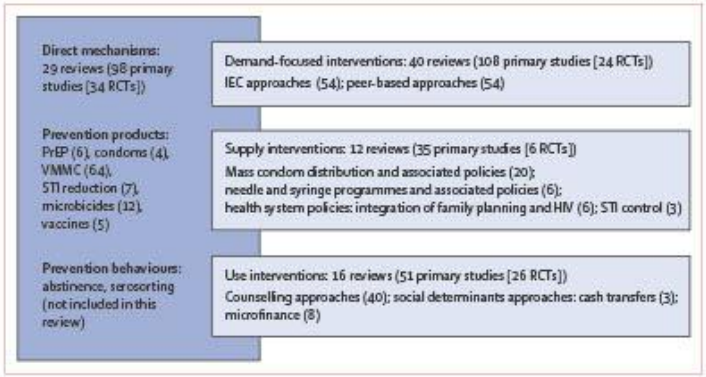

Figure 2: Mapping evidence for the HIV prevention cascade
RCT=randomised controlled trial. PrEP=pre-exposure prophylaxis. VMMC=voluntary medical male circumcision. STI=sexually transmitted infections. IEC=information, education, and communication.

Two reviews describe evidence from six RCTs done between 2007 and 2009 to assess the effect on HIV incidence of oral PrEP (of daily tenofovir disoproxil fumarate, with or without emtricitabine, *vs* placebo).[82–84] Four trials showed findings in support of the intervention, with an efficacy of up to 75%, whereas two, which included women only, did not show any effect (as was also the case in the more recent VOICE trial. One RCT assessed the efficacy of PrEP on HIV incidence among people who inject drugs (B1) and one assessed the efficacy of PrEP on HIV incidence among MSM (B1). This latter RCT, the iPrEx trial, was done in six countries and involved approximately 2500 men comparing daily tenofovir disoproxil fumarate plus emtricitabine versus placebo and demonstrated a positive effect on incidence.[121]

We identified five RCTs of HIV vaccines in two reviews. One trial (RV144), a large trial conducted in 2009 in Thailand with the ALVAC-HIV vaccine and AIDSVAX B/E boosters, demonstrated moderate efficacy.[122] In a modified intention-to-treat analysis, vaccine efficacy was 31·2% (95% CI 1·1–52·1). Other vaccines trialled have not protected against HIV infection or reduced viral load, including the MRKAd5 HIV-1 gag/pol/nef subtype B vaccine used in the Step and Phambili studies, which was discontinued at interim analysis because it showed no protective effect.[123,124]

	Incidence		Prevalence		Condom use		HIV testing	
	Number of studies	Quality assessment rating	Number of studies	Quality assessment rating	Number of studies	Quality assessment rating	Number of studies	Quality assessment rating
Demand-side interventions								
Effect of IEC interventions focused on young people[6–10]	3 (1)	B4	1 (1)	B4	28 (7)	A3	..	..
Effect of IEC interventions focused on men[11,12,20–23]	..	..	..	..	9 (3)	A2	1 (0)	C1
Effect of IEC interventions focused on women[21,23]	..	..	..	..	2 (2)	B3	..	..
Effect of IEC interventions using mass media[7,13,14]	1 (1)	B3	..	..	9 (1)	B4	..	..
Effect of IEC interventions focused on people who use drugs[16,17,24]	..	..	..	..	4 (3)	A1	..	..
Effect of peer-based interventions focused on young people[6,8,11,12,21,25,26–28]	1 (1)	B4	..	..	11 (0)	C2	2 (0)	C1
Effect of peer-based interventions focused on MSM[29–35]	..	..	..	..	3 (1)	B1	1 (0)	C1
Effect of peer-based interventions focused on female sex workers[9,11,12,18,36,37–44]	3 (1)	C4	4 (0)	C4	22 (3)	B2	3 (0)	C1
Effect of peer-based interventions focused on people who use drugs or alcohol[21,28,29,31,45–47]	2 (2)	B4	1 (1)	B4	5 (2)	B3		
Effect of peer-based interventions with no population focus[6,8,11,12,18,21,31,48]	..	..	..	..	10 (2)	B1	1 (0)	C1
Supply-side interventions								
Effect of interventions that integrate HIV services into routine care[49,50]	..	..	..	..	1 (0)	C1	5 (0)	C1
Effect of clean needle or syringe programmes[48,51]	2 (0)	C3	6 (0)	C1	..	..	..	..
Effect of condom distribution interventions[13,31,52,53,54,55]	..	..	3 (0)	C1	20 (5)	A1	..	..
Effect of community-level STI interventions[57]	3 (3)	A4	..	..	1 (1)	B4	..	..
Adherence interventions								
Effect of couples-based counselling[58,59–67]	1 (0)	C1	..	..	9 (3)	A1	4 (3)	A3
Effect of HIV testing and counselling[34,35,53,54,68]	1 (1)	B4	..	..	8 (1)	B2	3 (2)	B1
Effect of individual-level counselling[14,26,31,34,37–39]	1 (1)	B3	..	..	12 (7)	A1	2 (1)	B3
Effect of HIV-positive prevention counselling[22,31,69,70,71,72]	..	..	..	..	7 (4)	A3	..	..
Effect of microfinance interventions[73–76]	1 (1)	B4	..	..	8 (4)	A3	1 (1)	B1
Effect of cash transfer interventions[61]	2 (2)	B4	2 (2)	B1	1 (1)	B4		
Direct mechanisms								
Medical male circumcision for heterosexual route risk (female to male)[66–74]	38 (3)	A1	..	..	..	..	..	..
Medical male circumcision for heterosexual route risk (male to female)[75,76]	7 (1)	B3	..	..	..	..	..	..
Male circumcision men who have sex with men route individual-level studies[75,76–78]	19 (0)	C3	..	..	..	..	..	..
Condoms (heterosexual) individual-level studies[79–81]	4 (0)	C1	..	..	..	..	..	..
Oral PrEP (overall) individual-level studies[82–84]	6 (6)	A2	..	..	..	..	..	..
Microbicide prophylaxis individual-level studies[48,78,85–88]	12 (12)	A3	..	..	..	..	..	..
STI treatment individual-level studies[48,84,89,90–92]	7 (7)	A4	..	..	..	..	..	..
HIV vaccine individual-level studies[75,93]	5 (5)	A3	..	..	..	..	..	..

In cells showing the number of studies, numbers in parentheses are randomised controlled trials. IEC=information, education, and communication. STI=sexually transmitted infections. PrEP=pre-exposure prophylaxis.

Table 3: Number and type of studies describing HIV prevention interventions and the impact of these interventions on key outcomes

Discussion

We found evidence from several randomised trials in support of the efficacy of direct mechanisms to prevent HIV. Evidence also suggests that supply-side interventions that increase access to these efficacious technologies can be effective, and that there is a need for continued research on interventions to increase demand for and adherence to direct mechanisms to prevent HIV. As the cascade highlights, demand, supply, and use of interventions are all crucial domains to increases in uptake of and adherence to direct HIV prevention mechanisms. The interventions and combination of interventions required to translate the efficacy of direct mechanisms into population-level impact will require monitoring for these domains to understand gaps and support intervention development.

HIV prevention technologies such as male and female condoms or clean injecting equipment have existed for several years. In recent years, evidence for the efficacy of other direct mechanisms, including medical male circumcision and oral PrEP, has emerged. Much is left to learn about how these mechanisms increase coverage and support adherence to achieve population-level impacts. Our review identified a range of potential interventions addressing these elements of the cascade. Supply-side interventions, such as mass condom distribution and needle and syringe exchange initiatives, have shown impact on use of these methods. However, relatively few studies have explored the effect of these interventions on HIV outcomes, and where these were studied, randomised trials have rarely been used.

Findings from demand-side interventions such as information, education, and communication and peer-based interventions on HIV outcomes have been disappointing, with these interventions rarely reducing HIV incidence or prevalence. Few trials and studies identified in the reviews evaluated interventions to increase demand for medical male circumcision or adherence to PrEP, although evidence for this domain is emerging.[115,116] There remains a need for additional research to understand why, despite supply, there is low uptake of these strategies and for evaluations of novel interventions to increase this uptake and adherence. With evidence arising on how to increase demand for medical male circumcision, systematic reviews of such strategies are warranted. As new direct mechanisms, including microbicides and vaccines, emerge, lessons learned from existing interventions could improve access.[126]

The evidence for the effectiveness of supply-side interventions is a timely reminder of the gains that can be made in HIV prevention by making prevention products accessible and available to populations in need. In circumstances where social barriers threaten efforts to reduce HIV incidence, these interventions can be effective at increasing access to HIV prevention methods and possibly reducing incidence. Policy changes are sometimes necessary to create the platforms to ensure biomedical and behavioural interventions reach and can be used by those who need them at scale. Overall, our review draws similar conclusions to Mavadzenge and colleagues:[5] there is some evidence that in-school interventions can have an impact on some HIV outcomes, and there is proven efficacy of several biomedical HIV prevention tools.

Our mapping of the literature highlights that distinction between the structural and the behavioural has not clearly distinguished interventions, and that classifying interventions this way might have created some confusion. For example, Stepping Stones was identified in reviews of interventions targeted at young people and women and in a review to explore the effect of this intervention on individual biological outcomes through to structural level changes in gender norms.[109] Similarly, an intervention of social marketing to youth for condom use was included in reviews identified through the behavioural search and the structural search.[103] These examples highlight that defining the level at which an intervention operates might be less useful than would categorising it by the objective of the intervention (eg, to increase demand for HIV prevention or support adherence).

Our review also shows the many gaps that still exist in the literature on the effectiveness of interventions for HIV prevention, particularly when it comes to demand-side, supply-side, and adherence interventions. Although we identified a large number of studies across these typologies, most were observational in design and often relied on self-reported behavioural outcomes. This might be interpreted as meaning that these studies contribute less to the evidence base for effectiveness than do those using randomised trial designs. However, observational studies are necessary and important when randomisation is either not feasible or even unethical, providing strong evidence that an intervention likely had an effect if the design is robust. As stated, our goal here is to describe the current state of HIV prevention research and to highlight key research gaps. As such, it is necessary to describe the evidence from these studies, alongside that from studies with more robust study designs to accurately map the state of the evidence.

Our mapping method has several limitations. First, our search strategy might have missed reviews of prevention technologies. However, in light of the large overlap found between the primary studies included in the reviews, we consider it unlikely that this would have led to us excluding a large number of relevant primary studies or have affected our overall conclusions. Second, because we carried out a review of reviews, we only assessed studies that were themselves included in a systematic review (no extra studies of biomedical HIV prevention interventions were included when we opened the search to primary papers). Such an approach will inevitably miss recently published studies. For example, the FACTS 001 trial, a phase 3, multicentre RCT in South Africa that evaluated the safety and effectiveness of pericoital tenofovir 1% gel, announced trial results in early 2015 and was therefore not included in any systematic reviews we identified. The study found no evidence of an effect on HIV incidence.[127] Results of two trials showing efficacy of oral PrEP in MSM were also published after our search.[118,119] The one review we identified that described cash transfer interventions included 16 studies, but at the time of publication, only three studies had reported relevant data on HIV-related outcomes. Subsequently, findings from at least one study, the HPTN 068 trial, have been released.[120]

Third, we identified a large number of primary studies of complex interventions that had components aimed at increasing demand through information, education, and communication and peer interventions. We aimed to map interventions to the HIV prevention framework by

the main intervention component. However, classification was subjective and reviewers might classify interventions differently or might have opted to categorise interventions into multiple categories. The implications of this are that we might under-report available evidence in a certain category. We opted to classify studies into only one category to avoid overstating the evidence available on HIV prevention interventions. Additionally, two reviewers discussed classification in detail and consulted a third if there was strong disagreement and so it is unlikely that any misclassification would change our findings substantially.

Fourth, where possible, we discussed the available evidence for biological HIV outcomes. However, self-reported behavioural outcomes were often the only measure of intervention effect presented in studies, particularly those describing demand-side, adherence, and supply-side interventions. Such outcomes have insufficient ability to show actual changes in behaviour; however, only including studies that reported biological HIV outcomes would have vastly reduced the number of primary studies assessed. The inclusion of studies assessing condom use as an outcome allows us to describe evidence from key interventions that align with the prevention cascade. By including these studies, we highlight evidence showing that interventions do influence proximate measures of demand, supply, and adherence.

Finally, our objective was to do a systematic review of systematic reviews. Our objective was not to assess the methodological rigour of the primary studies identified by these reviews. Our decision to categorise primary studies, rather than the reviews themselves, into the specific cascade domains was led by the large overlap across primary studies included in the reviews. As such, our review provides an overview of the rigour and strength of the evidence; however, it does not provide nuanced detail of the quality of the primary studies.[1] Given the minimal data extraction that we did at the level of the primary study, we cannot comment on heterogeneity across populations included in the studies. We appreciate that it is important to understand whether populations in studies with robust study designs and showing consistent effectiveness are similar or different to those in studies using mostly observational study designs, and demonstrating inconsistent or no effectiveness. Understanding the potential relationship between evidence quality and the populations studied is an important next step. Again, our objective was not to critically appraise primary studies or specific interventions but to map where along the prevention cascade evidence of interventions is available, the number and type of studies, and whether these studies generally supported the intervention or not. A primary goal was to highlight areas in which more research is needed.

The current evidence base on HIV prevention shows that we have methods that work at the individual level, and that the goal of ensuring population-level effect is achievable through the use of interventions that support demand for HIV prevention, supply of HIV prevention technologies, and adherence to the direct mechanisms that prevent HIV. The use of an HIV prevention cascade that includes these domains provides a framework to understand why a proven direct mechanism is failing to have a population-level impact and support the development and implementation of interventions to target these domains. Systematic reviews that explore the current evidence in the four categories identified in this paper should be done to understand fully what works, for whom, and under which circumstances. This is an essential next step for the evidence mapping we have initiated here. Future research that builds on the current evidence base and shows approaches to gaining impact for HIV prevention methods is necessary to ensure intervention effectiveness.

Contributors

SK did the search for structural reviews, developed the data extraction forms at the review and primary study level, extracted data at the review and primary study level for structural and behavioural reviews, did the evidence assessment, and contributed to the writing of the manuscript. BH conducted the search for behavioural and structural reviews, extracted data at the review and primary study level for behavioural reviews, did the evidence assessment for structural and behavioural reviews, and contributed to the writing of the manuscript. JC assisted with data extraction at the review and primary study level for behavioural reviews. JE did the search for biomedical reviews, extracted data at the review and primary study level for biomedical reviews, did the evidence assessment for biomedical reviews, and contributed to writing of the manuscript. JRH and SK conceived the idea for this paper, as commissioned by the funding source. JRH contributed to the writing of the manuscript, provided the framework upon which the evidence in this review is mapped, and provided oversight throughout all aspects of the review and writing process.

Declaration of interests

We declare no competing interests.

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Paper 2: Stigma and Judgment Toward People Living with HIV and Key Population Groups Among Three Cadres of Health Workers in South Africa and Zambia: Analysis of Data from the HPTN 071 (PopART) Tria

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Stigma and Judgment Toward People Living with HIV and Key Population Groups Among Three Cadres of Health Workers in South Africa and Zambia: Analysis of Data from the HPTN 071 (PopART) Trial

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Abstract

Stigma and judgment by health workers toward people living with HIV (PLHIV) and key populations can undermine the uptake of HIV services. In 2014, we recruited health workers delivering HIV services from 21 urban communities in South Africa and Zambia participating in the first year of the HPTN 071 (PopART) cluster-randomized trial. We analyzed self-reported levels of stigma and judgment toward (1) PLHIV, (2) women who sell sex, (3) men who have sex with men (MSM), and (4) young women who become pregnant before marriage. Using logistic regression, we compared responses between three health worker cadres and explored risk factors for stigmatizing attitudes. Highest levels of stigma and judgment were in relation to women who sell sex and MSM, especially in Zambia. Heath workers did not generally think that clients should be denied services, although this was reported slightly more commonly by community health workers. Higher education levels were associated with lower judgmental beliefs, whereas higher perceptions of coworker stigmatizing behaviors toward PLHIV and each key population were associated with holding judgmental beliefs. Training experience was not associated with judgmental attitudes for any of the key populations. Our findings confirm a high prevalence of judgmental attitudes toward key population groups but lower levels in relation to PLHIV, among all cadres of health workers in both countries. Planning and implementing targeted stigma reduction interventions within health settings are critical to meet the needs of vulnerable populations that face more stigmatizing attitudes from health workers.

Keywords: HIV, stigma, health care, key populations, judgmental attitudes

Introduction

Recent successes in the treatment and management of HIV have led to declines in global HIV incidence.[1] Despite this, the global HIV burden remains high, and the target of reducing incidence to fewer than 500,000 new infections by 2020 is challenging.[2] An ambitious cluster randomized trial, HPTN 071 (PopART), reduced incidence in urban communities by 30% through a door-to-door HIV combination prevention approach.[3] In understanding who was harder to reach through this approach, and how this might contribute to HIV incidence, it is important to consider the

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role of key populations, including men who have sex with men (MSM), adolescent girls and young women, and female sex workers, who are disproportionately affected by HIV.[2,4] Negative attitudes and beliefs about these populations by health workers could have adverse effects on the uptake of HIV services and thereby influence HIV prevention and care.

Stigma is "the co-occurrence of labelling, stereotyping, separation, status loss, and discrimination in a context in which power is exercised."[5] Moral judgment is a common manifestation of HIV stigma.[6] Stigma can act as a barrier to HIV testing and uptake of treatment,[7–10] and stigma among health workers may affect service delivery.[11–14] Perceived or anticipated stigma can reduce demand for services. Some clients, including key populations, may avoid accessing HIV services due to fear of being stigmatized by health workers who may talk badly about them or reveal their HIV status to others without their permission.[15,16] Stronger antidiscrimination policies within health settings have been called for.[17]

Stigma among health workers may hinder HIV control efforts based on a universal test-and-treat (UTT) approach.[18–20] In this model, HIV incidence reductions are achieved by increasing levels of diagnosis among those infected with HIV, starting treatment among those who are diagnosed as early as possible, and successfully maintaining viral suppression among those who initiate treatment.[20,21] Delivering these services will involve lay and trained health workers in both facility and community settings. However, health practitioners delivering an intervention based on these principles in South Africa found that community members sometimes refrained from accessing testing due to fear of being seen entering a health facility, or fear of status disclosure by health workers after being tested.[19]

Fear of "being seen" was linked to demarcated HIV services, visibility and orientation of HIV service structures, particular items and distinctive client flow in the 21 health facilities that were situated in the 21 South African and Zambian communities that were part of the HPTN 071 (PopART) trial.[22] Home, community-based or self-testing may overcome such health facility stigma barriers, but stigma may still act as a barrier to members of key populations.[23] Indeed, stigma may affect already marginalized and disempowered populations more so than others.[5] Female sex workers living with HIV in Zimbabwe reported experiencing more stigma in relation to their work than in relation to their HIV status, although their experience of discrimination by health workers was relatively low.[23]

Intersectional stigma has also been described among MSM in Swaziland.[24] It is important to understand how layered or intersectional stigma persists among key populations. Failing to understand and address them may mean that the stigma that these populations experience, and the adverse effects of these experiences, may be underestimated and therefore be more likely to persist.

A growing body of literature seeks to understand how stigma might influence health seeking practices, and how stigma among health workers might influence these behaviors in various contexts.[25–27] We set out to explore stigma and judgment toward both people living with HIV (PLHIV) and key population groups reported by health workers delivering HIV services in the 21 urban South African and Zambian communities taking part in the HPTN 071 (PopART) trial.[28,29] During the first year of the study, we compared levels of stigma and judgment toward different population groups, and between different cadres of health workers, and identified risk factors for stigmatizing attitudes.

Methods

Setting

The HPTN 071 (PopART) trial was a three-arm cluster randomized trial evaluating the effectiveness of the PopART combination HIV prevention intervention package in reducing HIV incidence. The trial was implemented in 21 study communities (7 matched triplets), 12 in Zambia and 9 in the Western Cape province, South Africa.[29] In the two treatment arms (A and B), a new cadre of community-based health workers (CHWs) known as community HIV care providers (CHiPs) were locally recruited to carry out door-to-door HIV testing and referral services. In all arms, health facility- and existing CHWs received training on the PopART intervention.

Study population

From August 2014 to May 2015, data collection took place at enrollment to an open cohort study of CHiPs (arms A and B only), and health facility staff (HFS) and CHWs (in all trial arms). By this time, the HPTN 071 (PopART) trial had been running for 8–18 months depending on the study communities.[30] Inclusion criteria for all cadres were that they had to be at least 18 years of age and able to provide informed consent for participation. All CHiPs were automatically considered eligible for the study upon recruitment to the PopART intervention team. The procedure for the selection of CHiPs is described in detail elsewhere.[29] All staff at health facilities were eligible, including doctors, nurses, laboratory technicians, cleaners, and security guards. CHWs who primarily worked in the field but were part of community HIV services and worked on a weekly basis were also eligible. For this analysis, we included 1557 participants across all three cadres of health workers who responded "yes" when asked "Do you directly provide HIV-related services to clients?" This was the enrollment survey in a cohort study that stretched from 2014 to 2018.[28]

Data collection procedures

After providing informed consent, participants completed a self-administered questionnaire on an electronic data collection device. Data were anonymized and participants were given a unique study identification number. We asked questions about sociodemographic characteristics, experience at the facility in which they work, training, job stress, experiences providing care, and stigma, including questions about their own beliefs as well as about their perceptions of the behaviors of coworkers.

Stigma measurement

The survey presented to health workers the same four statements about judgments toward four groups of people: PLHIV, "women who sell sex," MSM, and young women who become pregnant before marriage. We used the broad terminology "women who sell sex" in question wording

following local consultation. Participants were asked to respond to the statements using a 4-point Likert scale (strongly agree, agree, disagree, strongly disagree). We used standardized questions from the Nyblade et al. tool for assessing HIV stigma and discrimination in health facilities that was validated in six countries.[31]

Two statements related solely to judgmental attitudes that may be held by participants: "I would be ashamed if someone (a man, a woman, a young woman) in my family was (living with HIV, had sex with men, sold sex, became pregnant before marriage)" and, "(PLHIV, MSM, women who sell sex, or young women who become pregnant before marriage) engage in irresponsible behaviors." Two statements further linked these attitudes to aspects of health service provision: "Other people deserve access to health services more than (PLHIV, MSM, women who sell sex, or young women who become pregnant before marriage)"; and, "If I had a choice, I would prefer not to provide services to (PLHIV, MSM, women who sell sex, or young women who become pregnant before marriage)."

Data analysis

First, we enumerated the eligible population and described details of nonparticipation and nonresponse. Second, for participants included in the analysis, we described sociodemographics and job-related characteristics across the three cadres of health workers and the two countries. Third, we analyzed the levels of judgmental attitudes toward each of the different population groups within each country, and compared these between the health worker cadres adjusting for age, sex, and study triplet to reflect the cluster randomized trial design of the study. Fourth, we pooled the data and used logistic regression to explore individual risk factors associated with each of the items in turn, adjusting for age, sex, cadre of health worker, and triplet.

We restricted the analysis to health workers who had responded to all four questions about each key population. We hypothesized that stigma would be associated with sociodemographic variables and level of training: age, gender, and education level have all previously been associated with stigmatizing attitudes.[32,33]

We hypothesized that perceptions about the stigmatizing behavior of coworkers would also be associated with their own judgmental beliefs, as in other recent literature.[34] This association might occur because health workers are more likely to hold stigmatizing attitudes if they think their coworkers share the same attitudes, or because health workers who hold stigmatizing attitudes think that others share their attitudes. We repeated this final stage of the analysis in relation to each of the four groups. We report the full findings for PLHIV in this article, and for women who sell sex, MSM, and young women who become pregnant before marriage in Supplementary Tables S1–S7.

Ethics

The HPTN 071 (PopART) trial [Division of AIDS (DAIDS) number 11865 and Clinical Trials registration number NCT01900977] and the stigma ancillary study (DAIDS number HPTN071a) received Institutional Review Board approval from the London School of Hygiene and Tropical Medicine, LSHTM, the Health Research Ethics Committee, Stellenbosch University, and the Biomedical Research Ethics Committee at the University of Zambia. Written informed consent was sought and obtained from all participants for all aspects of the research.

Results

Recruitment of participants

We enumerated 2833 eligible health workers (Fig. 1). The most important reason for not being included in the analysis was difficulty in locating respondents rather than refusal. Three hundred eighteen participants (HFS = 227, CHiPs = 30, and CHWs = 61) answered "no" to the question "Do you directly provide HIV-related services to clients" and so were excluded. Ultimately, 1557 health workers were included in the analysis (66% of the total number of eligible participants), including 736 HFS, 601 CHiPs, and 220 CHWs. The response rate was highest among the CHiP workers and lowest among HFS.

Description of study populations

Across all cadres, the majority of participants were women (73.1% for HFS; 69.6% for CHiPs; 86.8% for CHWs; Table 1). Just over half of HFS and CHWs were married (57.5% and 52.7%, respectively), while just over half of CHiPs were unmarried (54.4%). More HFS and CHWs were 44 years of age or older (34.0% and 39.5%, respectively), while more CHiPs were younger (e.g., 42.9% were aged 25–34 years). HFS, 65.4%, had completed further education beyond secondary school, while CHiPs had a higher education background compared with CHWs (44.6% and 11.4% had completed further education, respectively). More than 95% of CHWs lived in the community where they were working, but that proportion was lower among CHiPs (76.2%) and lowest among HFS (58.4%).

Religion was more important to participants in Zambia (91.8%) than South Africa (74.7%). More than 95% of participants said they had ever received an HIV test. The self-reported proportion of health workers saying they had previously tested HIV positive was slightly higher among CHiPs and CHWs (19.5%, 117/601 and 22.3%, 49/220, respectively) compared with HFS (14.3%, 105/736). In Zambia, 8.7% (91/1051) of participants declined to answer this question, while in South Africa, 15.2% (77/506) did not answer the question. Zambian participants were more likely than South African participants to agree or strongly agree with the statement that their coworkers treat PLHIV poorly (17.3%, 181/1051 and 7.7%, 39/506, respectively; $p < 0.001$) or talk badly about them (36.2%, 381/1051 and 18.3%, 93/506, respectively; $p < 0.001$; Table 1).

Measures of stigma and judgment

In Zambia, 5.2% (52/1004) of respondents agreed with the statement "I would be ashamed if someone in my family had HIV." Similarly, in South Africa, 5.5% (24/435) agreed. There was no strong evidence that levels of agreement with this statement differed by health worker cadre in either country ($p_{adj} = 0.307$ in Zambia, $p_m = 0.074$ in South Africa; Table 2). A much larger proportion of health workers agreed with this statement in relation to women who sell sex in both

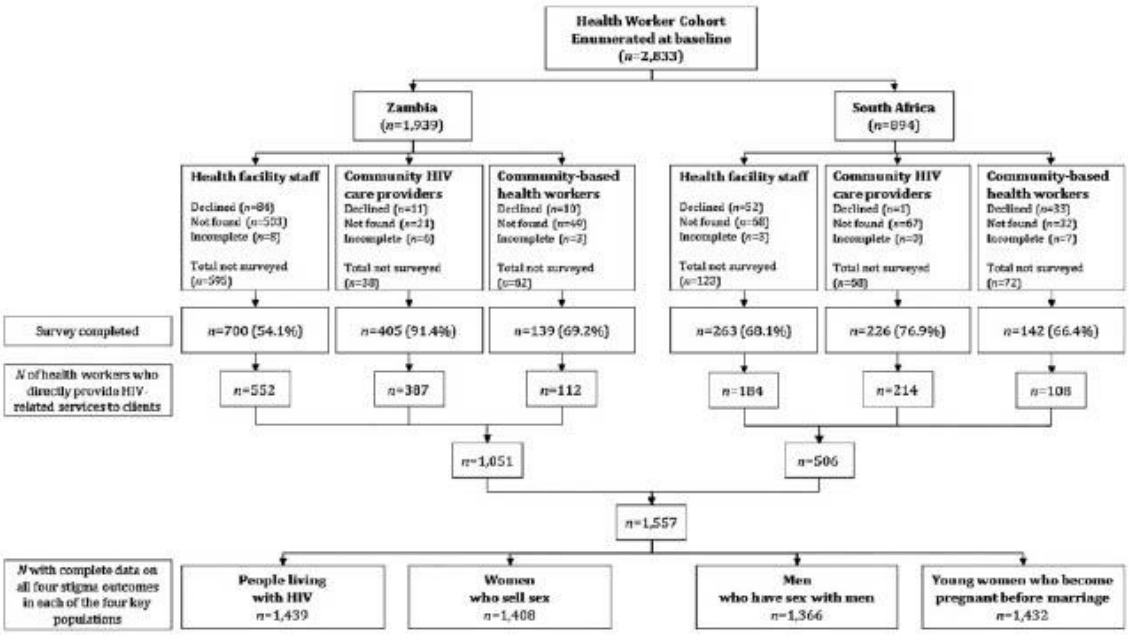

FIG. 1. Participant flow diagram.

countries. Agreement was higher in Zambia than in South Africa (81.3%, 815/1002 and 70.2%, 285/406, respectively) with little evidence of a difference between health worker cadres in either country ($p_m = 0.130$ in Zambia, and $p_m = 0.344$ in South Africa). Even higher proportions of health workers agreed to this statement in relation to MSM in Zambia (88.1%, 856/972), whereas in South Africa agreement was lower (53.0%, 209/394).

There was some evidence for a difference in judgmental attitudes toward MSM between health worker cadres in Zambia, with CHiPs and CHWs being less likely to agree compared with HFS ($p_m = 0.052$), but not in South Africa ($p_{adj} = 0.287$). In Zambia, 48.4% (517/1068) of respondents agreed that they would be ashamed if a young woman in their family became pregnant before marriage with nonsignificant differences observed between cadres despite the model being statistically significant ($p_{adj} = 0.005$). In South Africa, 31.2% (136/436) agreed with this statement with CHiPs being two times [adjusted odds ratio (aOR) = 2.10, 95% confidence interval (CI): 1.28–3.46] and CHWs being three times (aOR = 3.07, 95% CI: 1.78–5.31) more likely to agree compared with HFS ($p_{adj} < 0.001$).

Patterns of responses to the second statement, "[Key population members] engage in irresponsible behaviors," were similar to the "ashamed" statement with two exceptions. First, more participants agreed with this statement in relation to PLHIV (29.6%, 297/1004 and 26.2%, 114/435 in Zambia and South Africa, respectively), whereas fewer participants agreed in relation to MSM (76.4%, 761/996 and 29.6%, 129/436, respectively). Second, CHiPs were 1.33 times and CHWs were two times more likely, compared with HFS, to agree with the "irresponsible" statement in relation to young women who become pregnant before marriage in Zambia (aOR = 1.33, 95% CI: 1.01–1.75 and aOR = 2.15, 95% CI: 1.36–3.40, respectively; Table 2). Although most models fit the data well ($p < 0.05$ in all cases, but Zambia for MSM and South Africa for young women who become pregnant before marriage), no evidence of a difference in this statement between cadres was observed (Table 2).

In Zambia, 21.0% (221/1004) of respondents reported that: "Other people deserve access to services more than PLHIV," compared with 24.1% (105/435) in South Africa. Slightly lower proportions of health workers reported this sentiment in relation to women who sell sex (15.3%, 152/996 and 15.1%, 66/436), MSM (16.1%, 160/996 and 14.2%, 62/436), and young women who become pregnant before marriage (16.5%, 164/996 and 18.1%, 79/436) in Zambia and South Africa, respectively. In relation to all of the key population groups, CHWs were the most likely to report this sentiment [aORs (95% CI)] compared with HFS, varying from 1.95 (1.15–3.33) to 3.88 (1.90–7.92; Table 2).

Finally, in relation to the final statement "If I had a choice, I would prefer not to provide services to (key population group)," a lower proportion reported this in both countries, by each health worker cadre, and in relation to each key population group than for all previous statements. The only exception was PLHIV, where proportions were similar when compared with the "ashamed" statement. In both countries, CHWs were once again the most likely to report this sentiment [aORs (95% CI) varying from 1.06 (0.45–2.50) to 8.74 (2.85–26.77)] in comparison with HFS (Table 2).

Risk factors

Sociodemographic factors, HIV testing, HIV status, and training experience were generally not significantly associated

TABLE 1. SOCIODEMOGRAPHIC AND BEHAVIORAL CHARACTERISTICS OF 1557 HEALTH WORKERS WHO PROVIDE HIV-RELATED SERVICES BY COUNTRY

	Cadre of health worker				*Country*		
	HFS (n=736), n (%)	*CHiP (n=601), n (%)*	*CHW (n=220), n (%)*	p	*Zambia (n=1051), n (%)*	*South Africa (n=506), n (%)*	p
Cadre of health worker							**<0.001**
HFS					552 (52.5)	184 (36.4)	
CHiP					387 (36.8)	214 (42.3)	
CHW					112 (10.7)	108 (21.3)	
Age group				**<0.001**			**<0.001**
<25 years	57 (7.7)	58 (9.7)	15 (6.8)		69 (6.6)	61 (12.1)	
25–34 years	230 (31.3)	258 (42.9)	57 (25.9)		322 (30.6)	223 (44.1)	
35–44 years	199 (27.0)	142 (23.6)	61 (27.7)		267 (25.4)	135 (26.7)	
>44 year	250 (34.0)	143 (23.8)	87 (39.5)		393 (37.4)	87 (17.2)	
Sex				**<0.001**			**<0.001**
Male	198 (26.9)	183 (30.4)	29 (13.2)		340 (32.4)	70 (13.8)	
Female	538 (73.1)	418 (69.6)	191 (86.8)		711 (67.6)	436 (86.2)	
Marital status				**<0.001**			**<0.001**
Married	423 (57.5)	274 (45.6)	116 (52.7)		622 (59.2)	191 (37.7)	
Not married	313 (42.5)	327 (54.4)	104 (47.3)		429 (40.8)	315 (62.3)	
Education				**<0.001**			**<0.001**
Did not complete secondary	33 (4.5)	9 (1.5)	30 (13.6)		64 (6.1)	8 (1.6)	
Completed secondary	222 (30.2)	324 (53.9)	165 (75.0)		400 (38.1)	311 (61.5)	
Further[a]	481 (65.4)	268 (44.6)	25 (11.4)		587 (55.9)	187 (37.0)	
How important is religion to you				0.221			**<0.001**
Very important	632 (85.9)	522 (86.9)	189 (85.9)		965 (91.8)	378 (74.7)	
Important	82 (11.1)	68 (11.3)	25 (11.4)		73 (6.9)	102 (20.2)	
Somewhat important	11 (1.5)	6 (1.0)	1 (0.5)		5 (0.5)	13 (2.6)	
Not important	10 (1.4)	2 (0.3)	5 (2.3)		8 (0.8)	9 (1.8)	
Missing	1 (0.1)	3 (0.5)	0 (0.0)		0 (0.0)	4 (0.8)	
Do you live in this community				**<0.001**			**<0.001**
No	306 (41.6)	143 (23.8)	9 (4.1)		340 (32.4)	118 (23.3)	
Yes	430 (58.4)	458 (76.2)	211 (95.9)		711 (67.6)	388 (76.7)	
Have you ever tested for HIV				**0.042**			0.952
No	16 (2.2)	8 (1.3)	8 (3.6)		22 (2.1)	10 (2.0)	
Yes	711 (96.6)	592 (98.5)	211 (95.9)		1022 (97.2)	492 (97.2)	
Missing	9 (1.2)	1 (0.2)	1 (0.5)		7 (0.7)	4 (0.8)	
Please indicate the result of your last HIV test				**<0.001**			**<0.001**
Negative	549 (74.6)	428 (71.2)	132 (60.0)		742 (70.6)	367 (72.5)	
Positive	105 (14.3)	117 (19.5)	49 (22.3)		214 (20.4)	57 (11.3)	
Undetermined	3 (0.4)	2 (0.3)	4 (1.8)		4 (0.4)	5 (1.0)	
Missing	79 (10.7)	54 (9.0)	35 (15.9)		91 (8.7)	77 (15.2)	
Did you ever receive training in infection control and universal precautions (including PEP and waste management)?				**0.003**			**<0.001**
No	169 (23.0)	135 (22.5)	63 (28.6)		258 (24.5)	109 (21.5)	
Yes	532 (72.3)	419 (69.7)	134 (60.9)		747 (71.1)	338 (66.8)	
Missing	35 (4.8)	47 (7.8)	23 (10.5)		46 (4.4)	59 (11.7)	
My coworkers sometimes treat PLHIV poorly when providing them with health services				0.121			**<0.001**
Strongly disagree	265 (36.0)	240 (39.9)	73 (33.2)		356 (33.9)	222 (43.9)	
Disagree	333 (45.2)	269 (44.8)	101 (45.9)		487 (46.3)	216 (42.7)	
Agree	88 (12.0)	58 (9.7)	34 (15.5)		151 (14.4)	29 (5.7)	
Strongly agree	25 (3.4)	13 (2.2)	2 (0.9)		30 (2.9)	10 (2.0)	
Missing	25 (3.4)	21 (3.5)	10 (4.5)		27 (2.6)	29 (5.7)	

(*continued*)

TABLE 1. (CONTINUED)

	Cadre of health worker				*Country*		
	HFS (n = 736), n (%)	*CHiP (n = 601), n (%)*	*CHW (n = 220), n (%)*	p	*Zambia (n = 1051), n (%)*	*South Africa (n = 506), n (%)*	p
My coworkers sometimes talk badly about people thought to be living with HIV				0.322			**<0.001**
Strongly disagree	146 (19.8)	135 (22.5)	46 (20.9)		185 (17.6)	142 (28.1)	
Disagree	347 (47.1)	270 (44.9)	103 (46.8)		472 (44.9)	248 (49.0)	
Agree	177 (24.0)	136 (22.6)	43 (19.5)		287 (27.3)	69 (13.6)	
Strongly agree	54 (7.3)	41 (6.8)	23 (10.5)		94 (8.9)	24 (4.7)	
Missing	12 (1.6)	19 (3.2)	5 (2.3)		13 (1.2)	23 (4.5)	

[a]Completed college/university or postgraduate studies.
CHiP, community HIV care provider; CHW, community-based health worker; HFS, health facility staff; PEP, postexposure prophylaxis; PLHIV, people living with HIV.
p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

with judgmental attitudes toward PLHIV, with a few exceptions (Tables 3 and 4). Perceptions of coworkers' stigmatizing behaviors were significantly related to all four judgmental attitudes (Table 4). Female health workers were less likely to hold judgmental attitudes, and this was statistically significant in relation to the "irresponsible" statement (aOR = 0.45, 95% CI: 0.35–0.59; Table 3). Health workers who were more educated were least likely to agree with three of the statements about PLHIV (this was statistically significant with respect to the "ashamed" statement (aOR = 0.31, 95% CI: 0.10–0.94; Table 3) and yet more likely to hold stigmatizing and judgmental attitudes in relation to the "irresponsible" and "ashamed" statements for key populations. However, they were also less likely to hold such attitudes toward key populations in relation to the other two statements (not providing services and deserving access).

Health workers who perceived that their coworkers either talked badly about their clients living with HIV or treated them poorly were more likely to hold judgmental and stigmatizing attitudes ($p < 0.01$ in all cases; Table 4). Specifically, health workers who strongly agreed with the statement that coworkers treat PHLIV poorly or talk badly about them were more likely to believe that "other people deserve access to health services more than PLHIV" (aOR = 1.93, 95% CI: 1.15–3.26) or would "prefer not to provide services to PLHIV" (aOR = 8.38, 95% CI: 3.23–21.72), respectively (Table 4). Across all key populations, perceptions about coworker stigmatizing behaviors were strongly associated with agreement with all four statements (Supplementary Table S1).

We found inconsistent patterns in relation to each of the other key populations for most of the risk factors we examined (Supplementary Tables S2–S7). We found no associations between age, marital status, HIV testing and status, and training experience and agreement with statements describing stigmatizing attitudes, with a few exceptions. Older health workers (44+) were more likely to agree that they would be ashamed if a young women in their family became pregnant before marriage (aOR = 1.85, 95% CI: 1.23–2.78; Supplementary Table S6). Older health workers were also more likely to agree that young women who become pregnant before marriage and MSM engage in irresponsible behaviors [aOR = 1.81, 95% CI: 1.11–2.94 (Supplementary Table S6) and aOR = 1.65, 95% CI: 1.09–2.49 (Supplementary Table S4), respectively]. Female health workers were less likely to hold judgmental attitudes in relation to the "irresponsible" statement for young women who become pregnant before marriage (aOR = 0.76, 95% CI: 0.64–0.91; Supplementary Table S6).

Health workers who tested for HIV were less likely to hold judgmental attitudes in relation to the "provision of services" statement for women who sell sex (aOR = 0.33, 95% CI: 0.12–0.91; Supplementary Table S2) and for young women who become pregnant before marriage (aOR = 0.29, 95% CI: 0.13–0.65; Supplementary Table S6), and for the "irresponsible" statement for MSM (aOR = 0.10, 95% CI: 0.01–0.81; Supplementary Table S4). Health workers who tested positive for HIV were less likely to hold judgmental attitudes in relation to the "irresponsible" statement for women who sell sex (aOR = 0.63, 95% CI: 0.42–0.95; Supplementary Table S2) and for the "provision of services" statement for young women who become pregnant before marriage (aOR = 0.54, 95% CI: 0.31–0.97; Supplementary Table S6). Health workers who reported that religion was somewhat important were more likely to report judgmental attitudes in relation to the "access" and "provision of services" statements for women who sell sex (aOR = 3.45, 95% CI: 1.21–9.84 and aOR = 5.63, 95% CI: 1.85–17.17, respectively; Supplementary Table S2).

Discussion

We found high levels of judgmental attitudes toward key population groups among 1557 health workers delivering HIV services in 21 urban communities in South Africa and Zambia and that these attitudes were more commonly and heavily targeted at women who sell sex, MSM, and adolescents who become pregnant before marriage than PLHIV. Health workers commonly agreed with statements linking key population groups to "being ashamed" and having "engaged in irresponsible behavior," especially in relation to women who sell sex and MSM. Agreement was common, but less so, in relation to young women who get pregnant before marriage, but was relatively uncommon in relation to PLHIV. Fewer health workers reported that key populations did not

TABLE 2. LOGISTIC REGRESSION DESCRIBING HEALTH WORKERS' PERSONAL ATTITUDES TOWARD PEOPLE LIVING WITH HIV AND KEY POPULATIONS BY COUNTRY

	PLHIV (n = *1439*)		*Women who sell sex* (n = *1408*)		*MSM* (n = *1366*)		*Young women who become pregnant before marriage* (n = *1432*)	
	n/N (%)	*aORs (95% CIs)**	*n/N (%)*	*aORs (95% CIs)**	*n/N (%)*	*aORs (95% CIs)**	*n/N (%)*	*aORs (95% CIs)**
I would be ashamed if someone in my family was (key population)								
Zambia								
HFS	32/528 (6.1)	1 [0.307]†	437/523 (83.6)	1 [0.130]†	451/500 (90.2)	1 [0.052]†	257/517 (49.7)	1 [**0.005**]†
CHiP	13/373 (3.5)	0.57 (0.30–1.10)	299/373 (80.2)	0.83 (0.58–1.19)	314/366 (85.8)	0.71 (0.46–1.08)	191/371 (51.5)	0.97 (0.73–1.28)
CHW	7/103 (6.8)	1.62 (0.72–3.67)	79/106 (74.5)	0.61 (0.36–1.03)	91/106 (85.8)	0.67 (0.35–1.30)	69/108 (63.9)	1.32 (0.85–2.07)
South Africa								
HFS	8/159 (5)	1 [0.074]†	108/153 (70.6)	1 [0.344]†	75/147 (51)	1 [0.287]†	36/162 (22.2)	1 [**<0.001**]†
CHiP	6/181 (3.3)	0.55 (0.18–1.66)	119/162 (73.5)	1.27 (0.79–2.05)	83/157 (52.9)	0.96 (0.62–1.48)	58/178 (32.6)	**2.10 (1.28–3.46)**
CHW	10/95 (10.5)	2.58 (1.01–6.57)	58/91 (63.7)	0.89 (0.52–1.51)	51/90 (56.7)	1.20 (0.72–1.99)	42/96 (43.8)	**3.07 (1.78–5.31)**
(Key population) engage in irresponsible behaviors								
Zambia								
HFS	152/528 (28.8)	1 [**<0.001**]†	432/523 (82.6)	1 [**0.001**]†	387/500 (77.4)	1 [0.170]†	237/517 (45.8)	1 [**<0.001**]†
CHiP	105/373 (28.2)	0.96 (0.71–1.31)	302/373 (81)	0.92 (0.64–1.32)	287/366 (78.4)	0.98 (0.70–1.38)	203/371 (54.7)	**1.33 (1.01–1.75)**
CHW	40/103 (38.8)	1.45 (0.91–2.32)	88/106 (83)	1.13 (0.62–2.05)	87/106 (82.1)	1.10 (0.62–1.95)	73/108 (67.6)	**2.15 (1.36–3.40)**
South Africa								
HFS	47/159 (29.6)	1 [**<0.001**]†	92/153 (60.1)	1 [**0.049**]†	79/147 (53.7)	1 [**0.010**]†	63/162 (38.9)	1 [0.366]†
CHiP	36/181 (19.9)	0.67 (0.40–1.13)	93/162 (57.4)	0.94 (0.59–1.50)	67/157 (42.7)	0.80 (0.51–1.28)	60/178 (33.7)	0.86 (0.54–1.35)
CHW	31/95 (32.6)	1.44 (0.83–2.51)	55/91 (60.4)	0.93 (0.55–1.59)	43/90 (47.8)	0.80 (0.47–1.35)	37/96 (38.5)	1.09 (0.65–1.82)
Other people deserve access to health services more than (key population)								
Zambia								
HFS	90/528 (17)	1 [**0.020**]†	61/523 (11.7)	1 [**0.018**]†	68/500 (13.6)	1 [**0.017**]†	76/517 (14.7)	1 [0.088]†
CHiP	91/373 (24.4)	**1.64 (1.17–2.31)**	69/373 (18.5)	**1.78 (1.21–2.62)**	64/366 (17.5)	1.38 (0.94–2.03)	61/371 (16.4)	1.16 (0.79–1.70)
CHW	**30/103 (29.1)**	**2.23 (1.35–3.70)**	22/106 (20.8)	**2.04 (1.16–3.60)**	28/106 (26.4)	**2.42 (1.42–4.13)**	27/108 (25)	**1.95 (1.15–3.33)**
South Africa								
HFS	22/159 (13.8)	1 [**0.001**]†	14/153 (9.2)	1 [**0.002**]†	15/147 (10.2)	1 [0.106]†	20/162 (12.3)	1 [**0.020**]†
CHiP	51/181 (28.2)	**2.71 (1.53–4.82)**	27/162 (16.7)	**2.52 (1.26–5.04)**	27/157 (17.2)	2.18 (1.09–4.32)	36/178 (20.2)	1.75 (0.97–3.15)
CHW	**32/95 (33.7)**	**3.54 (1.90–6.58)**	25/91 (27.5)	**3.88 (1.90–7.92)**	20/90 (22.2)	2.90 (1.40–5.97)	23/96 (24)	**2.46 (1.30–4.64)**
If I had a choice, I would prefer not to provide services to (key population)								
Zambia								
HFS	37/528 (7)	1 [0.492]†	39/523 (7.5)	1 [0.123]†	53/500 (10.6)	1 [**0.165**]†	27/517 (5.2)	1 [0.210]†
CHiP	20/373 (5.4)	0.84 (0.48–1.48)	24/373 (6.4)	0.95 (0.55–1.63)	33/366 (9)	0.90 (0.56–1.43)	9/371 (2.4)	0.45 (0.20–0.98)
CHW	7/103 (6.8)	1.06 (0.45–2.50)	17/106 (16)	2.51 (1.27–4.95)	20/106 (18.9)	2.01 (1.08–3.73)	8/108 (7.4)	1.41 (0.57–3.48)
South Africa								
HFS	4/159 (2.5)	1 [**<0.001**]†	11/153 (7.2)	1 [**0.004**]†	9/147 (6.1)	1 [0.128]†	10/162 (6.2)	1 [**0.014**]†
CHiP	8/181 (4.4)	1.27 (0.38–4.23)	11/162 (6.8)	0.92 (0.39–2.15)	11/157 (7)	1.02 (0.42–2.47)	11/178 (6.2)	1.09 (0.45–2.63)
CHW	13/95 (13.7)	**8.74 (2.85–26.77)**	16/91 (17.6)	**2.90 (1.29–6.49)**	15/90 (16.7)	3.38 (1.46–7.83)	12/96 (12.5)	**2.90 (1.23–6.84)**

HFS is the reference category with overall p_{adj} value of the model presented in brackets.
*Adjusted for sex, age, and triplet.
†p_m Value for model.
aOR, adjusted odds ratio; CIs, confidence intervals; CHiP, community HIV care provider; CHW, community-based health worker; HFS, health facility staff; MSM, men who have sex with men; PLHIV, people living with HIV.
p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

TABLE 3. THE ASSOCIATION BETWEEN SOCIODEMOGRAPHIC CHARACTERISTICS OF HEALTH WORKERS AND FOUR STIGMA OUTCOMES FOR PEOPLE LIVING WITH HIV

		I would be ashamed if someone in my family was a person living with HIV			*PLHIV engage in irresponsible behaviors*			*If I had a choice, I would prefer not to provide services to PLHIV*			*Other people deserve access to health services more than PLHIV*		
Variable	*Categories*	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡
Sex	Male	25/386 (6.5)	1	0.082	150/386 (38.9)	1	**<0.001**	29/386 (7.5)	1	0.074	88/386 (22.8)	1	0.330
	Female	51/1053 (4.8)	0.63 (0.37–1.06)		261/1053 (24.8)	0.45 (0.35–0.59)		60/1053 (5.7)	0.64 (0.39–1.04)		228/1053 (21.7)	0.86 (0.64–1.16)	
Age	<25 years	7/117 (6.0)	1	0.594	34/117 (29.1)	1	**<0.001**	9/117 (7.7)	1	0.170	30/117 (25.6)	1	0.437
	25–34 years	24/490 (4.9)	0.80 (0.33–1.92)		115/490 (23.5)	0.71 (0.45–1.13)		21/490 (4.3)	0.54 (0.24–1.22)		99/490 (20.2)	0.74 (0.46–1.20)	
	35–44 years	16/376 (4.3)	0.66 (0.26–1.67)		101/376 (26.9)	0.87 (0.54–1.40)		23/376 (6.1)	0.78 (0.35–1.75)		84/376 (22.3)	0.89 (0.54–1.45)	
	>44 year	29/456 (6.4)	1 (0.42–2.39)		161/456 (35.3)	1.35 (0.85–2.13)		36/456 (7.9)	1 (0.46–2.19)		103/456 (22.6)	0.94 (0.57–1.52)	
Education	Did not complete secondary	5/64 (7.8)	1	**<0.001**	22/64 (34.4)	1	0.188	7/64 (10.9)	1	0.065	12/64 (18.8)	1	0.106
	Completed secondary	51/650 (7.8)	1.16 (0.43–3.17)		204/650 (31.4)	1.02 (0.58–1.81)		51/650 (7.8)	0.88 (0.37–2.12)		174/650 (26.8)	1.55 (0.79–3.07)	
	Further	20/725 (2.8)	0.31 (0.10–0.94)		185/725 (25.5)	0.80 (0.44–1.44)		31/725 (4.3)	0.49 (0.19–1.25)		130/725 (17.9)	1.18 (0.59–2.39)	
Marital status	Married	42/752 (5.6)	1	0.886	231/752 (30.7)	1	0.488	56/752 (7.4)	1	0.094	165/752 (21.9)	1	0.516
	Not married	34/687 (4.9)	0.96 (0.58–1.61)		180/687 (26.2)	0.91 (0.70–1.18)		33/687 (4.8)	0.65 (0.40–1.07)		151/687 (22.0)	0.91 (0.69–1.20)	
Religion	Very important	65/1245 (5.2)	1	0.726	354/1245 (28.4)	1	0.618	74/1245 (5.9)		0.482	276/1245 (22.2)	1	0.308
	Important	8/160 (5.0)	0.94 (0.43–2.04)		47/160 (29.4)	1.12 (0.76–1.64)		12/160 (7.5)	1.41 (0.73–2.73)		31/160 (19.4)	0.85 (0.55–1.30)	
	Somewhat important	2/17 (11.8)	2.44 (0.50–11.75)		3/17 (17.6)	0.48 (0.13–1.79)		2/17 (11.8)	2.71 (0.56–13.06)		6/17 (35.3)	2.14 (0.77–6.00)	
	Not important	1/15 (6.7)	0.87 (0.11–7.01)		6/15 (40.0)	1.29 (0.44–3.80)		1/15 (6.7)	0.85 (0.10–6.82)		2/15 (13.3)	0.51 (0.11–2.34)	
	Missing	0/2 (0.0)			1/2 (50.0)			0/2 (0.0)			1/2 (50.0)		
Ever tested	No	4/29 (13.8)	1	0.093	13/29 (44.8)	1	0.109	4/29 (13.8)	1	0.162	12/29 (41.4)	1	**0.020**
	Yes	72/1403 (5.1)	0.39 (0.13–1.17)		396/1403 (28.2)	0.54 (0.25–1.15)		85/1403 (6.1)	0.46 (0.15–1.37)		303/1403 (21.6)	0.40 (0.19–0.87)	
	Missing	0/7 (0.0)			2/7 (28.6)			0/7 (0.0)			1/7 (14.3)		
HIV status	Negative	47/1029 (4.6)	1	0.077	294/1029 (28.6)	1	0.575	58/1029 (5.6)	1	0.204	225/1029 (21.9)	1	0.302
	Positive	17/257 (6.6)	1.75 (0.94–3.24)		81/257 (31.5)	1.10 (0.80–1.51)		20/257 (7.8)	1.44 (0.82–2.53)		53/257 (20.6)	0.83 (0.58–1.18)	
	Undetermined	0/8 (0.0)			2/8 (25.0)			0/8 (0.0)			2/8 (25.0)		
	Missing	12/145 (8.3)			34/145 (23.4)			11/145 (7.6)			36/145 (24.8)		

*Proportion of health workers responding strongly agree or agree.

†The aOR for sex is adjusted for age group, cadre of health worker, and triplet; the aOR for age group is adjusted for sex, cadre of health worker, and triplet; the aOR for all other predictor variables is adjusted for sex, age group, cadre of health worker, and triplet.

‡A p value of <0.05 indicates that the predictor creates a statistically significant improvement in the fit of the model.

aOR, adjusted odds ratio; CIs, confidence intervals; *n*, number of individuals reporting the four types of stigma within groups; *N*, total number of individuals within groups; PLHIV, people living with HIV; p_w, p value of the Wald test.

p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

TABLE 4. THE ASSOCIATION BETWEEN HEALTH WORKERS' TRAINING, PERCEPTIONS OF COWORKER ATTITUDES, AND STIGMATIZING ATTITUDES WITH FOUR STIGMA OUTCOMES FOR PEOPLE LIVING WITH HIV

		I would be ashamed if someone in my family was a person living with HIV			*PLHIV engage in irresponsible behaviors*			*If I had a choice, I would prefer not to provide services to a person living with HIV*			*Other people deserve access to health services more than PLHIV*		
Variable	*Categories*	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡
Training on infection control[a]	No	17/340 (5.0)	1	0.640	94/340 (27.6)	1	0.858	16/340 (4.7)	1	0.156	68/340 (20.0)	1	0.491
	Yes	56/1019 (5.5)	1.14 (0.65–2.02)		293/1019 (28.8)	1.03 (0.77–1.36)		70/1019 (6.9)	1.50 (0.86–2.65)		219/1019 (21.5)	1.12 (0.82–1.52)	
	Missing	3/80 (3.8)			24/80 (30.0)			3/80 (3.8)			29/80 (36.3)		
My coworkers sometimes treat PLHIV poorly[b]	Strongly disagree	14/541 (2.6)	1	**<0.001**	114/541 (21.1)	1	**<0.001**	16/541 (3.0)	1	**<0.001**	90/541 (16.6)	1	**<0.001**
	Disagree	35/658 (5.3)	2.15 (1.14–4.07)		209/658 (31.8)	1.69 (1.28–2.21)		40/658 (6.1)	2.12 (1.16–3.85)		148/658 (22.5)	1.49 (1.10–2.00)	
	Agree	19/172 (11.0)	4.64 (2.23–9.66)		64/172 (37.2)	1.96 (1.33–2.89)		22/172 (12.8)	4.57 (2.29–9.11)		61/172 (35.5)	2.97 (1.98–4.45)	
	Strongly agree	7/38 (18.4)	8.00 (2.92–21.92)		19/38 (50.0)	3.16 (1.58–6.32)		8/38 (21.1)	8.38 (3.23–21.72)		12/38 (31.6)	2.78 (1.32–5.82)	
	Missing	1/30 (3.3)			5/30 (16.7)			3/30 (10.0)			5/30 (16.7)		
My coworkers sometimes talk badly about PLHIV[c]	Strongly disagree	10/297 (3.4)	1	**<0.001**	48/297 (16.2)	1	**<0.001**	7/297 (2.4)	1	**<0.001**	53/297 (17.8)	1	**0.007**
	Disagree	25/672 (3.7)	1.15 (0.54–2.45)		200/672 (29.8)	2.16 (1.51–3.11)		36/672 (5.4)	2.49 (1.09–5.73)		138/672 (20.5)	1.26 (0.88–1.81)	
	Agree	24/339 (7.1)	2.37 (1.10–5.13)		109/339 (32.2)	2.39 (1.60–3.56)		30/339 (8.8)	4.22 (1.80–9.89)		89/339 (26.3)	1.83 (1.23–2.72)	
	Strongly agree	17/114 (14.9)	5.30 (2.29–12.24)		51/114 (44.7)	4.13 (2.50–6.82)		16/114 (14.0)	6.96 (2.72–17.78)		32/114 (28.1)	1.93 (1.15–3.26)	
	Missing	0/17 (0.0)			3/17 (17.6)			0/17 (0.0)			4/17 (23.5)		

*Proportion of health workers responding strongly agree or agree.
†Adjusted for sex, age, cadre of health worker, and triplet.
‡A p value of <0.05 indicates that the predictor creates a statistically significant improvement in the fit of the model.
[a]Infection control and universal precautions (including postexposure prophylaxis and waste management).
[b]My coworkers sometimes treat PLHIV poorly when providing them.
[c]My coworkers sometimes talk badly about people thought to be living with HIV.
aOR, adjusted odds ratio; CIs, confidence intervals; *n*, number of individuals reporting the four types of stigma within groups; *N*, total number of individuals within groups; PLHIV, people living with HIV; p_w, p value of the Wald test.
p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

"deserve access to health services as much as other people," or stated that they "would prefer not to provide services" to key population groups. In relation to these statements, there were fewer differences between PLHIV and other groups; in other words, irrespective of social and health condition identity, key populations were considered to have a right to health care services by the majority of health workers. However, CHWs, including the CHiPS, employed by the HPTN071 (PopART) study, were more likely than HFS to report that "other people deserve access to health services more than the key population group."

Education level and perceptions of coworker behaviors toward PLHIV and each of the key populations were associated with holding judgmental beliefs. More educated health workers were more likely not to link "shame" and "irresponsible behavior" with PLHIV, while linking both attributes with other key populations. Health workers who reported stigma among coworkers were more likely to report judgmental views toward PLHIV and key populations. We found inconsistent patterns of association between sex, age, religion, HIV status and testing, and judgmental and stigmatizing attitudes across the four key populations. Training experience was not associated with judgmental attitudes for any of the key populations.

Ours was a large and novel study of stigma among health workers. We compared responses to questions about PLHIV and key population groups, and between different cadres of health workers involved in the delivery of HIV services. Our analyses, while robust, have some limitations. They are reflective of the inherent difficulties when assessing stigma, particularly in health facilities in high HIV prevalence settings where many health workers may be living with, or affected by, HIV in their personal lives. Health workers may misreport stigmatizing or judgmental views.[31] Despite multiple efforts to contact every eligible health worker, our participant rates were quite low in some groups, reflecting the complexity of conducting this kind of research with health workers. It is difficult to compare the response rate of participants in our study to other similar studies because these studies used different populations (often only medical students, or only nurses), and sometimes did not report response rates.[32,34–38]

Some health workers opted not to answer questions about attitudes toward women who sell sex and MSM, perhaps reflecting discomfort or embarrassment with the wording of questions. Consequently, there may be some biases in our data, perhaps with fewer people holding stigmatizing attitudes choosing to respond. In Zambia, it is also illegal for MSM and anecdotally some participants reported that this made it hard to answer the questions comfortably. This raises questions about the contextual differences that may drive stigma in different countries and how they might have influenced our findings, and other similar studies measuring stigma toward PLHIV and key populations. The study was conducted in 21 purposively selected communities participating in the trial, and caution is warranted in considering how these results may be reflective of broader patterns of stigma. To truly understand the role that stigma plays in health worker interactions with PLHIV and key populations, it is necessary to understand why health worker attitudes are the way they are, which means understanding the mechanisms that drive their behaviors. There is a wide body of literature that seeks to understand such mechanisms through theoretical frameworks of the acceptability of interventions.[39] Acceptability is the belief or consideration from those involved in the health care intervention that the intervention is appropriate, or good, based on their anticipated or experienced responses or reactions to the intervention.[39] Understanding health workers within this intervention using a framework such as this one might help to uncover underlying social and contextual factors, which may be essential for developing appropriate and effective stigma reduction interventions.

Our study is limited in that it measures stigmatizing attitudes and beliefs against knowledge about HIV and key populations, as well as training on providing care. Other factors such as social and cultural norms and job satisfaction are not assessed in the present study, and these may heavily influence health workers (HW) feelings about the acceptability of the intervention, which in turn might influence the way they think about or treat clients.

We found that there were high levels of judgment toward key population groups, but lower levels in relation to PLHIV, among all cadres of health workers in both countries. This agrees with other literatures that seek to measure intersectional stigma.[23,24] Agreement with statements about PLHIV was generally lower than previous literature has suggested.[40] Our data may be consistent with reports that stigma toward PLHIV is reducing over time as testing and treatment expand. Normalization and increased tolerance of HIV in settings where UTT approaches are used have been reported.[21]

The HPTN 071 (PopART) intervention, being universal and implemented across whole communities, hopes to "avoid stigmatization, and should encourage community-wide support for HIV prevention and care."[29] Such interventions can help to reduce fear through increasing awareness about stigma and about PLHIV. Longitudinal cohort data from our study present a unique opportunity to track these dynamics.[28] However, recent research from South Africa has indicated that normalization might not always occur.[41] Stigma toward key population groups may be more resistant to change. Within our study, this was particularly notable in Zambian communities, and in relation to MSM. Zambia has a stronger moralizing culture than South Africa as noted in wider qualitative research,[25] and pronounced prejudice toward MSM endorsed by law.[42] This demonstrates a need for program and policy changes that specifically aim to address stigma toward key populations. These changes could happen at several levels, including at the policy level (i.e., national laws that protect lesbian, gay, bisexual, transgender, and queer (LGBTQ) populations against discrimination, and those that decriminalize sex work), community level (i.e., through mass sensitization campaigns and education), or at the organizational level (i.e., training on human rights and culturally competent care for key populations).

The stigma reduction framework outlined by Nyblade et al. suggests that increased awareness about stigmatizing behaviors toward PLHIV, reducing fear surrounding HIV, and understanding how to provide nonstigmatizing care to clients are fundamental for reducing stigma.[33] This framework could be applied to key populations and scaled up to address the inherent stigmas that these populations face. Further, the main drivers of stigma and the mechanisms, which instigate stigmatizing behaviors from health workers, will be influenced

by the social norms about key populations, as well as gender, and attitudes toward LGBTQ populations. A key goal for future research will be to understand how social and cultural norms such as these can be changed so that stigma does not persist in environments outside the health setting in different country contexts.

Anticipated stigma from health workers might act as a barrier to people accessing treatment and prevention services.[8,44] We found that despite high levels of judgment, health workers were less likely to link this to whether PLHIV or key population groups deserve access to services, or whether they themselves would prefer not to provide such services. Nevertheless, 10–20% of participants did express these views in relation to key population groups. It will be important to consider over time whether the presence of judgmental attitudes acts as a barrier to PLHIV or other groups accessing services.

It was interesting that community health workers, who generally had lower levels of formal education than other groups, were more likely to agree that key population groups were less deserving of services than other health worker cadres. Interventions such as those in the HPTN 071 (PopART) study offered a chance to build on wider tolerance and empathy toward PLHIV and extend this to other key populations, and this may be an important consideration if the intervention were to be rolled out and/or replicated.[35] A study of medical students in Malaysia found that clinical encounters with PLHIV were associated with higher knowledge about HIV and lower stigmatizing attitudes.[36] Similar results were seen in a study of health care providers in Ethiopia.[32] Nevertheless, anticipated negative perceptions from health workers can hinder a person's access to HIV services.[11,12,45] Qualitative interviews with members of key population groups collected as part of our ongoing study will provide deeper insight into key population perceptions and experiences of how they are treated. The level of stigmatizing attitudes toward key populations may have hindered or lessened the effectiveness of the HPTN 071 (PopART) interventions.

For those PLHIV who know their status, intersecting stigma about living with HIV and being a member of a key population could undermine accessing key HIV treatment and prevention services. As such, members of key populations might not benefit from normalization of HIV among the wider public. We noted also that health workers' judgmental beliefs were associated with their perceptions of coworker behaviors, as in other studies.[34,37] This might be because health workers are influenced by their peers, or because they believe peers hold the same beliefs as they do. Stigma reduction activities within health settings might work best when reaching all staff working in a health facility, and workplace-based antistigma campaigns might benefit from peer-led interventions and activities in an effort to facilitate a more tolerant environment.

Our findings highlight several factors within health settings, and based on HWs' previous interactions with PLHIV and key populations, but they do not interrogate the contextual or societal factors that might heavily contribute to HW attitudes, perceptions, and beliefs. To understand if and how stigma among HWs drives HIV testing and treatment, it is essential to understand the wider context in which they exist. This will be useful for the development of effective interventions to reduce stigma among this and other populations.

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Supplementary Material

Supplementary Table S1
Supplementary Table S2
Supplementary Table S3
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Supplementary Table S5
Supplementary Table S6
Supplementary Table S7

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Supplementary Data

SUPPLEMENTARY TABLE S1. TRAINING AND PERCEPTIONS OF COWORKER STIGMA AMONG 1557 HEALTH WORKERS WHO PROVIDE HIV-RELATED SERVICES BY COUNTRY

	Cadre of health worker				*Country*		
	HFS (n=736), n (%)	*CHiP (n=601), n (%)*	*CHW (n=220), n (%)*	p	*Zambia (n=1051), n (%)*	*South Africa (n=506), n (%)*	p
Did you ever receive training in infection control and universal precautions (including PEP and waste management)?				0.003			**<0.001**
No	169 (23.0)	135 (22.5)	63 (28.6)		258 (24.5)	109 (21.5)	
Yes	532 (72.3)	419 (69.7)	134 (60.9)		747 (71.1)	338 (66.8)	
Missing	35 (4.8)	47 (7.8)	23 (10.5)		46 (4.4)	59 (11.7)	
Did you ever receive training in client confidentiality?				**<0.001**			0.163
No	34 (4.6)	3 (0.5)	16 (7.3)		35 (3.3)	18 (3.6)	
Yes	687 (93.3)	598 (99.5)	200 (90.9)		1007 (95.8)	478 (94.5)	
Missing	15 (2.0)	0 (0.0)	4 (1.8)		9 (0.9)	10 (2.0)	
Did you ever receive training in providing reproductive health services and information to young people?				0.154			**0.002**
No	117 (15.9)	78 (13.0)	25 (11.4)		170 (16.2)	50 (9.9)	
Yes	606 (82.3)	516 (85.9)	194 (88.2)		865 (82.3)	451 (89.1)	
Missing	13 (1.8)	7 (1.2)	1 (0.5)		16 (1.5)	5 (1.0)	
Did you ever receive training in HIV-related stigma and discrimination in the workplace?				**<0.001**			**<0.001**
No	209 (28.4)	101 (16.8)	60 (27.3)		247 (23.5)	123 (24.3)	
Yes	508 (69.0)	482 (80.2)	156 (70.9)		789 (75.1)	357 (70.6)	
Missing	19 (2.6)	18 (3.0)	4 (1.8)		15 (1.4)	26 (5.1)	
Did you ever receive training in providing health services to women who sell sex?				**<0.001**			**<0.001**
No	306 (41.6)	142 (23.6)	69 (31.4)		343 (32.6)	174 (34.4)	
Yes	394 (53.5)	430 (71.5)	138 (62.7)		680 (64.7)	282 (55.7)	
Missing	36 (4.9)	29 (4.8)	13 (5.9)		28 (2.7)	50 (9.9)	
Did you ever receive training in providing health services to MSM?				**<0.001**			**<0.001**
No	388 (52.7)	193 (32.1)	80 (36.4)		516 (49.1)	145 (28.7)	
Yes	318 (43.2)	375 (62.4)	127 (57.7)		502 (47.8)	318 (62.8)	
Missing	30 (4.1)	33 (5.5)	13 (5.9)		33 (3.1)	43 (8.5)	

(*continued*)

SUPPLEMENTARY TABLE S1. (CONTINUED)

	Cadre of health worker				*Country*		
	HFS (n=736), n (%)	*CHiP (n=601), n (%)*	*CHW (n=220), n (%)*	p	*Zambia (n=1051), n (%)*	*South Africa (n=506), n (%)*	p
My coworkers sometimes treat people living with HIV poorly when providing them with health services				0.121			**<0.001**
Strongly disagree	265 (36.0)	240 (39.9)	73 (33.2)		356 (33.9)	222 (43.9)	
Disagree	333 (45.2)	269 (44.8)	101 (45.9)		487 (46.3)	216 (42.7)	
Agree	88 (12.0)	58 (9.7)	34 (15.5)		151 (14.4)	29 (5.7)	
Strongly agree	25 (3.4)	13 (2.2)	2 (0.9)		30 (2.9)	10 (2.0)	
Missing	25 (3.4)	21 (3.5)	10 (4.5)		27 (2.6)	29 (5.7)	
My coworkers sometimes talk badly about people thought to be living with HIV				0.322			**<0.001**
Strongly disagree	146 (19.8)	135 (22.5)	46 (20.9)		185 (17.6)	142 (28.1)	
Disagree	347 (47.1)	270 (44.9)	103 (46.8)		472 (44.9)	248 (49.0)	
Agree	177 (24.0)	136 (22.6)	43 (19.5)		287 (27.3)	69 (13.6)	
Strongly agree	54 (7.3)	41 (6.8)	23 (10.5)		94 (8.9)	24 (4.7)	
Missing	12 (1.6)	19 (3.2)	5 (2.3)		13 (1.2)	23 (4.5)	
My coworkers sometimes treat women who sell sex poorly when providing them with health services				0.242			**<0.001**
Strongly disagree	185 (25.1)	128 (21.3)	50 (22.7)		240 (22.8)	123 (24.3)	
Disagree	365 (49.6)	346 (57.6)	115 (52.3)		554 (52.7)	272 (53.8)	
Agree	97 (13.2)	70 (11.6)	29 (13.2)		160 (15.2)	36 (7.1)	
Strongly agree	37 (5.0)	26 (4.3)	14 (6.4)		57 (5.4)	20 (4.0)	
Missing	52 (7.1)	31 (5.2)	12 (5.5)		40 (3.8)	55 (10.9)	
My coworkers sometimes talk badly about women who sell sex				**0.004**			**<0.001**
Strongly disagree	65 (8.8)	45 (7.5)	26 (11.8)		86 (8.2)	50 (9.9)	
Disagree	178 (24.2)	200 (33.3)	76 (34.5)		256 (24.4)	198 (39.1)	
Agree	316 (42.9)	225 (37.4)	80 (36.4)		480 (45.7)	141 (27.9)	
Strongly agree	121 (16.4)	93 (15.5)	27 (12.3)		187 (17.8)	54 (10.7)	
Missing	56 (7.6)	38 (6.3)	11 (5.0)		42 (4.0)	63 (12.5)	
My coworkers sometimes treat MSM poorly when providing them with health services				**0.001**			**<0.001**
Strongly disagree	189 (25.7)	116 (19.3)	37 (16.8)		233 (22.2)	109 (21.5)	
Disagree	362 (49.2)	353 (58.7)	121 (55.0)		539 (51.3)	297 (58.7)	
Agree	72 (9.8)	52 (8.7)	35 (15.9)		122 (11.6)	37 (7.3)	
Strongly agree	50 (6.8)	37 (6.2)	16 (7.3)		86 (8.2)	17 (3.4)	
Missing	63 (8.6)	43 (7.2)	11 (5.0)		71 (6.8)	46 (9.1)	

(*continued*)

SUPPLEMENTARY TABLE S1. (CONTINUED)

	Cadre of health worker				*Country*		
	HFS (n=736), n (%)	*CHiP (n=601), n (%)*	*CHW (n=220), n (%)*	p	*Zambia (n=1051), n (%)*	*South Africa (n=506), n (%)*	p
My coworkers sometimes talk badly about men who are thought to have sex with men				**0.019**			**<0.001**
Strongly disagree	80 (10.9)	49 (8.2)	21 (9.5)		73 (6.9)	77 (15.2)	
Disagree	190 (25.8)	211 (35.1)	76 (34.5)		256 (24.4)	221 (43.7)	
Agree	272 (37.0)	210 (34.9)	76 (34.5)		434 (41.3)	124 (24.5)	
Strongly agree	141 (19.2)	90 (15.0)	36 (16.4)		225 (21.4)	42 (8.3)	
Missing					63 (6.0)	42 (8.3)	
My coworkers sometimes treat young women who become pregnant before marriage poorly when providing them with health services				0.197			**<0.001**
Strongly disagree	196 (26.6)	140 (23.3)	47 (21.4)		248 (23.6)	135 (26.7)	
Disagree	372 (50.5)	339 (56.4)	114 (51.8)		535 (50.9)	290 (57.3)	
Agree	124 (16.8)	81 (13.5)	45 (20.5)		205 (19.5)	45 (8.9)	
Strongly agree	21 (2.9)	22 (3.7)	8 (3.6)		42 (4.0)	9 (1.8)	
Missing	23 (3.1)	19 (3.2)	6 (2.7)		21 (2.0)	27 (5.3)	
My coworkers sometimes talk badly about young women who become pregnant before marriage				**0.005**			**<0.001**
Strongly disagree	119 (16.2)	88 (14.6)	31 (14.1)		133 (12.7)	105 (20.8)	
Disagree	265 (36.0)	269 (44.8)	96 (43.6)		366 (34.8)	264 (52.2)	
Agree	275 (37.4)	184 (30.6)	60 (27.3)		428 (40.7)	91 (18.0)	
Strongly agree	48 (6.5)	36 (6.0)	25 (11.4)		90 (8.6)	19 (3.8)	
Missing	29 (3.9)	24 (4.0)	8 (3.6)		34 (3.2)	27 (5.3)	

CHiP, community HIV care provider; CHW, community-based health worker; HFS, health facility staff; MSM, men who have sex with men; PEP, postexposure prophylaxis.
p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

SUPPLEMENTARY TABLE S2. THE ASSOCIATION BETWEEN SOCIODEMOGRAPHIC CHARACTERISTICS OF HEALTH WORKERS WITH FOUR STIGMA OUTCOMES FOR WOMEN WHO SELL SEX

		I would be ashamed if a woman in my family sold sex			*Other people deserve access to health services more than women who sell sex*			*If I had a choice, I would prefer not to provide services to women who sell sex*			*Women who sell sex engage in irresponsible behaviors*		
Variable	*Categories*	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡
Sex	Male	305/389 (78.4)	1	0.853	60/389 (15.4)	1	0.875	33/389 (8.5)	1	0.665	295/389 (75.8)	1	0.799
	Female	795/1019 (78.0)	0.97 (0.69–1.35)		158/1019 (15.5)	0.98 (0.74–1.30)		85/1019 (8.3)	0.94 (0.69–1.26)		767/1019 (75.3)	0.95 (0.65–1.40)	
Age	<25 years	93/115 (80.9)	1	0.782	20/115 (17.4)	1	0.111	13/115 (11.3)	1	0.210	91/115 (79.1)	1	0.298
	25–34 years	371/481 (77.1)	0.80 (0.47–1.36)		63/481 (13.1)	0.71 (0.48–1.07)		29/481 (6.0)	0.50 (0.23–1.11)		350/481 (72.8)	0.70 (0.45–1.11)	
	35–44 years	279/360 (77.5)	0.82 (0.39–1.70)		57/360 (15.8)	0.89 (0.51–1.56)		31/360 (8.6)	0.74 (0.42–1.32)		279/360 (77.5)	0.91 (0.50–1.66)	
	>44 years	357/452 (79.0)	0.89 (0.45–1.75)		78/452 (17.3)	0.99 (0.59–1.67)		45/452 (10.0)	0.87 (0.43–1.77)		342/452 (75.7)	0.82 (0.44–1.54)	
Education	Did not complete secondary	49/68 (72.1)	1	**<0.001**	13/68 (19.1)	1	**0.001**	10/68 (14.7)	1	**<0.001**	43/68 (63.2)	1	**<0.001**
	Completed secondary	468/624 (75.0)	1.26 (0.80–1.97)		121/624 (19.4)	1.05 (0.54–2.01)		68/624 (10.9)	0.73 (0.25–2.13)		430/624 (68.9)	1.47 (0.81–2.66)	
	Further	583/716 (81.4)	1.91 (1.14–3.20)		84/716 (11.7)	0.59 (0.35–1.01)		40/716 (5.6)	0.37 (0.14–0.94)		589/716 (82.3)	3.31 (1.99–5.50)	
Marital status	Married	584/749 (78.0)	1.00	0.960	119/749 (15.9)	1.00	0.755	64/749 (8.5)	1.00	0.826	568/749 (75.8)	1	0.798
	Not married	516/659 (78.3)	1.00 (0.85–1.19)		99/659 (15.0)	0.95 (0.66–1.35)		54/659 (8.2)	0.96 (0.65–1.41)		494/659 (75.0)	0.96 (0.69–1.33)	
Religion	Very important	964/1226 (78.6)	1	0.806	193/1226 (15.7)	1	**0.043**	100/1226 (8.2)	1	**0.010**	933/1226 (76.1)	1	0.770
	Important	110/149 (73.8)	0.91 (0.61–1.37)		19/149 (12.8)	0.81 (0.48–1.36)		13/149 (8.7)	1.14 (0.61–2.14)		106/149 (71.1)	1.09 (0.72–1.63)	
	Somewhat important	14/17 (82.4)	1.66 (0.46–5.91)		6/17 (35.3)	3.45 (1.21–9.84)		5/17 (29.4)	5.63 (1.85–17.17)		10/17 (58.8)	0.78 (0.28–2.19)	
	Not important	10/14 (71.4)	0.79 (0.24–2.63)		0/14 (0.0)	—		0/14 (0.0)	-		11/14 (78.6)	1.79 (0.47–6.83)	
	Missing	2/2 (100.0)			0/2 (0.0)			0/2 (0.0)			2/2 (100.0)		
Ever tested	No	20/27 (74.1)	1	0.618	8/27 (29.6)	1	0.121	6/27 (22.2)	1	**0.032**	20/27 (74.1)	1	0.806
	Yes	1073/1374 (78.1)	1.27 (0.49–3.28)		210/1374 (15.3)	0.45 (0.16–1.23)		112/1374 (8.2)	0.33 (0.12–0.91)		1035/1374 (75.3)	1.10 (0.52–2.35)	
	Missing	7/7 (100.0)			0/7 (0.0)			0/7 (0.0)			7/7 (100.0)		
HIV status	Negative	789/1003 (78.7)	1	0.530	145/1003 (14.5)	1	0.288	83/1003 (8.3)	1	0.348	768/1003 (76.6)	1	**0.028**
	Positive	198/257 (77.0)	0.90 (0.65–1.25)		46/257 (17.9)	1.25 (0.83–1.87)		18/257 (7.0)	0.78 (0.47–1.30)		175/257 (68.1)	0.63 (0.42–0.95)	
	Undetermined	5/8 (62.5)			1/8 (12.5)			1/8 (12.5)			8/8 (100.0)		
	Missing	108/140 (77.1)			26/140 (18.6)			16/140 (11.4)			111/140 (79.3)		

*Proportion of health workers responding strongly agree or agree.
†The aOR for sex is adjusted for age group; the aOR for age group is adjusted for sex; the aOR for all other predictor variables is adjusted for sex and age group.
‡A p value of <0.05 indicates that the predictor creates a statistically significant improvement in the fit of the model.
aOR, adjusted odds ratio; CIs, confidence intervals; n, number of individuals reporting four types of stigma within groups; N, total number of individuals within groups; p_w, p value of the Wald test.
p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

SUPPLEMENTARY TABLE S3. THE ASSOCIATION BETWEEN HEALTH WORKER TRAINING, PERCEPTIONS OF COWORKER ATTITUDES, AND STIGMATIZING ATTITUDES WITH FOUR STIGMA OUTCOMES FOR WOMEN WHO SELL SEX

		I would be ashamed if a woman in my family sold sex			*Other people deserve access to health services more than women who sell sex*			*If I had a choice, I would prefer not to provide services to women who sell sex*			*Women who sell sex engage in irresponsible behaviors*		
Variable	*Categories*	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡
Training on infection control[a]	No	261/334 (78.1)	1	0.794	40/334 (12.0)	1	0.206	27/334 (8.1)	1	0.749	266/334 (79.6)	1	0.092
	Yes	789/1001 (78.8)	1.04 (0.79–1.35)		159/1001 (15.9)	1.36 (0.85–2.17)		79/1001 (7.9)	0.93 (0.59–1.46)		744/1001 (74.3)	0.73 (0.50–1.05)	
	Missing	50/73 (68.5)			19/73 (26.0)			12/73 (16.4)			52/73 (71.2)		
My coworkers sometimes treat people living with HIV poorly[b]	Strongly disagree	398/524 (76.0)	1	**0.048**	54/524 (10.3)	1	**<0.001**	28/524 (5.3)	1	**<0.001**	357/524 (68.1)	1	**<0.001**
	Disagree	504/653 (77.2)	1.07 (0.82–1.40)		105/653 (16.1)	1.65 (1.10–2.48)		50/653 (7.7)	1.45 (0.97–2.16)		513/653 (78.6)	1.70 (1.32–2.18)	
	Agree	144/166 (86.7)	2.07 (1.22–3.52)		42/166 (25.3)	2.96 (1.89–4.63)		29/166 (17.5)	3.74 (2.02–6.91)		140/166 (84.3)	2.48 (1.54–3.99)	
	Strongly agree	30/37 (81.1)	1.36 (0.61–3.00)		13/37 (35.1)	4.75 (2.68–8.41)		8/37 (21.6)	4.90 (2.00–11.96)		28/37 (75.7)	1.44 (0.61–3.41)	
	Missing	24/28 (85.7)			4/28 (14.3)			3/28 (10.7)			24/28 (85.7)		
My coworkers sometimes talk badly about PLHIV[c]	Strongly disagree	206/290 (71.0)	1	**<0.001**	28/290 (9.7)	1	**<0.001**	14/290 (4.8)	1	**<0.001**	196/290 (67.6)	1	**<0.001**
	Disagree	509/655 (77.7)	1.45 (1.04–2.01)		97/655 (14.8)	1.63 (0.99–2.70)		46/655 (7.0)	1.51 (1.04–2.18)		476/655 (72.7)	1.28 (0.92–1.80)	
	Agree	275/334 (82.3)	1.92 (1.30–2.83)		62/334 (18.6)	2.12 (1.36–3.32)		39/334 (11.7)	2.59 (1.60–4.20)		289/334 (86.5)	3.08 (1.99–4.77)	
	Strongly agree	97/112 (86.6)	2.68 (1.40–5.10)		30/112 (26.8)	3.40 (2.16–5.37)		18/112 (16.1)	3.76 (1.73–8.16)		89/112 (79.5)	1.86 (1.21–2.86)	
	Missing	13/17 (76.5)			1/17 (5.9)			1/17 (5.9)			12/17 (70.6)		
I would be ashamed if someone in my family had HIV[d]	Strongly disagree	539/704 (76.6)	1	0.103	73/704 (10.4)	1	**<0.001**	29/704 (4.1)	1	**<0.001**	518/704 (73.6)	1	0.364
	Disagree	492/614 (80.1)	1.23 (1.03–1.46)		114/614 (18.6)	1.95 (1.60–2.38)		62/614 (10.1)	2.56 (1.88–3.49)		476/614 (77.5)	1.22 (0.97–1.55)	
	Agree	31/39 (79.5)	1.18 (0.51–2.70)		14/39 (35.9)	4.81 (2.45–9.42)		13/39 (33.3)	11.49 (6.13–21.53)		30/39 (76.9)	1.16 (0.57–2.35)	
	Strongly agree	30/40 (75.0)	0.89 (0.42–1.89)		16/40 (40.0)	5.59 (2.69–11.64)		12/40 (30.0)	9.56 (4.36–20.94)		31/40 (77.5)	1.23 (0.62–2.47)	
	Missing	8/11 (72.7)			1/11 (9.1)			2/11 (18.2)			7/11 (63.6)		
PLHIV engage in irresponsible behaviors[e]	Strongly disagree	255/346 (73.7)	1	**0.008**	36/346 (10.4)	1	**<0.001**	12/346 (3.5)	1	**0.001**	231/346 (66.8)	1	**<0.001**
	Disagree	487/630 (77.3)	1.22 (0.83–1.79)		97/630 (15.4)	1.57 (0.99–2.49)		54/630 (8.6)	2.63 (1.22–5.68)		476/630 (75.6)	1.55 (1.09–2.20)	
	Agree	242/299 (80.9)	1.51 (0.98–2.32)		62/299 (20.7)	2.20 (1.57–3.10)		36/299 (12.0)	3.74 (1.78–7.87)		249/299 (83.3)	2.51 (1.68–3.74)	
	Strongly agree	91/106 (85.8)	2.16 (1.36–3.41)		19/106 (17.9)	1.83 (1.19–2.82)		13/106 (12.3)	3.85 (1.40–10.62)		87/106 (82.1)	2.36 (1.33–4.19)	
	Missing	25/27 (92.6)			4/27 (14.8)			3/27 (11.1)			19/27 (70.4)		
Other people deserve access to services more than PLHIV[f]	Strongly disagree	387/490 (79.0)	1	0.621	24/490 (4.9)	1	**<0.001**	17/490 (3.5)	1	**<0.001**	357/490 (72.9)	1	0.278
	Disagree	442/570 (77.5)	0.91 (0.68–1.22)		54/570 (9.5)	2.00 (1.18–3.41)		38/570 (6.7)	1.93 (1.02–3.62)		432/570 (75.8)	1.14 (0.86–1.51)	
	Agree	182/229 (79.5)	1.02 (0.67–1.55)		104/229 (45.4)	16.02 (10.93–23.48)		47/229 (20.5)	6.98 (3.85–12.64)		185/229 (80.8)	1.54 (0.93–2.54)	
	Strongly agree	61/82 (74.4)	0.77 (0.46–1.29)		32/82 (39.0)	12.23 (6.78–22.06)		9/82 (11.0)	3.34 (1.90–5.85)		61/82 (74.4)	1.07 (0.56–2.04)	
	Missing	28/37 (75.7)			4/37 (10.8)			7/37 (18.9)			27/37 (73.0)		
Prefer not to provide services to PLHIV[g]	Strongly disagree	574/740 (77.6)	1	0.798	71/740 (9.6)	1	**<0.001**	31/740 (4.2)	1	**<0.001**	546/740 (73.8)	1	0.283
	Disagree	447/568 (78.7)	1.06 (0.88–1.28)		105/568 (18.5)	2.10 (1.50–2.95)		53/568 (9.3)	2.28 (1.27–4.11)		441/568 (77.6)	1.21 (0.94–1.57)	
	Agree	43/53 (81.1)	1.22 (0.56–2.66)		26/53 (49.1)	8.88 (5.46–14.44)		23/53 (43.4)	16.84 (8.38–33.83)		38/53 (71.7)	0.87 (0.42–1.81)	
	Strongly agree	30/39 (76.9)	0.94 (0.49–1.83)		13/39 (33.3)	4.56 (2.21–9.39)		8/39 (20.5)	5.65 (2.13–14.98)		31/39 (79.5)	1.35 (0.76–2.39)	
	Missing	6/8 (75.0)			3/8 (37.5)			3/8 (37.5)			6/8 (75.0)		

(*continued*)

SUPPLEMENTARY TABLE S3. (CONTINUED)

Variable	Categories	*I would be ashamed if a woman in my family sold sex*			*Other people deserve access to health services more than women who sell sex*			*If I had a choice, I would prefer not to provide services to women who sell sex*			*Women who sell sex engage in irresponsible behaviors*		
		n/N (%)*	aOR (95% CIs)†	p_w‡	n/N (%)*	aOR (95% CIs)†	p_w‡	n/N (%)*	aOR (95% CIs)†	p_w‡	n/N (%)*	aOR (95% CIs)†	p_w‡
I would be ashamed if a man in my family had sex with other men[h]	Strongly disagree	35/80 (43.8)	1	**<0.001**	12/80 (15.0)	1	0.426	6/80 (7.5)	1	0.603	46/80 (57.5)	1	**<0.001**
	Disagree	105/220 (47.7)	1.15 (0.69–1.94)		26/220 (11.8)	0.77 (0.35–1.71)		13/220 (5.9)	0.79 (0.27–2.29)		110/220 (50.0)	0.73 (0.50–1.05)	
	Agree	464/557 (83.3)	6.40 (4.50–9.11)		97/557 (17.4)	1.18 (0.63–2.18)		50/557 (9.0)	1.18 (0.48–2.89)		449/557 (80.6)	3.05 (2.04–4.57)	
	Strongly agree	489/539 (90.7)	12.62 (7.09–22.49)		81/539 (15.0)	0.99 (0.55–1.78)		49/539 (9.1)	1.22 (0.51–2.89)		452/539 (83.9)	3.85 (2.28–6.50)	
	Missing	7/12 (58.3)			2/12 (16.7)			0/12 (0.0)			5/12 (41.7)		
MSM engage in irresponsible behaviors[i]	Strongly disagree	61/91 (67.0)	1	**<0.001**	8/91 (8.8)	1	**<0.001**	2/91 (2.2)	1	0.089	32/91 (35.2)	1	**<0.001**
	Disagree	204/313 (65.2)	0.91 (0.42–1.97)		38/313 (12.1)	1.47 (0.44–4.87)		25/313 (8.0)	4.07 (0.78–21.38)		154/313 (49.2)	1.73 (1.05–2.85)	
	Agree	539/647 (83.3)	2.44 (1.13–5.28)		110/647 (17.0)	2.09 (0.75–5.82)		52/647 (8.0)	3.81 (1.04–13.88)		565/647 (87.3)	12.59 (8.14–19.48)	
	Strongly agree	259/302 (85.8)	2.97 (1.24–7.08)		58/302 (19.2)	2.47 (0.95–6.42)		34/302 (11.3)	5.65 (1.24–25.77)		278/302 (92.1)	21.24 (12.30–36.65)	
	Missing	37/55 (67.3)			4/55 (7.3)			5/55 (9.1)			33/55 (60.0)		
Other people deserve access to services more than MSM[j]	Strongly disagree	340/445 (76.4)	1	0.177	14/445 (3.1)	1	**<0.001**	6/445 (1.3)	1	**<0.001**	314/445 (70.6)	1	0.061
	Disagree	561/720 (77.9)	1.08 (0.80–1.46)		58/720 (8.1)	2.65 (1.22–5.75)		53/720 (7.4)	5.69 (2.54–12.73)		560/720 (77.8)	1.43 (1.09–1.88)	
	Agree	135/163 (82.8)	1.47 (1.00–2.14)		104/163 (63.8)	54.16 (26.03–112.67)		41/163 (25.2)	23.95 (10.19–56.30)		127/163 (77.9)	1.44 (0.94–2.19)	
	Strongly agree	47/59 (79.7)	1.20 (0.50–2.88)		37/59 (62.7)	51.61 (21.47–124.02)		15/59 (25.4)	24.44 (10.26–58.21)		46/59 (78.0)	1.44 (0.78–2.67)	
	Missing	17/21 (81.0)			5/21 (23.8)			3/21 (14.3)			15/21 (71.4)		
Prefer not to provide services to MSM[k]	Strongly disagree	365/486 (75.1)	1	**0.008**	46/486 (9.5)	1	**<0.001**	12/486 (2.5)	1	**<0.001**	340/486 (70.0)	1	**0.008**
	Disagree	613/768 (79.8)	1.31 (0.98–1.74)		106/768 (13.8)	1.50 (0.93–2.42)		40/768 (5.2)	2.09 (0.91–4.82)		605/768 (78.8)	1.57 (1.18–2.08)	
	Agree	77/90 (85.6)	1.93 (1.04–3.59)		42/90 (46.7)	8.20 (5.21–12.92)		44/90 (48.9)	36.90 (18.56–73.35)		70/90 (77.8)	1.47 (0.75–2.90)	
	Strongly agree	34/48 (70.8)	0.79 (0.43–1.45)		22/48 (45.8)	7.94 (4.24–14.90)		21/48 (43.8)	30.41 (17.85–51.81)		39/48 (81.3)	1.84 (0.70–4.88)	
	Missing	11/16 (68.8)			2/16 (12.5)			1/16 (6.3)			8/16 (50.0)		
I would be ashamed if a young woman in my family became pregnant before marriage[l]	Strongly disagree	146/239 (61.1)	1	**<0.001**	19/239 (7.9)	1	**0.017**	15/239 (6.3)	1	**0.039**	150/239 (62.8)	1	**<0.001**
	Disagree	372/508 (73.2)	1.75 (1.28–2.41)		75/508 (14.8)	2.03 (1.10–3.78)		34/508 (6.7)	1.08 (0.54–2.20)		361/508 (71.1)	1.45 (1.00–2.09)	
	Agree	400/450 (88.9)	5.17 (3.65–7.32)		83/450 (18.4)	2.61 (1.35–5.05)		47/450 (10.4)	1.72 (1.04–2.86)		381/450 (84.7)	3.26 (2.03–5.23)	
	Strongly agree	166/191 (86.9)	4.28 (2.70–6.78)		38/191 (19.9)	2.85 (1.39–5.84)		20/191 (10.5)	1.71 (0.83–3.52)		153/191 (80.1)	2.38 (1.28–4.41)	
	Missing	16/20 (80.0)			3/20 (15.0)			2/20 (10.0)			17/20 (85.0)		
Young women who become pregnant before marriage engage in irresponsible behaviors[m]	Strongly disagree	101/156 (64.7)	1	**<0.001**	15/156 (9.6)	1	**<0.001**	8/156 (5.1)	1	**0.001**	82/156 (52.6)	1	**<0.001**
	Disagree	415/574 (72.3)	1.43 (0.82–2.49)		68/574 (11.8)	1.27 (0.64–2.56)		35/574 (6.1)	1.23 (0.55–2.73)		382/574 (66.6)	1.80 (1.20–2.69)	
	Agree	467/543 (86.0)	3.40 (1.92–6.02)		101/543 (18.6)	2.16 (1.09–4.27)		62/543 (11.4)	2.42 (1.25–4.66)		479/543 (88.2)	6.80 (4.47–10.33)	
	Strongly agree	102/118 (86.4)	3.55 (1.63–7.72)		30/118 (25.4)	3.24 (1.59–6.64)		11/118 (9.3)	1.94 (0.93–4.05)		106/118 (89.8)	8.19 (4.12–16.27)	
	Missing	15/17 (88.2)			4/17 (23.5)			2/17 (11.8)			13/17 (76.5)		
Other people deserve access to services more than young women who become pregnant before marriage[n]	Strongly disagree	372/476 (78.2)	1	**0.045**	14/476 (2.9)	1	**<0.001**	16/476 (3.4)	1	**<0.001**	334/476 (70.2)	1	**0.016**
	Disagree	521/676 (77.1)	0.94 (0.66–1.33)		57/676 (8.4)	3.03 (1.75–5.28)		42/676 (6.2)	1.86 (1.02–3.38)		530/676 (78.4)	1.53 (1.11–2.09)	
	Agree	155/182 (85.2)	1.60 (0.99–2.58)		109/182 (59.9)	49.53 (24.49–100.18)		41/182 (22.5)	8.08 (3.99–16.38)		142/182 (78.0)	1.48 (1.00–2.17)	
	Strongly agree	39/57 (68.4)	0.60 (0.37–0.97)		33/57 (57.9)	45.24 (21.33–95.94)		15/57 (26.3)	9.88 (5.65–17.29)		43/57 (75.4)	1.27 (0.67–2.43)	
	Missing	13/17 (76.5)			5/17 (29.4)			4/17 (23.5)			13/17 (76.5)		

(*continued*)

SUPPLEMENTARY TABLE S3. (CONTINUED)

Variable	Categories	*I would be ashamed if a woman in my family sold sex*			*Other people deserve access to health services more than women who sell sex*			*If I had a choice, I would prefer not to provide services to women who sell sex*			*Women who sell sex engage in irresponsible behaviors*		
		n/N (%)*	aOR (95% CIs)†	p_w‡	n/N (%)*	aOR (95% CIs)†	p_w‡	n/N (%)*	aOR (95% CIs)†	p_w‡	n/N (%)*	aOR (95% CIs)†	p_w‡
Prefer not to provide services to young women who become pregnant before marriage[o]	Strongly disagree	492/624 (78.8)	1	0.427	59/624 (9.5)	1	**<0.001**	20/624 (3.2)	1	**<0.001**	458/624 (73.4)	1	0.516
	Disagree	544/701 (77.6)	0.92 (0.69–1.24)		116/701 (16.5)	1.87 (1.36–2.58)		62/701 (8.8)	2.85 (1.48–5.48)		540/701 (77.0)	1.20 (0.92–1.55)	
	Agree	42/52 (80.8)	1.10 (0.52–2.32)		30/52 (57.7)	12.76 (8.62–18.88)		25/52 (48.1)	26.65 (10.10–70.31)		40/52 (76.9)	1.16 (0.61–2.19)	
	Strongly agree	19/27 (70.4)	0.62 (0.32–1.20)		11/27 (40.7)	6.39 (3.03–13.48)		10/27 (37.0)	17.03 (6.42–45.14)		22/27 (81.5)	1.59 (0.50–5.08)	
	Missing	3/4 (75.0)			2/4 (50.0)	7.21 (3.60–14.47)		1/4 (25.0)			2/4 (50.0)		

*Proportion of health workers responding strongly agree or agree.
†The aOR for sex is adjusted for age group; the aOR for age group is adjusted for sex; the aOR for all other predictor variables is adjusted for sex and age group.
‡A p value of <0.05 indicates that the predictor creates a statistically significant improvement in the fit of the model.
[a]Infection control and universal precautions (including postexposure prophylaxis and waste management).
[b]My coworkers sometimes treat people living with HIV poorly when providing them.
[c]My coworkers sometimes talk badly about people thought to be living with HIV.
[d]I would be ashamed is a woman in my family was PLHIV.
[e]PLHIV engage in irresponsible behaviors.
[f]Other people deserve access to health services more than PLHIV.
[g]If I had a choice, I would prefer not to provide services to PLHIV.
[h]I would be ashamed if a man in my family was MSM.
[i]MSM engage in irresponsible behaviors.
[j]Other people deserve access to health services more than MSM.
[k]If I had a choice, I would prefer not to provide services to MSM.
[l]I would be ashamed if a young woman in my family became pregnant before marriage.
[m]YW engage in irresponsible behaviors.
[n]Other people deserve access to health services more than YW.
[o]If I had a choice, I would prefer not to provide services to YW.
aOR, adjusted odds ratio; CIs, confidence intervals; MSM, men who have sex with men; n, number of individuals experiencing the three types of stigma within groups; N, total number of individuals within groups; PLHIV, people living with HIV; p_w, p value of the Wald test; YW, young women who become pregnant before marriage.
p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

SUPPLEMENTARY TABLE S4. THE ASSOCIATION BETWEEN SOCIODEMOGRAPHIC CHARACTERISTICS OF HEALTH WORKERS WITH FOUR STIGMA OUTCOMES FOR MEN WHO HAVE SEX WITH MEN

		I would be ashamed if someone in my family was a man who has sex with men			*Other people deserve access to health services more than MSM*			*If I had a choice, I would prefer not to provide services to MSM*			*MSM engage in irresponsible behaviors*		
Variable	*Categories*	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡	n/N (%)*	*aOR (95% CIs)*†	p_w‡
Sex	Male	302/373 (81.0)	1	0.163	66/373 (17.7)	1	0.262	42/373 (11.3)	1	0.379	266/373 (71.3)	1	0.419
	Female	763/993 (76.8)	0.74 (0.49–1.13)		156/993 (15.7)	0.85 (0.64–1.13)		99/993 (10.0)	0.86 (0.61–1.20)		684/993 (68.9)	0.84 (0.54–1.29)	
Age	<25 years	86/112 (76.8)	1	**<0.001**	22/112 (19.6)	1	0.067	14/112 (12.5)	1	0.097	75/112 (67.0)	1	**0.001**
	25–34 years	346/466 (74.2)	0.86 (0.43–1.69)		69/466 (14.8)	0.70 (0.45–1.09)		46/466 (9.9)	0.76 (0.45–1.29)		294/466 (63.1)	0.83 (0.58–1.20)	
	35–44 years	273/353 (77.3)	1.04 (0.45–2.43)		50/353 (14.2)	0.68 (0.43–1.06)		27/353 (7.6)	0.58 (0.24–1.39)		247/353 (70.0)	1.16 (0.81–1.66)	
	>44 year	360/435 (82.8)	1.47 (0.71–3.07)		81/435 (18.6)	0.94 (0.60–1.48)		54/435 (12.4)	1.00 (0.60–1.67)		334/435 (76.8)	1.65 (1.09–2.49)	
Education	Did not complete secondary	55/64 (85.9)	1	**<0.001**	13/64 (20.3)	1	**<0.001**	12/64 (18.8)	1	**<0.001**	42/64 (65.6)	1	**<0.001**
	Completed secondary	447/615 (72.7)	0.54 (0.25–1.17)		128/615 (20.8)	1.03 (0.59–1.82)		80/615 (13.0)	0.63 (0.37–1.07)		398/615 (64.7)	1.33 (0.63–2.80)	
	Further	563/687 (82.0)	1.01 (0.44–2.32)		81/687 (11.8)	0.52 (0.32–0.84)		49/687 (7.1)	0.32 (0.17–0.58)		510/687 (74.2)	2.41 (1.28–4.55)	
Marital status	Married	585/720 (81.3)	1	**0.018**	122/720 (16.9)	1	0.230	78/720 (10.8)	1	0.278	523/720 (72.6)	1	0.166
	Not married	480/646 (74.3)	0.69 (0.51–0.94)		100/646 (15.5)	0.87 (0.69–1.09)		63/646 (9.8)	0.84 (0.61–1.15)		427/646 (66.1)	0.79 (0.57–1.10)	
Religion	Very important	955/1187 (80.5)	1	**0.029**	200/1187 (16.8)	1	0.205	121/1187 (10.2)	1	0.053	838/1187 (70.6)	1	0.740
	Important	90/146 (61.6)	0.60 (0.40–0.90)		16/146 (11.0)	0.62 (0.36–1.08)		16/146 (11.0)	1.19 (0.67–2.12)		94/146 (64.4)	1.12 (0.75–1.66)	
	Somewhat important	9/15 (60.0)	0.76 (0.25–2.30)		4/15 (26.7)	2.03 (0.62–6.64)		4/15 (26.7)	4.35 (1.30–14.52)		8/15 (53.3)	0.76 (0.25–2.31)	
	Not important	8/15 (53.3)	0.35 (0.11–1.11)		2/15 (13.3)	0.71 (0.15–3.23)		0/15 (0.0)	-		8/15 (53.3)	0.63 (0.21–1.91)	
	Missing	3/3 (100.0)			0/3 (0.0)			0/3 (0.0)			2/3 (66.7)		
Ever tested	No	20/24 (83.3)	1	0.482	4/24 (16.7)	1	0.986	4/24 (16.7)	1	0.296	23/24 (95.8)	1	**0.031**
	Yes	1036/1333 (77.7)	0.74 (0.32–1.71)		218/1333 (16.4)	1.01 (0.28–3.62)		136/1333 (10.2)	0.58 (0.21–1.61)		919/1333 (68.9)	0.10 (0.01–0.81)	
	Missing	9/9 (100.0)			0/9 (0.0)			1/9 (11.1)			8/9 (88.9)		
HIV status	Negative	766/978 (78.3)	1	0.231	157/978 (16.1)	1	0.828	105/978 (10.7)	1	0.106	682/978 (69.7)	1	0.084
	Positive	189/246 (76.8)	0.84 (0.63–1.12)		42/246 (17.1)	1.04 (0.72–1.51)		19/246 (7.7)	0.69 (0.44–1.08)		164/246 (66.7)	0.77 (0.58–1.03)	
	Undetermined	6/9 (66.7)			2/9 (22.2)			1/9 (11.1)			6/9 (66.7)		
	Missing	104/133 (78.2)			21/133 (15.8)			16/133 (12.0)			98/133 (73.7)		

*Proportion of health workers responding strongly agree or agree.

†The aOR for sex is adjusted for age group; the aOR for age group is adjusted for sex; the aOR for all other predictor variables is adjusted for sex and age group.

‡A p value of <0.05 indicates that the predictor creates a statistically significant improvement in the fit of the model.

aOR, adjusted odds ratio; CIs, confidence intervals; MSM, men who have sex with men; n, number of individuals experiencing the three types of stigma within groups; N, total number of individuals within groups; p_w, p value of the Wald test.

p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

SUPPLEMENTARY TABLE S5. THE ASSOCIATION BETWEEN HEALTH WORKER TRAINING, PERCEPTIONS OF COWORKER ATTITUDES, AND STIGMATIZING ATTITUDES WITH FOUR STIGMA OUTCOMES FOR MEN WHO HAVE SEX WITH MEN

		I would be ashamed if a man in my family had sex with other men			*Other people deserve access to health services more than MSM*			*If I had a choice, I would prefer not to provide services to MSM*			*MSM engage in irresponsible behaviors*		
Variable	*Categories*	*n/N (%)**	*aOR (95% CIs)†*	*p_w‡*	*n/N (%)**	*aOR (95% CIs)†*	*p_w‡*	*n/N (%)**	*aOR (95% CIs)†*	*p_w‡*	*n/N (%)**	*aOR (95% CIs)†*	*p_w‡*
Training on infection control[a]	No	243/318 (76.4)	1	0.349	41/318 (12.9)	1	0.077	30/318 (9.4)	1	0.725	218/318 (68.6)	1	0.821
	Yes	773/977 (79.1)	1.13 (0.87–1.47)		164/977 (16.8)	1.34 (0.97–1.85)		99/977 (10.1)	1.06 (0.75–1.50)		683/977 (69.9)	1.03 (0.81–1.30)	
	Missing	49/71 (69.0)			17/71 (23.9)			12/71 (16.9)			49/71 (69.0)		
My coworkers sometimes treat people living with HIV poorly[b]	Strongly disagree	386/510 (75.7)	1	0.065	55/510 (10.8)	1	**<0.001**	27/510 (5.3)	1	**<0.001**	326/510 (63.9)	1	**0.007**
	Disagree	481/623 (77.2)	1.07 (0.70–1.65)		100/623 (16.1)	1.58 (1.09–2.27)		60/623 (9.6)	1.92 (1.23–2.98)		439/623 (70.5)	1.33 (1.02–1.74)	
	Agree	143/167 (85.6)	1.85 (1.09–3.14)		53/167 (31.7)	3.88 (2.61–5.78)		40/167 (24.0)	5.84 (3.33–10.27)		137/167 (82.0)	2.56 (1.50–4.38)	
	Strongly agree	28/35 (80.0)	1.15 (0.45–2.97)		12/35 (34.3)	4.32 (1.76–10.62)		9/35 (25.7)	6.32 (2.81–14.20)		27/35 (77.1)	1.76 (0.65–4.76)	
	Missing	27/31 (87.1)			2/31 (6.5)			5/31 (16.1)			21/31 (67.7)		
My coworkers sometimes talk badly about PLHIV[c]	Strongly disagree	205/281 (73.0)	1	**0.008**	34/281 (12.1)	1	**<0.001**	24/281 (8.5)	1	**<0.001**	156/281 (55.5)	1	**<0.001**
	Disagree	479/630 (76.0)	1.15 (0.72–1.84)		84/630 (13.3)	1.14 (0.75–1.72)		47/630 (7.5)	0.88 (0.57–1.38)		438/630 (69.5)	1.80 (1.42–2.27)	
	Agree	274/327 (83.8)	1.85 (1.20–2.87)		70/327 (21.4)	2.00 (1.41–2.84)		48/327 (14.7)	1.87 (1.11–3.17)		258/327 (78.9)	2.93 (2.07–4.15)	
	Strongly agree	92/108 (85.2)	2.04 (1.09–3.82)		31/108 (28.7)	2.98 (1.87–4.77)		18/108 (16.7)	2.21 (1.28–3.80)		85/108 (78.7)	2.85 (1.77–4.58)	
	Missing	15/20 (75.0)			3/20 (15.0)			4/20 (20.0)			13/20 (65.0)		
I would be ashamed if someone in my family had HIV[d]	Strongly disagree	528/685 (77.1)	1	0.235	81/685 (11.8)	1	**<0.001**	45/685 (6.6)	1	**<0.001**	462/685 (67.4)	1	0.482
	Disagree	466/593 (78.6)	1.08 (0.78–1.48)		106/593 (17.9)	1.62 (1.21–2.16)		60/593 (10.1)	1.61 (1.08–2.38)		424/593 (71.5)	1.19 (0.90–1.57)	
	Agree	35/39 (89.7)	2.53 (0.64–9.99)		17/39 (43.6)	5.72 (2.82–11.63)		21/39 (53.8)	17.42 (7.34–41.35)		30/39 (76.9)	1.58 (0.78–3.21)	
	Strongly agree	29/40 (72.5)	0.71 (0.30–1.67)		15/40 (37.5)	4.23 (2.06–8.69)		10/40 (25.0)	4.33 (2.07–9.06)		28/40 (70.0)	1.02 (0.47–2.20)	
	Missing	7/9 (77.8)			3/9 (33.3)			5/9 (55.6)			6/9 (66.7)		
PLHIV engage in irresponsible behaviors[e]	Strongly disagree	251/339 (74.0)	1	0.118	30/339 (8.8)	1	**<0.001**	18/339 (5.3)	1	**0.007**	205/339 (60.5)	1	**0.002**
	Disagree	474/607 (78.1)	1.22 (0.77–1.92)		103/607 (17.0)	2.12 (1.33–3.36)		65/607 (10.7)	2.16 (1.05–4.44)		424/607 (69.9)	1.49 (0.96–2.31)	
	Agree	228/292 (78.1)	1.14 (0.70–1.87)		58/292 (19.9)	2.48 (1.78–3.45)		38/292 (13.0)	2.59 (1.45–4.66)		222/292 (76.0)	1.95 (1.24–3.07)	
	Strongly agree	92/104 (88.5)	2.32 (1.17–4.60)		25/104 (24.0)	3.11 (1.82–5.32)		14/104 (13.5)	2.63 (1.12–6.15)		84/104 (80.8)	2.48 (1.51–4.09)	
	Missing	20/24 (83.3)			6/24 (25.0)			6/24 (25.0)			15/24 (62.5)		
Other people deserve access to services more than PLHIV[f]	Strongly disagree	385/478 (80.5)	1	0.249	32/478 (6.7)	1	**<0.001**	32/478 (6.7)	1	**<0.001**	336/478 (70.3)	1	0.051
	Disagree	424/558 (76.0)	0.75 (0.53–1.06)		53/558 (9.5)	1.46 (0.85–2.51)		38/558 (6.8)	1.02 (0.53–1.95)		373/558 (66.8)	0.82 (0.59–1.15)	
	Agree	172/224 (76.8)	0.79 (0.48–1.29)		99/224 (44.2)	10.96 (6.57–18.29)		51/224 (22.8)	4.07 (2.52–6.55)		169/224 (75.4)	1.27 (0.85–1.92)	
	Strongly agree	61/76 (80.3)	0.93 (0.58–1.50)		31/76 (40.8)	9.48 (4.65–19.31)		13/76 (17.1)	2.84 (1.44–5.60)		53/76 (69.7)	0.91 (0.62–1.35)	
	Missing	23/30 (76.7)			7/30 (23.3)			7/30 (23.3)			19/30 (63.3)		
Prefer not to provide services to PLHIV[g]	Strongly disagree	556/714 (77.9)	1	0.525	82/714 (11.5)	1	**<0.001**	49/714 (6.9)	1	**<0.001**	491/714 (68.8)	1	0.906
	Disagree	431/555 (77.7)	0.97 (0.69–1.37)		104/555 (18.7)	1.78 (1.30–2.43)		56/555 (10.1)	1.53 (0.99–2.37)		391/555 (70.5)	1.05 (0.83–1.31)	
	Agree	44/51 (86.3)	1.76 (0.59–5.27)		21/51 (41.2)	5.28 (3.60–7.75)		24/51 (47.1)	12.04 (7.03–20.64)		37/51 (72.5)	1.17 (0.50–2.75)	
	Strongly agree	27/38 (71.1)	0.61 (0.27–1.34)		13/38 (34.2)	3.89 (1.88–8.04)		10/38 (26.3)	4.69 (2.10–10.46)		26/38 (68.4)	0.84 (0.47–1.50)	
	Missing	7/8 (87.5)			2/8 (25.0)			2/8 (25.0)			5/8 (62.5)		

(*continued*)

SUPPLEMENTARY TABLE S5. (CONTINUED)

		I would be ashamed if a man in my family had sex with other men			*Other people deserve access to health services more than MSM*			*If I had a choice, I would prefer not to provide services to MSM*			*MSM engage in irresponsible behaviors*		
Variable	*Categories*	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡
I would be ashamed if a woman in my family sold sex[h]	Strongly disagree	39/75 (52.0)	1	**<0.001**	6/75 (8.0)	1	0.271	8/75 (10.7)	1	0.909	41/75 (54.7)	1	**<0.001**
	Disagree	93/212 (43.9)	0.72 (0.37–1.40)		34/212 (16.0)	2.26 (0.85–6.00)		19/212 (9.0)	0.86 (0.48–1.55)		107/212 (50.5)	0.83 (0.51–1.37)	
	Agree	513/610 (84.1)	4.97 (2.83–8.74)		102/610 (16.7)	2.33 (0.97–5.59)		66/610 (10.8)	1.04 (0.50–2.16)		447/610 (73.3)	2.26 (1.42–3.60)	
	Strongly agree	414/457 (90.6)	9.11 (4.55–18.23)		80/457 (17.5)	2.49 (0.99–6.24)		48/457 (10.5)	1.01 (0.52–1.97)		348/457 (76.1)	2.64 (1.40–5.01)	
	Missing	6/12 (50.0)			0/12 (0.0)			0/12 (0.0)			7/12 (58.3)		
Women who sell sex engage in irresponsible behaviors[i]	Strongly disagree	52/81 (64.2)	1	**<0.001**	10/81 (12.3)	1	0.381	2/81 (2.5)	1	**0.041**	23/81 (28.4)	1	**<0.001**
	Disagree	127/234 (54.3)	0.68 (0.34–1.34)		37/234 (15.8)	1.32 (0.56–3.14)		26/234 (11.1)	4.96 (0.97–25.31)		79/234 (33.8)	1.37 (0.67–2.82)	
	Agree	604/716 (84.4)	3.04 (1.42–6.50)		125/716 (17.5)	1.48 (0.76–2.87)		65/716 (9.1)	3.94 (1.03–15.00)		573/716 (80.0)	10.74 (5.43–21.26)	
	Strongly agree	270/311 (86.8)	3.81 (1.58–9.19)		48/311 (15.4)	1.29 (0.65–2.53)		46/311 (14.8)	6.90 (1.51–31.42)		269/311 (86.5)	18.07 (10.05–32.50)	
	Missing	12/24 (50.0)			2/24 (8.3)			2/24 (8.3)			6/24 (25.0)		
Other people deserve access to services more than women who sell sex[j]	Strongly disagree	326/423 (77.1)	1	0.378	16/423 (3.8)	1	**<0.001**	20/423 (4.7)	1	**<0.001**	278/423 (65.7)	1	**<0.001**
	Disagree	556/723 (76.9)	0.98 (0.78–1.22)		66/723 (9.1)	2.58 (1.57–4.25)		54/723 (7.5)	1.65 (0.83–3.28)		500/723 (69.2)	1.15 (0.85–1.55)	
	Agree	139/166 (83.7)	1.46 (0.87–2.46)		111/166 (66.9)	52.03 (30.71–88.16)		51/166 (30.7)	8.95 (5.06–15.86)		129/166 (77.7)	1.72 (1.21–2.45)	
	Strongly agree	36/45 (80.0)	1.20 (0.53–2.71)		28/45 (62.2)	43.66 (17.44–109.32)		14/45 (31.1)	9.52 (5.13–17.68)		37/45 (82.2)	2.44 (1.50–3.97)	
	Missing	8/9 (88.9)			1/9 (11.1)			2/9 (22.2)			6/9 (66.7)		
Prefer not to provide services to women who sell sex[k]	Strongly disagree	391/514 (76.1)	1	0.536	51/514 (9.9)	1	**<0.001**	22/514 (4.3)	1	**<0.001**	338/514 (65.8)	1	0.142
	Disagree	574/733 (78.3)	1.13 (0.78–1.63)		114/733 (15.6)	1.69 (1.16–2.47)		53/733 (7.2)	1.80 (1.11–2.90)		521/733 (71.1)	1.26 (0.94–1.68)	
	Agree	71/84 (84.5)	1.67 (0.84–3.34)		42/84 (50.0)	9.14 (5.36–15.57)		45/84 (53.6)	27.06 (14.75–49.65)		61/84 (72.6)	1.32 (0.78–2.26)	
	Strongly agree	24/29 (82.8)	1.41 (0.47–4.28)		13/29 (44.8)	7.11 (3.29–15.40)		18/29 (62.1)	35.97 (14.89–86.88)		25/29 (86.2)	3.02 (0.90–10.09)	
	Missing	5/6 (83.3)			2/6 (33.3)			3/6 (50.0)			5/6 (83.3)		
I would be ashamed if a young woman in my family became pregnant before marriage[l]	Strongly disagree	163/229 (71.2)	1	**<0.001**	28/229 (12.2)	1	**<0.001**	16/229 (7.0)	1	**0.005**	130/229 (56.8)	1	**<0.001**
	Disagree	342/493 (69.4)	0.93 (0.68–1.26)		62/493 (12.6)	1.05 (0.68–1.63)		36/493 (7.3)	1.08 (0.58–2.02)		315/493 (63.9)	1.37 (0.92–2.06)	
	Agree	386/439 (87.9)	2.90 (1.77–4.74)		93/439 (21.2)	1.94 (1.37–2.73)		60/439 (13.7)	2.14 (1.24–3.71)		350/439 (79.7)	2.94 (1.85–4.68)	
	Strongly agree	160/188 (85.1)	2.24 (1.28–3.92)		36/188 (19.1)	1.69 (1.05–2.73)		26/188 (13.8)	2.15 (1.14–4.07)		143/188 (76.1)	2.34 (1.45–3.78)	
	Missing	14/17 (82.4)			3/17 (17.6)			3/17 (17.6)			12/17 (70.6)		

(continued)

SUPPLEMENTARY TABLE S5. (CONTINUED)

		I would be ashamed if a man in my family had sex with other men			*Other people deserve access to health services more than MSM*			*If I had a choice, I would prefer not to provide services to MSM*			*MSM engage in irresponsible behaviors*		
Variable	*Categories*	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡
Young women who become pregnant before marriage engage in irresponsible behaviors[m]	Strongly disagree	104/144 (72.2)	1	**<0.001**	12/144 (8.3)	1	**<0.001**	5/144 (3.5)	1	**<0.001**	71/144 (49.3)	1	**<0.001**
	Disagree	379/554 (68.4)	0.87 (0.53–1.41)		71/554 (12.8)	1.67 (0.85–3.29)		48/554 (8.7)	2.76 (1.09–7.02)		332/554 (59.9)	1.63 (1.03–2.56)	
	Agree	468/537 (87.2)	2.66 (1.66–4.25)		102/537 (19.0)	2.67 (1.32–5.39)		69/537 (12.8)	4.32 (1.87–9.98)		438/537 (81.6)	4.72 (2.87–7.75)	
	Strongly agree	102/116 (87.9)	2.81 (1.38–5.70)		35/116 (30.2)	4.92 (2.35–10.29)		16/116 (13.8)	4.60 (1.68–12.64)		103/116 (88.8)	8.29 (4.50–15.26)	
	Missing	12/15 (80.0)			2/15 (13.3)			3/15 (20.0)			6/15 (40.0)		
Other people deserve access to services more than young women who become pregnant before marriage[n]	Strongly disagree	360/453 (79.5)	1	0.335	20/453 (4.4)	1	**<0.001**	31/453 (6.8)	1	**<0.001**	303/453 (66.9)	1	0.501
	Disagree	507/667 (76.0)	0.81 (0.59–1.12)		54/667 (8.1)	1.93 (1.34–2.78)		42/667 (6.3)	0.92 (0.68–1.26)		468/667 (70.2)	1.15 (0.84–1.58)	
	Agree	143/176 (81.3)	1.11 (0.69–1.77)		115/176 (65.3)	43.24 (25.13–74.40)		48/176 (27.3)	5.27 (3.21–8.65)		127/176 (72.2)	1.25 (0.80–1.97)	
	Strongly agree	43/54 (79.6)	0.94 (0.41–2.14)		26/54 (48.1)	20.02 (9.92–40.42)		15/54 (27.8)	5.22 (2.55–10.68)		41/54 (75.9)	1.46 (0.84–2.54)	
	Missing	12/16 (75.0)			7/16 (43.8)			5/16 (31.3)			11/16 (68.8)		
Prefer not to provide services to young women who become pregnant before marriage[o]	Strongly disagree	465/602 (77.2)	1	0.436	66/602 (11.0)	1	**<0.001**	30/602 (5.0)	1	**<0.001**	410/602 (68.1)	1	0.884
	Disagree	535/685 (78.1)	1.03 (0.77–1.38)		117/685 (17.1)	1.67 (1.28–2.18)		68/685 (9.9)	2.15 (1.51–3.05)		485/685 (70.8)	1.10 (0.87–1.40)	
	Agree	43/50 (86.0)	1.76 (0.80–3.90)		26/50 (52.0)	8.72 (4.72–16.12)		32/50 (64.0)	36.07 (19.54–66.60)		35/50 (70.0)	1.05 (0.58–1.88)	
	Strongly agree	19/25 (76.0)	0.88 (0.25–3.08)		11/25 (44.0)	6.17 (2.38–15.97)		9/25 (36.0)	10.30 (4.27–24.85)		18/25 (72.0)	1.13 (0.58–2.22)	
	Missing	3/4 (75.0)			2/4 (50.0)			2/4 (50.0)			2/4 (50.0)		

*Proportion of health workers responding strongly agree or agree.
†The aOR for sex is adjusted for age group; the aOR for age group is adjusted for sex; the aOR for all other predictor variables is adjusted for sex and age group.
‡A p value of <0.05 indicates that the predictor creates a statistically significant improvement in the fit of the model.
[a]Infection control and universal precautions (including postexposure prophylaxis and waste management).
[b]My coworkers sometimes treat people living with HIV poorly when providing them.
[c]My coworkers sometimes talk badly about people thought to be living with HIV.
[d]I would be ashamed is a woman in my family was PLHIV.
[e]PLHIV engage in irresponsible behaviors.
[f]Other people deserve access to health services more than PLHIV.
[g]If I had a choice, I would prefer not to provide services to PLHIV.
[h]I would be ashamed if a woman in my family was a woman who sells sex.
[i]Women who sell sex engage in irresponsible behaviors.
[j]Other people deserve access to health services more than women who sell sex.
[k]If I had a choice, I would prefer not to provide services to women who sell sex.
[l]I would be ashamed if a young woman in my family became pregnant before marriage.
[m]Young women who become pregnant before marriage engage in irresponsible behaviors.
[n]Other people deserve access to health services more than young women who become pregnant before marriage.
[o]If I had a choice, I would prefer not to provide services to young women who become pregnant before marriage.
aOR, adjusted odds ratio; CIs, confidence intervals; MSM, men who have sex with men; n, number of individuals reporting the four types of stigma within groups; N, total number of individuals within groups; PLHIV, people living with HIV; p_w, p value of the Wald test.
p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

SUPPLEMENTARY TABLE S6. THE ASSOCIATION BETWEEN SOCIODEMOGRAPHIC CHARACTERISTICS OF HEALTH WORKERS WITH FOUR STIGMA OUTCOMES FOR YOUNG WOMEN WHO BECOME PREGNANT BEFORE MARRIAGE

		I would be ashamed if a young woman in my family became pregnant before marriage			*Other people deserve access to health services more than young women who become pregnant before marriage*			*If I had a choice, I would prefer not to provide services to young women who become pregnant before marriage*			*Young women who become pregnant before marriage engage in irresponsible behaviors*		
Variable	*Categories*	n/N *(%)**	*aOR (95% CIs)†*	p_w‡	n/N *(%)**	*aOR (95% CIs)†*	p_w‡	n/N *(%)**	*aOR (95% CIs)†*	p_w‡	n/N *(%)**	*aOR (95% CIs)†*	p_w‡
Sex	Male	188/386 (48.7)	1	0.148	69/386 (17.9)	1	0.307	24/386 (6.2)	1	0.316	198/386 (51.3)	1	**0.003**
	Female	465/1046 (44.5)	0.81 (0.62–1.08)		174/1046 (16.6)	0.89 (0.71–1.11)		53/1046 (5.1)	0.77 (0.46–1.29)		475/1046 (45.4)	0.76 (0.64–0.91)	
Age	<25 years	43/118 (36.4)	1	**<0.001**	25/118 (21.2)	1	**0.009**	10/118 (8.5)	1	0.273	43/118 (36.4)	1	**0.047**
	25–34 years	200/490 (40.8)	1.19 (0.83–1.69)		68/490 (13.9)	0.59 (0.37–0.96)		18/490 (3.7)	0.40 (0.13–1.27)		208/490 (42.4)	1.26 (0.88–1.82)	
	35–44 years	179/374 (47.9)	1.60 (1.09–2.36)		72/374 (19.3)	0.89 (0.49–1.62)		21/374 (5.6)	0.64 (0.26–1.60)		194/374 (51.9)	1.89 (1.14–3.12)	
	>44 year	231/450 (51.3)	1.85 (1.23–2.78)		78/450 (17.3)	0.78 (0.42–1.46)		28/450 (6.2)	0.72 (0.29–1.81)		228/450 (50.7)	1.81 (1.11–2.94)	
Education	Did not complete secondary	30/69 (43.5)	1	0.140	11/69 (15.9)	1	**<0.001**	6/69 (8.7)	1	**0.019**	31/69 (44.9)	1	0.600
	Completed secondary	318/646 (49.2)	1.45 (0.90–2.34)		146/646 (22.6)	1.50 (0.70–3.18)		47/646 (7.3)	0.81 (0.22–2.96)		311/646 (48.1)	1.28 (0.73–2.25)	
	Further	305/717 (42.5)	1.18 (0.73–1.93)		86/717 (12.0)	0.70 (0.36–1.36)		24/717 (3.3)	0.36 (0.11–1.25)		331/717 (46.2)	1.25 (0.81–1.92)	
Marital status	Married	363/752 (48.3)	1	0.315	124/752 (16.5)	1	0.562	41/752 (5.5)	1	0.913	375/752 (49.9)	1	0.505
	Not married	290/680 (42.6)	0.90 (0.73–1.11)		119/680 (17.5)	1.11 (0.78–1.59)		36/680 (5.3)	0.97 (0.55–1.71)		298/680 (43.8)	0.90 (0.67–1.22)	
Religion	Very important	586/1239 (47.3)	1	0.227	212/1239 (17.1)	1	0.368	64/1239 (5.2)	1	0.370	595/1239 (48.0)	1	0.674
	Important	57/160 (35.6)	0.80 (0.56–1.15)		26/160 (16.3)	0.96 (0.61–1.52)		9/160 (5.6)	0.97 (0.46–2.04)		65/160 (40.6)	0.90 (0.63–1.28)	
	Somewhat important	6/17 (35.3)	0.87 (0.30–2.49)		5/17 (29.4)	2.15 (0.73–6.33)		3/17 (17.6)	3.34 (0.86–13.02)		5/17 (29.4)	0.55 (0.18–1.65)	
	Not important	3/14 (21.4)	0.32 (0.09–1.18)		0/14 (0.0)	1.00 (1.00–1.00)		1/14 (7.1)	0.81 (0.10–6.60)		7/14 (50.0)	1.18 (0.40–3.48)	
	Missing	1/2 (50.0)			0/2 (0.0)			0/2 (0.0)			1/2 (50.0)		
Ever tested	No	18/30 (60.0)	1	0.094	9/30 (30.0)	1	0.052	5/30 (16.7)	1	**0.003**	16/30 (53.3)	1	0.527
	Yes	631/1395 (45.2)	0.59 (0.32–1.09)		234/1395 (16.8)	0.49 (0.23–1.01)		72/1395 (5.2)	0.29 (0.13–0.65)		653/1395 (46.8)	0.82 (0.45–1.51)	
	Missing	4/7 (57.1)			0/7 (0.0)			0/7 (0.0)			4/7 (57.1)		
HIV status	Negative	454/1026 (44.2)	1	0.391	163/1026 (15.9)	1	0.440	55/1026 (5.4)	1	**0.038**	483/1026 (47.1)	1	0.318
	Positive	127/254 (50.0)	1.13 (0.85–1.49)		47/254 (18.5)	1.14 (0.82–1.57)		8/254 (3.1)	0.54 (0.31–0.97)		119/254 (46.9)	0.87 (0.67–1.14)	
	Undetermined	4/8 (50.0)			1/8 (12.5)			0/8 (0.0)			4/8 (50.0)		
	Missing	68/144 (47.2)			32/144 (22.2)			14/144 (9.7)			67/144 (46.5)		

*Proportion of health workers responding strongly agree or agree.
†The aOR for sex is adjusted for age group; the aOR for age group is adjusted for sex; the aOR for all other predictor variables is adjusted for sex and age group.
‡A p value of <0.05 indicates that the predictor creates a statistically significant improvement in the fit of the model.
aOR, adjusted odds ratio; CIs, confidence intervals; n, number of individuals experiencing the three types of stigma within groups; N, total number of individuals within groups; p_w, p value of the Wald test. p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

SUPPLEMENTARY TABLE S7. THE ASSOCIATION BETWEEN HEALTH WORKERS' TRAINING, PERCEPTIONS OF COWORKER ATTITUDES, AND STIGMATIZING ATTITUDES WITH FOUR STIGMA OUTCOMES FOR YOUNG WOMEN WHO BECOME PREGNANT BEFORE MARRIAGE

		I would be ashamed if a young woman in my family became pregnant before marriage			*Other people deserve access to health services more than young women who become pregnant before marriage*			*If I had a choice, I would prefer not to provide services to young women who become pregnant before marriage*			*Young women who become pregnant before marriage engage in irresponsible behaviors*		
Variable	*Categories*	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡
Training on infection control[a]	No	158/342 (46.2)	1	0.635	53/342 (15.5)	1	0.616	16/342 (4.7)	1	0.726	167/342 (48.8)	1	0.340
	Yes	458/1011 (45.3)	0.93 (0.70–1.24)		172/1011 (17.0)	1.08 (0.79–1.47)		55/1011 (5.4)	1.11 (0.62–2.00)		473/1011 (46.8)	0.89 (0.71–1.13)	
	Missing	37/79 (46.8)			18/79 (22.8)			6/79 (7.6)			33/79 (41.8)		
My coworkers sometimes treat people living with HIV poorly[b]	Strongly disagree	207/539 (38.4)	1	**<0.001**	64/539 (11.9)	1	**<0.001**	17/539 (3.2)	1	**<0.001**	197/539 (36.5)		**<0.001**
	Disagree	302/659 (45.8)	1.34 (1.06–1.70)		108/659 (16.4)	1.43 (1.02–2.01)		30/659 (4.6)	1.43 (0.79–2.58)		336/659 (51.0)	1.79 (1.42–2.26)	
	Agree	108/171 (63.2)	2.70 (2.02–3.61)		55/171 (32.2)	3.44 (2.32–5.11)		20/171 (11.7)	3.93 (2.11–7.32)		102/171 (59.6)	2.48 (1.70–3.61)	
	Strongly agree	19/35 (54.3)	1.75 (0.79–3.87)		12/35 (34.3)	3.82 (2.15–6.79)		6/35 (17.1)	6.17 (3.08–12.36)		23/35 (65.7)	3.04 (1.43–6.45)	
	Missing	17/28 (60.7)			4/28 (14.3)			4/28 (14.3)			15/28 (53.6)		
My coworkers sometimes talk badly about PLHIV[c]	Strongly disagree	104/295 (35.3)	1	**<0.001**	32/295 (10.8)	1	**<0.001**	8/295 (2.7)	1	**<0.001**	100/295 (33.9)	1	**<0.001**
	Disagree	297/668 (44.5)	1.41 (1.06–1.86)		90/668 (13.5)	1.27 (0.85–1.91)		24/668 (3.6)	1.36 (0.90–2.05)		299/668 (44.8)	1.50 (1.13–2.00)	
	Agree	180/337 (53.4)	2.01 (1.56–2.59)		86/337 (25.5)	2.77 (2.00–3.84)		32/337 (9.5)	3.73 (2.00–6.96)		189/337 (56.1)	2.36 (1.64–3.41)	
	Strongly agree	67/112 (59.8)	2.56 (1.58–4.15)		29/112 (25.9)	2.81 (1.73–4.57)		13/112 (11.6)	4.68 (2.61–8.39)		77/112 (68.8)	4.01 (2.78–5.79)	
	Missing	5/20 (25.0)			6/20 (30.0)			0/20 (0.0)			8/20 (40.0)		
I would be ashamed if someone in my family had HIV[d]	Strongly disagree	278/718 (38.7)	1	**<0.001**	92/718 (12.8)	1	**<0.001**	20/718 (2.8)	1	**<0.001**	295/718 (41.1)	1	**<0.001**
	Disagree	307/629 (48.8)	1.49 (1.24–1.79)		115/629 (18.3)	1.50 (1.14–1.96)		30/629 (4.8)	1.70 (1.16–2.51)		327/629 (52.0)	1.54 (1.26–1.88)	
	Agree	33/40 (82.5)	7.38 (3.68–14.80)		17/40 (42.5)	4.81 (2.76–8.39)		14/40 (35.0)	18.04 (9.63–33.80)		26/40 (65.0)	2.57 (1.23–5.38)	
	Strongly agree	30/38 (78.9)	5.82 (2.82–12.02)		18/38 (47.4)	6.20 (2.81–13.70)		12/38 (31.6)	15.56 (7.51–32.23)		22/38 (57.9)	1.98 (0.87–4.55)	
	Missing	5/7 (71.4)			1/7 (14.3)			1/7 (14.3)			3/7 (42.9)		
PLHIV engage in irresponsible behaviors[e]	Strongly disagree	147/355 (41.4)	1	**<0.001**	43/355 (12.1)	1	**<0.001**	11/355 (3.1)	1	**<0.001**	114/355 (32.1)	1	**<0.001**
	Disagree	263/650 (40.5)	0.93 (0.70–1.24)		92/650 (14.2)	1.20 (0.77–1.87)		24/650 (3.7)	1.20 (0.70–2.07)		304/650 (46.8)	1.81 (1.32–2.49)	
	Agree	173/306 (56.5)	1.74 (1.19–2.55)		79/306 (25.8)	2.49 (1.79–3.48)		31/306 (10.1)	3.39 (1.84–6.25)		183/306 (59.8)	3.02 (2.25–4.06)	
	Strongly agree	63/105 (60.0)	1.93 (1.32–2.83)		26/105 (24.8)	2.39 (1.36–4.21)		11/105 (10.5)	3.53 (1.47–8.51)		65/105 (61.9)	3.22 (1.95–5.29)	
	Missing	7/16 (43.8)			3/16 (18.8)			0/16 (0.0)			7/16 (43.8)		
Other people deserve access to services more than PLHIV[f]	Strongly disagree	194/501 (38.7)	1	**<0.001**	21/501 (4.2)	1	**<0.001**	7/501 (1.4)	1	**<0.001**	200/501 (39.9)	1	**<0.001**
	Disagree	271/589 (46.0)	1.33 (1.06–1.67)		67/589 (11.4)	2.87 (1.74–4.72)		23/589 (3.9)	2.77 (0.98–7.82)		281/589 (47.7)	1.36 (1.02–1.80)	
	Agree	134/232 (57.8)	2.18 (1.56–3.05)		110/232 (47.4)	20.35 (11.75–35.24)		34/232 (14.7)	11.70 (4.79–28.62)		139/232 (59.9)	2.28 (1.62–3.22)	
	Strongly agree	41/78 (52.6)	1.68 (1.20–2.37)		37/78 (47.4)	20.22 (10.56–38.72)		10/78 (12.8)	9.80 (3.34–28.81)		38/78 (48.7)	1.37 (0.88–2.15)	
	Missing	13/32 (40.6)			8/32 (25.0)			3/32 (9.4)			15/32 (46.9)		
Prefer not to provide services to PLHIV[g]	Strongly disagree	326/751 (43.4)	1	**0.004**	87/751 (11.6)	1	**<0.001**	13/751 (1.7)	1	**<0.001**	311/751 (41.4)	1	**<0.001**
	Disagree	268/584 (45.9)	1.08 (0.85–1.39)		112/584 (19.2)	1.79 (1.27–2.52)		34/584 (5.8)	3.46 (1.73–6.90)		301/584 (51.5)	1.50 (1.15–1.95)	
	Agree	30/52 (57.7)	1.77 (1.09–2.88)		27/52 (51.9)	7.99 (4.70–13.59)		20/52 (38.5)	34.11 (16.75–69.48)		34/52 (65.4)	2.70 (1.76–4.13)	
	Strongly agree	26/39 (66.7)	2.36 (1.21–4.60)		16/39 (41.0)	5.24 (2.35–11.69)		10/39 (25.6)	18.64 (6.12–56.81)		23/39 (59.0)	1.89 (0.99–3.62)	
	Missing	3/6 (50.0)			1/6 (16.7)			0/6 (0.0)			4/6 (66.7)		

(continued)

SUPPLEMENTARY TABLE S7. (CONTINUED)

		I would be ashamed if a young woman in my family became pregnant before marriage			*Other people deserve access to health services more than young women who become pregnant before marriage*			*If I had a choice, I would prefer not to provide services to young women who become pregnant before marriage*			*Young women who become pregnant before marriage engage in irresponsible behaviors*		
Variable	*Categories*	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡
I would be ashamed if a woman in my family sold sex[h]	Strongly disagree	23/84 (27.4)	1	**<0.001**	11/84 (13.1)	1	0.469	7/84 (8.3)	1	0.432	23/84 (27.4)	1	**<0.001**
	Disagree	51/225 (22.7)	0.76 (0.46–1.27)		32/225 (14.2)	1.06 (0.62–1.82)		11/225 (4.9)	0.56 (0.18–1.75)		71/225 (31.6)	1.19 (0.77–1.84)	
	Agree	295/625 (47.2)	2.36 (1.66–3.36)		111/625 (17.8)	1.38 (0.83–2.29)		37/625 (5.9)	0.67 (0.30–1.48)		309/625 (49.4)	2.57 (1.53–4.33)	
	Strongly agree	278/474 (58.6)	3.79 (2.59–5.53)		87/474 (18.4)	1.45 (0.78–2.73)		22/474 (4.6)	0.53 (0.23–1.21)		264/474 (55.7)	3.34 (2.00–5.57)	
	Missing	6/24 (25.0)			2/24 (8.3)			0/24 (0.0)			6/24 (25.0)		
Women who sell sex engage in irresponsible behaviors[i]	Strongly disagree	31/87 (35.6)	1	**<0.001**	12/87 (13.8)	1	0.625	2/87 (2.3)	1	0.573	15/87 (17.2)	1	**<0.001**
	Disagree	78/255 (30.6)	0.83 (0.53–1.32)		39/255 (15.3)	1.11 (0.49–2.50)		15/255 (5.9)	2.59 (0.68–9.83)		62/255 (24.3)	1.63 (0.75–3.53)	
	Agree	354/732 (48.4)	1.74 (1.04–2.93)		130/732 (17.8)	1.30 (0.59–2.86)		40/732 (5.5)	2.34 (0.65–8.46)		385/732 (52.6)	5.59 (3.12–10.00)	
	Strongly agree	180/310 (58.1)	2.67 (1.49–4.78)		56/310 (18.1)	1.35 (0.66–2.77)		18/310 (5.8)	2.54 (0.63–10.31)		198/310 (63.9)	9.22 (5.04–16.86)	
	Missing	10/48 (20.8)			6/48 (12.5)			2/48 (4.2)			13/48 (27.1)		
Other people deserve access to services more than women who sell sex[j]	Strongly disagree	174/449 (38.8)	1	**<0.001**	19/449 (4.2)	1	**<0.001**	9/449 (2.0)	1	**<0.001**	167/449 (37.2)	1	**<0.001**
	Disagree	350/757 (46.2)	1.34 (1.13–1.59)		78/757 (10.3)	2.53 (1.51–4.22)		29/757 (3.8)	1.88 (0.94–3.75)		369/757 (48.7)	1.59 (1.29–1.95)	
	Agree	97/168 (57.7)	2.09 (1.47–2.99)		108/168 (64.3)	39.85 (20.93–75.86)		29/168 (17.3)	9.61 (3.91–23.62)		103/168 (61.3)	2.62 (1.91–3.60)	
	Strongly agree	24/44 (54.5)	1.92 (1.00–3.72)		32/44 (72.7)	60.21 (34.84–104.03)		10/44 (22.7)	14.31 (7.58–26.99)		28/44 (63.6)	3.02 (1.91–4.76)	
	Missing	8/14 (57.1)			6/14 (42.9)			0/14 (0.0)			6/14 (42.9)		
Prefer not to provide services to women who sell sex[k]	Strongly disagree	231/546 (42.3)	1	**0.021**	61/546 (11.2)	1	**<0.001**	10/546 (1.8)	1	**<0.001**	212/546 (38.8)	1	**<0.001**
	Disagree	350/764 (45.8)	1.14 (0.95–1.36)		122/764 (16.0)	1.47 (1.09–1.98)		33/764 (4.3)	2.37 (1.05–5.37)		387/764 (50.7)	1.61 (1.35–1.91)	
	Agree	49/85 (57.6)	1.81 (1.23–2.66)		38/85 (44.7)	6.12 (3.56–10.53)		23/85 (27.1)	18.90 (10.48–34.08)		51/85 (60.0)	2.33 (1.60–3.39)	
	Strongly agree	17/27 (63.0)	2.27 (0.94–5.47)		18/27 (66.7)	15.40 (7.13–33.27)		11/27 (40.7)	34.38 (15.88–74.43)		19/27 (70.4)	3.80 (2.16–6.70)	
	Missing	6/10 (60.0)			4/10 (40.0)			0/10 (0.0)			4/10 (40.0)		
I would be ashamed if a man in my family had sex with other men[l]	Strongly disagree	26/82 (31.7)	1	**<0.001**	12/82 (14.6)	1	0.597	4/82 (4.9)	1	0.915	22/82 (26.8)	1	**<0.001**
	Disagree	56/233 (24.0)	0.70 (0.41–1.19)		35/233 (15.0)	1.02 (0.52–2.02)		11/233 (4.7)	0.99 (0.31–3.21)		64/233 (27.5)	1.04 (0.50–2.20)	
	Agree	265/555 (47.7)	1.95 (1.08–3.54)		101/555 (18.2)	1.26 (0.55–2.86)		34/555 (6.1)	1.24 (0.41–3.69)		271/555 (48.8)	2.58 (1.49–4.47)	
	Strongly agree	299/534 (56.0)	2.73 (1.54–4.84)		93/534 (17.4)	1.20 (0.55–2.66)		27/534 (5.1)	1.01 (0.33–3.15)		308/534 (57.7)	3.69 (2.20–6.19)	
	Missing	7/28 (25.0)			2/28 (7.1)			1/28 (3.6)			8/28 (28.6)		

(continued)

SUPPLEMENTARY TABLE S7. (CONTINUED)

		I would be ashamed if a young woman in my family became pregnant before marriage			*Other people deserve access to health services more than young women who become pregnant before marriage*			*If I had a choice, I would prefer not to provide services to young women who become pregnant before marriage*			*Young women who become pregnant before marriage engage in irresponsible behaviors*		
Variable	*Categories*	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡	*n/N (%)**	*aOR (95% CIs)†*	p_w‡
MSM engage in irresponsible behaviors[m]	Strongly disagree	35/93 (37.6)	1	**<0.001**	14/93 (15.1)	1	0.153	5/93 (5.4)	1	0.910	20/93 (21.5)	1	**<0.001**
	Disagree	97/321 (30.2)	0.75 (0.49–1.16)		46/321 (14.3)	0.94 (0.48–1.85)		15/321 (4.7)	0.87 (0.26–2.93)		94/321 (29.3)	1.56 (0.67–3.63)	
	Agree	329/644 (51.1)	1.73 (1.19–2.52)		113/644 (17.5)	1.16 (0.69–1.96)		35/644 (5.4)	0.96 (0.34–2.71)		352/644 (54.7)	4.44 (2.27–8.69)	
	Strongly agree	169/295 (57.3)	2.20 (1.52–3.19)		59/295 (20.0)	1.38 (0.83–2.28)		18/295 (6.1)	1.11 (0.37–3.35)		189/295 (64.1)	6.42 (3.09–13.34)	
	Missing	23/79 (29.1)			11/79 (13.9)			4/79 (5.1)			18/79 (22.8)		
Other people deserve access to services more than MSM[n]	Strongly disagree	183/457 (40.0)	1	**<0.001**	23/457 (5.0)	1	**<0.001**	7/457 (1.5)	1	**<0.001**	172/457 (37.6)	1	**<0.001**
	Disagree	331/735 (45.0)	1.21 (0.97–1.51)		65/735 (8.8)	1.76 (1.04–2.97)		30/735 (4.1)	2.65 (1.45–4.84)		358/735 (48.7)	1.55 (1.24–1.95)	
	Agree	101/159 (63.5)	2.59 (1.88–3.58)		110/159 (69.2)	42.66 (19.34–94.06)		28/159 (17.6)	13.00 (4.52–37.35)		93/159 (58.5)	2.34 (1.58–3.47)	
	Strongly agree	30/57 (52.6)	1.56 (1.00–2.42)		33/57 (57.9)	25.14 (13.40–47.17)		9/57 (15.8)	11.55 (3.73–35.80)		42/57 (73.7)	4.39 (2.30–8.38)	
	Missing	8/24 (33.3)			12/24 (50.0)			3/24 (12.5)			8/24 (33.3)		
Prefer not to provide services to MSM[o]	Strongly disagree	204/505 (40.4)	1	**<0.001**	56/505 (11.1)	1	**<0.001**	10/505 (2.0)	1	**<0.001**	190/505 (37.6)	1	**<0.001**
	Disagree	358/778 (46.0)	1.22 (0.97–1.53)		121/778 (15.6)	1.43 (0.94–2.18)		27/778 (3.5)	1.71 (0.78–3.76)		397/778 (51.0)	1.68 (1.34–2.12)	
	Agree	57/87 (65.5)	2.78 (1.70–4.55)		44/87 (50.6)	8.06 (4.04–16.09)		28/87 (32.2)	22.55 (9.96–51.05)		48/87 (55.2)	2.04 (1.44–2.90)	
	Strongly agree	29/48 (60.4)	2.08 (1.17–3.71)		18/48 (37.5)	4.76 (2.93–7.72)		11/48 (22.9)	14.34 (4.69–43.85)		34/48 (70.8)	3.79 (1.95–7.37)	
	Missing	5/14 (35.7)			4/14 (28.6)			1/14 (7.1)			4/14 (28.6)		

*Proportion of health workers responding strongly agree or agree.
†The aOR for sex is adjusted for age group; the aOR for age group is adjusted for sex; the aOR for all other predictor variables is adjusted for sex and age group.
‡A p value of <0.05 indicates that the predictor creates a statistically significant improvement in the fit of the model.
[a]Infection control and universal precautions (including postexposure prophylaxis and waste management).
[b]My coworkers sometimes treat people living with HIV poorly when providing them.
[c]My coworkers sometimes talk badly about people thought to be living with HIV.
[d]I would be ashamed if a woman in my family was PLHIV.
[e]PLHIV engage in irresponsible behaviors.
[f]Other people deserve access to health services more than PLHIV.
[g]If I had a choice, I would prefer not to provide services to PLHIV.
[h]I would be ashamed if a woman in my family was a woman who sells sex.
[i]Women who sell sex engage in irresponsible behaviors.
[j]Other people deserve access to health services more than women who sell sex.
[k]If I had a choice, I would prefer not to provide services to women who sell sex.
[l]I would be ashamed if a member of my family was a man who has sex with men.
[m]MSM engage in irresponsible behaviors.
[n]Other people deserve access to health services more than MSM.
[o]If I had a choice, I would prefer not to provide services to MSM.
aOR, adjusted odds ratio; CIs, confidence intervals; MSM, men who have sex with men; n, number of individuals reporting the four stigmas within groups; N, total number of individuals within groups; PLHIV, people living with HIV; p_w, p value of the Wald test.
p-Values marked in bold indicate numbers that are significant on the 95% confidence limit.

Paper 3: What mechanisms drive uptake of family planning when integrated with childhood immunisation in Ethiopia? A realist evaluation

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What mechanisms drive uptake of family planning when integrated with childhood immunisation in Ethiopia? A realist evaluation

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Abstract

Background: Maternal and child health are key priorities among the Sustainable Development Goals, which include a particular focus on reducing morbidity and mortality among women of reproductive age, newborns, and children under the age of five. Two components of maternal and child health are family planning (FP) and immunisation. Providing these services through an integrated delivery system could increase the uptake of vaccines and modern contraceptive methods (MCMs) particularly during the post-partum period.

Methods: A realist evaluation was conducted in two woredas in Ethiopia to determine the key mechanisms and their triggers that drive successful implementation and service uptake of an intervention of integrated delivery of immunisations and FP. The methodological approach included the development of an initial programme theory and the selection of relevant, published implementation related theoretical frameworks to aid organisation and cumulation of findings. Data from 23 semi-structured interviews were then analysed to determine key empirical mechanisms and drivers and to test the initial programme theory. These mechanisms were mapped against published theoretical frameworks and a revised programme theory comprised of context-mechanism-outcome configurations was developed. A critique of theoretical frameworks for abstracting empirical mechanisms was also conducted.

Results: Key contextual factors identified were: the use of trained Health Extension Workers (HEWs) to deliver FP services; a strong belief in values that challenged FP among religious leaders and community members; and a lack of support for FP from male partners based on religious values. Within these contexts, empirical mechanisms of acceptability, access, and adoption of innovations that drove decision making and intervention outcomes among health workers, religious leaders, and community members were identified to describe intervention implementation.

Conclusions: Linking context and intervention components to the mechanisms they triggered helped explain the intervention outcomes, and more broadly how and for whom the intervention worked. Linking empirical mechanisms to constructs of implementation related theoretical frameworks provided a level of abstraction through which findings could be cumulated across time, space, and conditions by theorising middle-range mechanisms.

Keywords: Family planning, Immunisation, Integration, Realist evaluation

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Background

Integrated approaches to health service delivery in low- and middle-income countries have steadily increased in scope and scale over the last decade. Evidence suggests that integrating health services can effectively address accessibility issues created or perpetuated by disjointed health services and fragmented funding [1]. For instance, a systematic review of strategies for integrating health services suggested that integration can lead to more efficient service delivery and that by reducing the burden on those seeking health care, it may increase access to health services overall [1]. The review also recognised the potential of integration to over-burden health care workers (HCWs) leading to their burnout and reducing the quality of the care they deliver, and highlighted that integration does little to address pre-existing inequities.

Recently, the integration of essential services such as childhood immunisations and reproductive health services has garnered attention from policy makers, implementers and researchers, in light of the Sustainable Development Goal of reducing child mortality and improving maternal health [2]. However, to date, few studies have focused on the integration of FP services and childhood immunisation as an approach to increase uptake of modern contraceptive methods (MCMs) and to improve maternal and child health [3–9], despite evidence linking short interpregnancy intervals to adverse health outcomes for mothers, infants, and children. Such adverse outcomes include: maternal death, third-trimester bleeding, and anaemia in mothers, as well as preterm birth and low birthweight in infants [10–12].

An intervention that integrated the delivery of FP with childhood immunisation services in Assosa and Bambasi woredas (districts), in the Benishangul-Gumuz Regional State (BGRS) of Ethiopia, offered the opportunity to contribute to this evidence base. The intervention was implemented in all 114 government health posts of Assosa and Bambasi woredas with support from the International Rescue Committee between January 2016 and May 2018. It aimed to strengthen FP, and childhood immunisation services, refine referral pathways for both services, improve immunisation monitoring, and build HCW capacity.

The intervention included: 1) training and mentoring of facility-based health extension workers (HEWs) on FP counselling and short-acting MCM provision and implant insertions which included the use of anatomic models for the practice of implant insertions and clinical coaching of insertions in the community; 2) expanding the range of MCM options available at health posts to include implant insertions (but not removals); 3) designing a job aid to support HEWs to improve immunisation defaulter tracing; and 4) developing community engagement strategies that involved community leaders and kebele command posts, which reviewed health post performance data and helped HEWs troubleshoot problems they encountered.

The intervention was mainly delivered by HEWs who provided FP counselling and aministered MCMs during household visits and at health or outreach posts (in particularly large woredas). Specifically, post-partum women were counselled on FP during the 1st, 3rd, and 7th day post-natal checks and MCMs were provided alongside the child's '45 day immunisation' or at a later date during a household visit or at a health or outreach post. The 45 day immunisation takes place 6 weeks after birth and is the first round of immunisations including Penta1 (DTP-HepB1-Hib1,OPV1, PCV1, Rota1). The provision of contraceptive implants by HEWs was a central component of the intervention. Though HEWs were trained to insert implants, national policy at the time of the intervention stipulated that implant removals should not be performed by HEWs, therefore this task was not included in the intervention [13]. Other HCWs, such as nurses and midwives, also played a key role in delivering the intervention by providing clinical coaching to HEWs and accepting referral clients from health posts at larger health facilities. According to monitoring data, between January 2017 and May 2018, the proportion of women who brought a child for immunisation at least once and who received an MCM was 63.0% (4260/6764). These data reflect the communities that were exposed to the intervention for 12 to 17 months. A total of 25,058 FP acceptors were recorded in Assosa and Bambasi between January 2017 and May 2018, of which 7945 (31.7%) were new FP acceptors and 17,113 (68.3%) were repeat acceptors.

We conducted an evaluation of the intervention with the aim of determing why (or why not) and for whom the intervention worked, by identifying and interrogating the mechanisms that drove implementation of the intervention.

Methods

Methodological approach

Process-focused, theory based realist evaluation presents a useful framework when seeking to answer questions of what works, for whom, and under what circumstances. A central tenet of realist evaluation is that interventions work, or do not work, based upon the decisions that actors make in response to available resources. These decisions constitute mechanisms which are triggered in some contexts and not in others. We explored this relationship between context, mechanism, resources/intervention, and resulting oucome(s) using the context-mechanism-outcome (CMO) configuration of realist evaluation [14]. Where a CMO relates to a specific

category of actor, a context-actor-mechanism-outcome (CAMO) is useful, and where the CMO relates to an intervention or component of an intervention, then a context-intervention-actor-mechanism-outcomes (CIAMO) configuration is better able to specify what works, for whom, why and where.

We used two further theory based approaches alongside the CMO/CAMO/CIAMO heuristic in our interrogation of the uptake of FP within the integrated service delivery model. The first of these was the development of an initial programme theory (Fig. 1). Discussions were held with intervention designers and implementers in a workshop 15 months into the implementation of the intervention. This exercise focussed on implementers' understanding of how the intervention and its components were expected to work, how they were currently perceived to be working, and how CMO/CAMO/CIAMO configurations could be used to determine and explain factors enabling or hindering the intervention. In constructing the initial programme theory we were able to elucidate factors that intervention designers and implementers perceived as the major drivers of the intervention [15]. These were adherence to clinical and counselling guidelines among HEWs, and community and religious leader support for FP. The initial programme theory also described potential barriers and mitigating factors to intervention implementation including the lack of tracking for referrals to higher level facilities for FP made by HEWs at health posts, long wait times at health posts in densely populated communities, and the lack of HEW training on implant removals. This initial programme theory was used in developing themes for interview guides and in identifying stakeholders for empirical interviews used to develop CMO/CAMO/CIAMOs.

Our second approach was to map our findings against the constructs of implementation related theoretical frameworks. Our reasons for using this approach hinge upon two methodological axes which are that the major challenge for evaluation is the cumulation of findings across time, space and conditions [14] and that for realist evaluation, such generalisation or transferability of findings occurs through abstraction. Abstraction is achieved through linking to theories including those from cognitive psychology, and behavioural science [16] and more recently also including a range of theories relating to behaviour change in health systems [17]. We assumed that the use of the constructs of implementation related frameworks rather than broader behavioural theories, for example, would provide more insight on mechanisms driving implementation outcomes and opportunites for cumulation of findings across evaluations.

We considered several theories and concluded that our initial programme theory had best fit with constructs

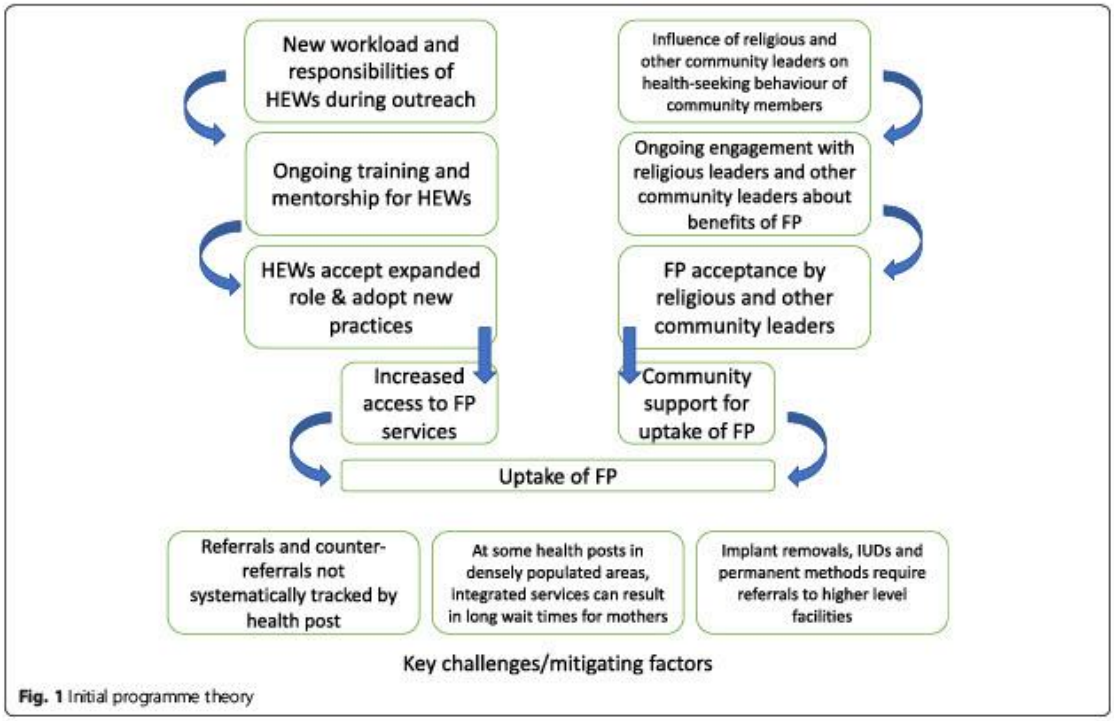

Fig. 1 Initial programme theory

of three theoretical frameworks. These were acceptability of FP and MCMs by both health workers and community members [18], adoption and diffusion of innovations particularly with respect to health workers [19, 20], and access by women [21]. The constructs described by these frameworks align with the concept of mechanisms within realist evaluation as they describe factors that drive or lead to decision making among different actors. By mapping our findings against these constructs, we aimed to identify transferrable theories which could be used by implementers in similar contexts. Sekhon et al describe acceptability using seven constructs in the Theoretical Framework of Acceptability (TFA): affective attitude, burden, perceived effectiveness, ethicality, intervention coherence, opportunity costs, and self-efficacy [18]. Rogers' diffusion (and adoption) of innovations framework consists of five contructs: relative advantage, compatibility, trialability, observability and complexity [20]. Finally, Penchansky and Thomas describe access using five constructs: availability, accessibility, accommodation, affordability and acceptability [21]. We linked the empirical mechanisms identified in the data to a construct(s) of the frameworks and critiqued the potential of this approach as an aid to cumulation of findings across studies.

Study site

BGRS is one of nine regional states in Ethiopia. It is predominantly rural and consists of twenty woredas (districts) and 398 kebeles (smallest administrative unit) [22]. Assosa and Bambasi are part of BGRS and encompass 74 and 40 kebeles respectively. Within BGRS, there are five native Ethnic groups (Bertha, Gumuz, Mao, Komo and Shenash) and other dwellers (predominantly Oromo and Amhara). The region has relatively low levels of literacy (60.9% of women and 30.3% of men are illiterate), and high religiosity, with Islam and Orthodox Christianity being the predominant religions (51.3 and 28.2% respectively) [22, 23]. At the time of the 2016 Demographic Health Survey (DHS), full immunisation coverage in BGRS was 57.4% compared to nearly 89.2% in the capital of Addis Ababa and a national average of 38.3% [23]. The proportion of women aged 15 to 49 using any FP method in BGRS was 28.5% compared to 55.9% in Addis Ababa. Knowledge about FP was only slighty lower in BGRS compared to Addis Ababa (97.6% vs 100.0% respectively). There was also more male involvement in decision-making about FP in BGRS compared to Addis Ababa: 9.8% compared to 2.4% of women reported that their male partner was the main decision maker about FP, while 14.4% compared to 25% of women said they made the decisions about FP. However, the majority of respondents said that decision making was done jointly (75.9% vs 72.2%) [23].

In BGRS, the Health Extension Programme (HEP) plays a key role in health service delivery by providing primary health services at health posts in rural communities. It was adopted by the government of Ethiopia in 2003 to achieve universal health coverage among rural populations by 2009 [24]. The HEP is driven by model families, the Health Development Army (HDA) and HEWs [24]. Model families are male and female headed households that have received specific training on the HEP and that follow best practices for health and hygiene. They serve as role models within the community [24]. The HDA is an organised community based movement aimed at improving health sector capacity by engaging with communities and community leaders [24]. HEWs, commonly women, typically staff health posts in pairs and provide services such as community integrated management of childhood illness, immunisations, injectable contraceptives, implant insertions (but not removals), as well as basic curative services such as first aid and malaria treatment. HEWs are the lowest level health cadre in Ethiopia, usually with an education up to Grade 10, supplemented with a 1 year didactic and practical training in different health care packages. Among other responsibilities, HEWs conduct household visits and outreach activities and refer cases to health centers as needed.

Empirical data collection and sampling

Semi-structured interviews (SSIs) with key stakeholders involved in the delivery and uptake of the intervention were conducted to identify contextual factors that triggered the mechanisms driving intervention outcomes. Purposive sampling was used for SSIs to select key stakeholders involved in, or with an interest in, the intervention including implementing partners, government officials, HEWs, and community leaders. Participants were selected to offer a range of perspectives and opinions of the intervention. HEWs selected were involved in the delivery of childhood immunisation and/or FP services and were from health posts where the intervention was perceived to be more, or less, well received based on project monitoring data.

An interview and discussion guide for SSIs was developed specifically for this study and was informed by the initial programme theory. Broad themes encompassed workload, socio-cultural norms, and healthcare access, and questions specific to particular participant groups and specific aspects of the intervention within the study context were included. This ensured that key issues captured within the initial programme theory were included in the interviews. Please see supplementary file S1 for the interview guide that was used. CMOs developed with the implementers were also included in interview and discussion guides [25]. Interviews were conducted in

October 2017 and March 2018 in Amharic and Afan Oromo by local research assistants with guidance and oversight from a London School of Hygiene & Tropical Medicine researcher and an implementation supervisor. All interviews were recorded, transcribed *verbatim* and then translated into English.

Data management and analysis

Translated transcripts were imported into NVivo 11.2 for coding and analysis. Quotes were anonymized, but the type of respondent attributable to each quote was retained to aid analyses. Key themes were identified based on the interview guides and supported by quotes from interview transcripts. Coding and analysis was based on an intial framework of: interventions; actors; context; mechanisms; outcomes and initial CAMO and CIAMO configurations. These categories were populated inductively with themes and sub-themes as they were identified from the data.

We developed CMO/CAMO/CIAMO configurations from the analysis of stakeholder interviews. Overarching contexts were identified as well as contextual and intervention triggers for specific mechanisms driving outcomes. The outcomes included in the CAMOs and CIAMOs were both outputs and outcomes. We then linked the identified mechanisms with constructs of the acceptability, adoption and diffusion of innovations, and access frameworks. Finally, we used the CMO/CAMO/CIAMO configurations to construct a revised programme theory.

Results

Twenty-three stakeholders SSIs were conducted (Table 1).

Context-mechanism-outcome configurations

Nine mechanisms were identified from the analysis. Six of these mechanisms were a reaction to a component of the intervention within the prevailing context (CIAMOs) and three were a direct reaction to the prevailing context (CAMOs) (Table 2).

Table 1 Participants in stakeholder interviews (SSIs)

Type of Participant	Number of participants
Religious Leader	1 SSI
Health Extension worker (HEW)	4 SSIs
Health Development Army/Leader (HDAL)	2 SSIs & 2 SSIs
Mothers (FP user)	1 SSI
Nurse	2 SSIs
Health professional	1 SSI
HEW supervisor	1 SSI
Woreda level officers	5 SSI
Kebele leaders	3 SSIs
Group 1–5 leader	1 SSI

HCW and HEW mechanisms

Mechanisms leading to outcomes of acceptability and adoption of innovations within the integrated service delivery model related to the integrated delivery itself, and to training in integrated delivery. HEWs perceived a decrease in their workload and therefore a reduced work burden given the integration of FP with immunisations, particularly in light of the 45 day immunisation visits, which involved both immunisations and FP counselling and/or provision of MCMs (CIAMO 1). HEWs viewed the integrated delivery of immunisation and FP services positively and felt that providing both services together had more impact than providing them alone (CIAMO 2).

Overall, FP training was viewed positively among HEWs, with the practical elements of using anatomical models for the practice of implant insertions and the clinical coaching of insertions in the community considered particularly helpful. This meant that HEWs were confident in their ability to provide implants for women and that integrated services were provided (CIAMO 3). However, HEWs did not receive training on implant removals and therefore could not provide this service, which left them feeling limited in their ability to provide FP services in general (CAMO 1).

> *"There are many good things to this project such as having fully trained extension workers, having the two services integrated. An improvement I would suggest would be to train us in removals. Women are currently being referred 27km away. Transport is 30 birr* [approximately $1 USD] *return. This is a burden to them and is hindering the project from reaching higher coverage levels. If we have 4 or more women we call the health facility workers here to carry out the removals." – Nurse_1*

Religious leader and male partners mechanims

Religion was the major contextual factor influencing FP acceptance in the study community, and the perceptions and beliefs of religious leaders were powerful. Preventing a child from being born was considered to directly oppose religious principles, particularly Islam. Religious beliefs including that preventing births is *haram* (forbidden) under Islamic law; dying and being buried with an implant in place is *haram*; blood spotting or losing blood that isn't part of the menstrual cycle is *haram*; and male partners not wanting women to cook during Ramadan whilst using an implant, were seen to hinder acceptability of FP.

Initially, FP acceptability was low among religious leaders and men, and it was thought that this context

Table 2 Context-Intervention-Actor-Mechanism-Outcome (CIAMO) and Context-Actor-Mechanism-Outcome (CAMO) configurations and acceptability constructs

Context	Project interventions	Actor, mechanism, and outcome	Constructs of acceptability, diffusion of innovations, and/or accessibility
CIAMO 1: Healthcare delivery is conducted by HEWs at health posts and home (C)	EPI and FP services offered at the 45 day post-natal check (I)	HEWs (A) perceive a reduced work burden due to EPI/FP service integration (M) and therefore provide integrated services (O)	Burden, affective attitude, observability, relative advantage
	"R: I strongly feel that having everything integrated is beneficial and actually makes my job easier. For example, when we go to vaccinate a child at 45 days we have to meet with the mother anyway and so that opportunity is used to also offer contraception. In my opinion this is a reduction of work rather than an increase." HEW_3		
CIAMO 2: Healthcare delivery is conducted by HEWs at health posts and home (C)	Ongoing training on EPI and FP integrated service delivery (I)	HEWs (A) feel that providing both services together has more impact' (M) and therefore provide integrated services (O)	Perceived effectiveness, relative advantage, compatibility, observability
	"R: Because this project has allowed me and other health workers to address vaccinations and family planning together as one package. Therefore, I feel our efforts have more of an impact than they did prior to the project. We are now seeing better outcomes because of its introduction." HEW_2		
CIAMO 3: FP delivery is conducted by HEWs (C)	HEWs given on-the job mentoring on implant insertion (I)	HEWs (A) feel confident in their ability to provide implants for women (M) and therefore provide integrated services including implants (O)	Self-efficacy, affective attitude, trialability
	"R: Previously, the long-acting family planning was given at health centre level. Currently, it is given by the health extension workers after they take training ….They took the training but since they haven't done this before, they may lack confidence. We overcame this by onsite mentorship with the presence of trained officer from the Woreda office, IRC and us. We made appointments with mothers to come and mentored the extension workers to practice giving the service while the team is there. Then we got in to the actual work after they practiced and started doing by themselves. Now it is good …." Regional level coordinator_1		
CAMO 1: HEWs are unable to remove implants (C)	No defined intervention (I)	HEWs (A) worry about not being able to remove implants (M) and therefore are limited in the FP services they can provide (O)	Self-efficacy
	"R: I have only taken training with regarding to administering the contraceptives. I have not had training in removals. Removals are a bit of challenge here because none of us are currently carrying them out." Nurse_1		
CIAMO 4: Strong belief in religious values among religious leaders and within the community (C)	Analysis of religious text together with religious leaders (I)	Religious leaders (A) recognise that FP aligns with their religious values (M) and support the use of FP (O)	Ethicality, opportunity costs, compatibility,
	"The religious leaders were first saying that family planning was Haram but since the project they had increase awareness and now are fully on board to point that they are teaching about family planning in the Mosque." MCH Woreda officer_1		
CIAMO 5: Religious leaders accept that FP aligns with religious values (C)	Religious leaders openly promote alignment of FP with religious principles (I)	Male partners (A) respect and trust the views of religious leaders (M) and support the use of FP (O)	Ethicality, opportunity costs, compatibility
	"I did have a situation where the women wanted the contraception on the same day as the immunisation day but her husband, who was with her at the time did not want her to take any contraception … What I then did was go to their house together with another religious leader to educate the husband about the benefits of family planning. To my surprise he actually agreed for his wife to have the 3 year implant." HEW_1		
CAMO 2: Supportive community environment for FP (C)	No defined intervention (I)	Women (A) feel supported by their partners and the wider community when making decisions about FP (M) and choose to take up an MCM (O)	Self-efficacy
	I: What is your husband's opinion regarding this program? R: He says nothing. We have agreed. There is no problem. I: What did he say when you first start it? R: After we have agreed, he asked me how long it was for and I told him that the 3 years is better. I explained to him that after our children grow		

Table 2 Context-Intervention-Actor-Mechanism-Outcome (CIAMO) and Context-Actor-Mechanism-Outcome (CAMO) configurations and acceptability constructs *(Continued)*

Context	Project interventions	Actor, mechanism, and outcome	Constructs of acceptability, diffusion of innovations, and/or accessibility
	with good health and clothes, I will then remove it and have another child. I: Did he agree on that? R: Yes, we have agreed." Woman user_2		
CIAMO 6: Women want long-term methods of contraception	Provision of long acting contraceptives (I)	Women (A) feel confident in their ability to access implants (M) and choose to take up long-acting contraceptives (O)	Self-efficacy
	"The awareness that we have gained about family planning has also been great … now thanks to the implant I can't get pregnant while I still have it in. We now try to have a 3–5 year gap between each child." Group leader_1		
CAMO 3: HEWs are unable to remove implants (C)	No defined intervention (I)	Women (A) worry about their inability to access implant removal (M) and may not choose to take up an implant (O)	Self-efficacy, accessibility, availability, burden, accommodation
	"R: There are many good things to this project …. An improvement I would suggest would be to train us in removals. Women are currently being referred 27 km away. Transport is 30 birr return. This is a burden to them and is hindering the project from reaching higher coverage levels." Nurse_1		

made it challenging for women to take up and use FP. Recognising this context, the intervention implementers worked with religious leaders to analyse religious texts. This component of the intervention triggered the recognition of the alignment between religious texts and FP in the religious leaders, ultimately resulting in their acceptance of FP (CIAMO 4).

> *R: … .. we initially trained religious leaders … … they had different views on whether the religion allowed modern contraceptives or not … .. so we engaged a sheik at the national level, a very supreme sheik who came down and spent three days of just purely going through the Quran linking it to maternal child health, linking the Quran to FP and immunisation and how it is important as religious leaders and husbands and you know. … ..he went through each method and linked it to the Quran and prophet Mohammed and you know said this be acceptable or not, he tracked everything conceptualizing, and you it was a light bulb, and all of them realized we have been teaching the community the wrong thing the whole time …… because they want to just follow the Quran as it is.* Implementing NGO_9

> *"R: As religious leader, I use to know that family planning was something bad but we were able to get the other religious leaders, the key Kenyan religious leaders and they taught us about it and even explained to us that it was even used back then in the era of our Prophet .This cleared all the doubts we ever had and we decided to share it to the community."* Religious leader_3

Similarly, beliefs about FP among male partners were influenced by their religious faith and the views of their religious leaders. If the latter were open about FP, male partners were more willing to support FP use. When religious leaders openly promoted the alignment of FP and religious text and principles, male partners became more supportive of FP, given the respect and trust they held in religious leaders. (CIAMO 5).

> *"Some women used to previously access family planning without the knowledge of their husbands but since the religious leaders have now accepted it as a good thing we have now seen the effects trickle down to the husbands. We include them whenever we do community based training. They are now happy as far as I am aware. But they were previously against family planning." District level administrator_1*

Post-partum women mechanisms

The one female FP user interviewed, the HEWs, and the community volunteers described factors that influenced women's decision making around FP use. Such factors included cultural, societal, and religious norms and attitudes towards FP. Support from religious leaders, other community members, and husbands, encouragement from HEWs about the benefits of FP, and knowledge about available FP resources were perceived to be factors that encouraged women to use MCMs. Religious leaders and men finding FP acceptable and in line with their religious beliefs strengthened the community context, which triggered the mechanism of feeling supported by their partners and the wider community, enabling women to confidently accept FP when it was offered to them (CAMO 2).

The training of HEWs on implant insertions was perceived as a positive aspect of the intervention by the one female FP user interviewed and among the HEWs. It was perceived that knowing that long-acting MCMs were available meant that women felt confident in their ability to access these methods (CIAMO 6). Conversely, HEWs' inability to remove implants presented a problem and HEWs perceived this to mean that women worried about their inability to access implant removals and may choose not to take up an implant (CAMO 3).

Linking context-mechanism-outcome configurations with implementation related theoretical framework constructs

Constructs linked to HCW and HEW mechanisms: empirical mechanisms driving outcomes of the integrated delivery of FP with immunisation services and the training component of the intervention linked to 4 constructs of the TFA (burden, affective attitude, perceived effectiveness and self-efficacy) and 3 constructs of adoption and diffusion of innovations (relative advantage, trialability, and observability).

Constructs linked to religious leader and male partner mechanisms: two constructs of the TFA (ethicality and opportunity costs) and 1 construct of the adoption and diffusion of innovations (compatibility) linked to the empirical mechanisms identified in the study as driving outcomes of the integrated delivery of FP and immunisations.

Constructs linked to post partum women mechanisms: the major construct identified in this study influencing post-partum women's uptake of FP within this integrated delivery model was that of sel-effficacy which is a construct of the TFA. Self-efficacy was also negatively influenced by 3 constructs of access which were accessibility, availability and accommodation.

Revised programme theory

The CAMOs and CIAMOs were used to develop a revised programme theory (RPT). The RPT represented

the intervention integrating FP and immunisation sevices and its key components: training of HEWs and HCWs on EPI and FP integrated service delivery; and information, education, and communication on the benefits of FP and socio-cultural and religious alignment within the community. For each of these components, the RPT represented the empirical mechanisms that drove actors' responses to the component. The theoretical framework constructs linked to the CAMO/CIAMO configurations of the RPT were then used to build a framework construct linked RPT inclusive of middle range mechanisms (Fig. 2).

Discussion

In this realist evaluation, we sought to identify key mechanisms driving the implementation of an intervention of integrated FP services and child immunisations in BGRS, Ethiopia. This evaluation contributes to a growing body of literature that seeks to understand uptake of FP when FP services are integrated with other health services [7–9, 26–29]. Recent studies from Rwanda, Zambia, and Ghana have looked specifically at the integration of FP with immunisations services and have found varying levels of success [7–9]. Issues such as inconsistent training for HCWs, poor monitoring systems, and disjointed referral systems have all been cited as barriers to effective integration [7–9]. Central to this evaluation was the exploration of if and how integration worked, for whom and what mechanisms drove FP uptake. There is currently a lack of literature in which context and mechanisms are used to explain intervention integration, and this evaluation offered a unique opportunity to explore this.

Constructs of implementation related theoretical frameworks as middle range mechanisms

We found empirical mechanisms of integrated delivery of FP with immunisation to link well to constructs of the TFA and the adoption and diffusion of innovations frameworks; and to a lesser extent to the access framework. For example, the perceived reduced work burden of delivering FP and immunisation through household visits increased the acceptability of the intervention for HEWs. The integrated delivery was thereby seen to have a relative advantage over the additional household visits needed to deliver the services seperately. This was linked to both the TFA and adoption and diffusion of innovations frameworks. Although there were some overlaps between links to TFA constructs and adoption and diffusion of innovations framework constructs in terms of HCW and HEW mechanisms, the frameworks were overall complementary. At the community level, the TFA constructs of ethicality and opportunity costs linked well with empirical mechanisms of recognising the alignment between religious texts and FP principles. Compatibility is a similar construct and therefore did

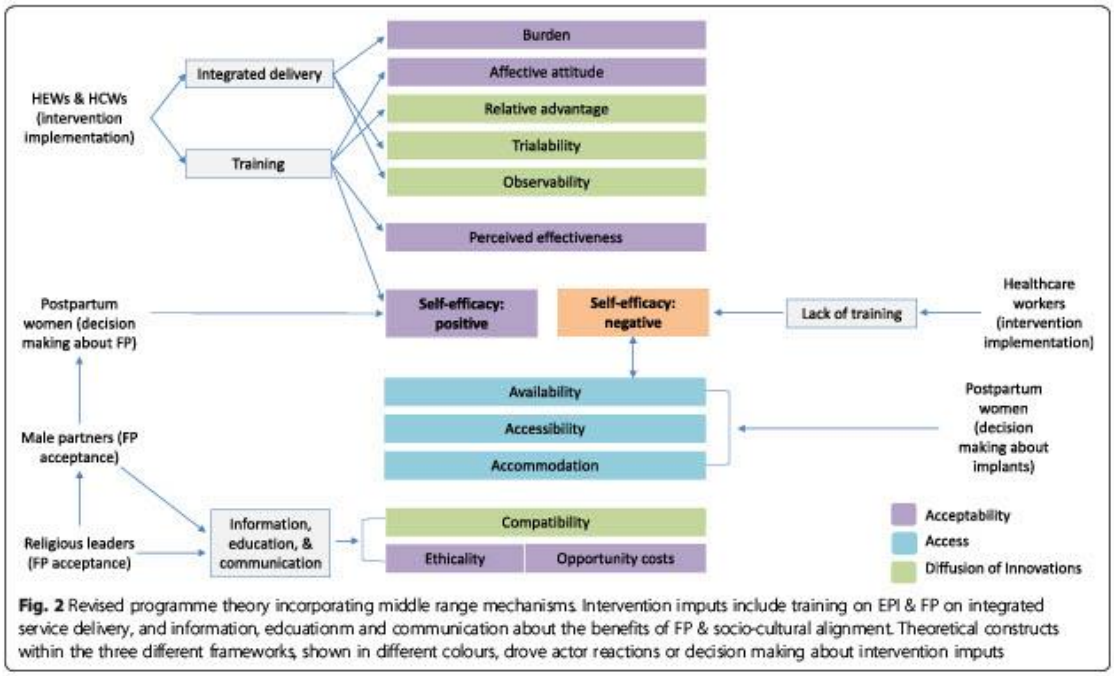

Fig. 2 Revised programme theory incorporating middle range mechanisms. Intervention imputs include training on EPI & FP on integrated service delivery, and information, edcuationm and communication about the benefits of FP & socio-cultural alignment. Theoretical constructs within the three different frameworks, shown in different colours, drove actor reactions or decision making about intervention imputs

not add extra value. Access constructs were linked to the mechanism of feeling unable to access implant removals, which led to negative self-efficacy.

We suggest that the constructs of the TFA, adoption and diffusion of innovations, and access frameworks act as middle-range mechanisms, that is, mechanisms with a relatively high level of abstraction compared to empirical mechanisms. For example, ethicality is a middle-range mechanism, whilst the recognition of alignment with religious texts and FP by religious leaders is an empirical mechanism triggered among religious leaders in a context of strong religious beliefs.

Middle-range mechanisms

Self-efficacy

Was a key construct among health workers and community members. Self-efficacy has been described as 'an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments' [30]. Among HEWs, feelings of self-efficacy were seen to drive motivation for and perceptions of the intervention. HEWs felt confident that they were sharing their workload with their co-workers. HEWs knew that they could carry out their work effectively, as the work was being shared, and this fostered a sense of teamwork among them. Studies that have assessed self-efficacy among health workers have found strong links between feelings of self-efficacy and motivation and have emphasized the links between team work, task-sharing, and self-efficacy [31–33].

The willingness of the HEWs to attend and engage with training was a key contributor to intervention outcomes, as these translated into HEWs feeling high levels of self-efficacy when delivering FP services. However, HEWs were not trained in implant removals and this was perceived to have adversely affected uptake of implants by women. HEWs expressed concerns about women having to travel far distances and incur costs to access larger health facilies where implant removals were carried out. This led to reduced self-efficacy among HEWs. It should be noted that national policy in Ethiopia does not currently task HEWs with implant removals [13] which has resulted in an unmet need of implant removals in the many rural and hard to reach areas [13, 34]. To address this, the Integrated Family Health Programme (IFHP) has attempted to scale-up the availability of trained health professionals who can provide this service, but the programme has yet to be extensively rolled out. The Ethiopia Ministry of Health had begun to pilot the training of select HEWs in implant removals across the country, including in BGRS [34].

At the community level, feelings of self-efficacy were triggered among women when they felt there was community support for FP use, particularly among male partners. This finding is supported by recent literature. A study from Guatemala found that feelings of self-efficacy were negatively impacted by the lack of knowledge about and availability of methods, the fear of side effects and of infertility, and husbands being against FP [35].

Relative advantage and burden

HEWs perceived integration of immunisation and FP services to be advantageous. Relative advantages included reduced workloads (burden), and a clear fit with their schedule, which focused on providing FP counselling during post-natal household visits and MCMs during the '45 day immunisation' visit. A recent Cochrane review of integrated interventions found that HCWs may become overloaded or deskilled in integration interventions leading to negative impacts on service provision and health outcomes [1]. However, our findings indicate that teamwork among HEWs, HCWs, and HDA members resulted in manageable workloads and a reduced burden.

The constructs triggered in our evaluation indicate that in order for health workers to perceive the intervention positively, they needed to see how it would be advantageous to them or their clients, and how it would reduce their workload. Studies that have explored the training of community-based health workers have cited manageable workload, organisation of tasks, supportive supervision, adequate supplies and equipment, and respect from the community and the health system as key drivers of successful service delivery [9, 36]. A recent study by Mayhew et al further supports our findings by concluding that structural factors at the health facility level, including issues of staffing and workload in integrated interventions can be mitigated and managed by HCWs themselves [37]. The authors highlight that when HCWs felt agency or power over their own decision-making, they were able to overcome potential challenges of integration [37]. These factors were mentioned by the HEWs interviewed in this evaluation and indicate that while the training they received was important, its effectiveness was dependent on having a supportive work environment that included workload sharing with colleagues, which triggered mechanisms of self-efficacy. This suggests that self-efficacy, relative advantage, and burden might be intrinsically linked, with the perceptions about the advantages of the intervention, and about the ability to share the workload, leading to feelings of confidence among HCWs and HEWs in their ability to deliver the intervention.

Ethicality

Acceptability of FP by religious leaders and community members, including men, was a key factor driving wider community acceptability and in turn, influencing

women's decisions around FP. FP acceptance among religious leaders was triggered by their ability to see that FP aligned with their religious beliefs. Knowing that they did not have to adjust or compromise their religious beliefs to support the use of FP is what drove acceptability among religious leaders. The influence of religious leaders on the health seeking behaviours of communities is well documented. A recent study from Nigeria found that women's attendance at ANC services increased after religious leaders in the community began promoting ANC as an essential component of maternal and child health [38]. In this context, religious leaders had a key role in the delivery of health messages. Similarly, Azmat et al. (2011) determined that religious leaders in Pakistan held a strong influence on communities and that they could play a key role in informing the community about the benefits of FP. FP acceptance among religious leaders in this context was influenced by exposure to messaging and information about FP from medical professionals [39].

Our findings suggest that FP acceptance among religious leaders led to FP acceptance among community members, particularly among men. Ethiopia's 2016 DHS data indicate that men have more decision-making power than women within couples regarding FP in BGRS compared to almost every other region in the country [23]. Studies from Nigeria and Malawi support the argument that men influence women's decision-making about FP and that a key component of FP interventions should be male partner education to encourage their support for FP [40–42]. DHS data also indicate that women in BGRS have lower rates of FP use than women in almost every other region in the country [43]. They are also less likely to give birth with skilled birth attendants either in health facilities or at households [43]. This indicates poor links with the formal health system and limited access to health services.

What this study adds

This evaluation demonstrates the empirical context-linked mechanisms that drove intervention outcomes among HCWs, religious leaders and community members, in the integrated delivery and uptake of FP services. By linking empirical findings to published theories of acceptability, adoption and diffusion of innovations, and accessibility, middle-range mechanisms were identified, that is mechanisms with a higher level of abstraction, which facilitate the cumulation of learnings from this and other evaluations. We identified self-efficacy, burden and relative advantage, and ethicality as particularly important middle-range mechanisms in our study of the integrated delivery of FP and immunisations.

Limitations

While SSIs were conducted with a wide range of stakeholders who were selected based on the initial programme theory, it is possible that a larger sample size would have yielded data describing additional CIAMOs to those presented in this paper. Also, only one woman was interviewed specifically for her role as an FP user. HDA members and other community volunteers were sometimes also female FP users. While they provided their perspectives as female FP users, they were not interviewed specifically for that role. A larger sample of female FP users and non-users would have yielded more perspectives from these groups.

Conclusions

In this study, key contextual factors identified were: the predominant use of trained HEWs to deliver FP services at health posts and in communities; a strong belief in values among religious leaders and community members that challenged the use of MCMs; and a lack of support for FP from male partners based on religious values. These contextual factors, combined with intervention components that emphasised the training of HEWs and HCWs on FP counselling and service delivery, the alignment of religious texts with FP concepts, and the use of religious leaders as agents of change, were found to trigger several mechanisms of acceptability, adoption of innovations and access. Key mechanisms included: a perceived relative advantage of integration and increased self-efficacy among HEWs and HCWs; religious leader acceptance of FP; and acceptance of FP among communities and male partners. By linking context and intervention components to the mechanisms they triggered, this evaluation describes how the intervention worked and for whom. By linking our findings to published theories we were able to identify middle-range mechanisms and to develop a revised programme theory that can be applied to the integrated delivery of FP services in similar contexts.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-020-10114-8.

Additional file 1.

Abbreviations

A: Actor; BGRS: Benishangul-Gumuz Regional State; C: Context; CIAMO: Context-Intervention-Actor-Mechanism-Outcome; CAMO: Context-Actor-Mechanism-Outcome; CMO: Context-Mechanism-Outcome; FP: Family Planning; HCW: Health Care Worker; HDA: Health Development Army; HEW: Health Extension Worker; I: Intervention; In: Interviewer; IRC: International Rescue Committee; IUD: Intrauterine Device; M: Mechanism; MCM: Modern Contraceptive Method; O: Outcome; SSI: Semi-Structured Interview.

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Authors' contributions
JW conceived the idea for this research. JW and SK wrote the first draft of the study tools and developed the study design and sampling approach with inputs from TC, JKH, JL, NS, and SD. SK and SM oversaw the data collection activities in Ethiopia with advice from JW, JKH and SD. The data analysis was carried out by JW, JH and SK. SK drafted the manuscript. All authors made substantial and important contributions to revising the manuscript and provided final approval of the version to be published.

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Availability of data and materials
The datasets generated and/or analysed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate
Ethics approval was obtained from the Benishangul-Gumuz Regional Ethical Review Board in Ethiopia and the ethics committee of the London School of Hygiene & Tropical Medicine.
All participants completed a detailed informed consent procedure and provided written consent before being enrolled in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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Publisher's Note

Paper 4: Acceptability of family planning in a changing context in Uganda: a realist evaluation at two time points

BMJ Open

Acceptability of family planning in a changing context in Uganda: a realist evaluation at two time points

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ABSTRACT

Objectives This study sought to understand, during an intervention which integrated family planning (FP) and immunisation, (1) if and how prevailing contextual factors influenced acceptability and use of modern contraceptive methods (MCMs) in a pastoral community in Uganda, (2) what mechanisms were triggered by these contextual factors (3) if these contextual factors changed between two time points 2 years apart and (4) the impact of contextual changes on mechanisms triggered and acceptability and use outcomes.

Design Qualitative realist evaluation over two time points.

Setting Government health facilities in Moroto District, Karamoja, Uganda.

Participants 69 participants involved in the delivery and uptake of integrated FP and childhood immunisation services.

Intervention Integrated delivery of FP and childhood immunisation services offered to women accessing immunisation services in health facilities between January 2016 and December 2019.

Results Four key themes were identified that encompassed context and mechanisms influencing acceptability of MCMs across both time points of the evaluation. These were: (1) fear of side effects of MCMs; (2) preference for natural FP methods; (3) pastoral lifestyles in the community and (4) food insecurity. The context of these themes changed over time leading to the triggering of mechanisms with an overall increase in acceptability of MCMs over time. Key mechanisms of acceptability triggered included: affective attitude, intervention coherence, self-efficacy, perceived effectiveness and opportunity cost, leading to the development of three context-acceptability theories.

Conclusions In this study, social and cultural norms played a strong role in influencing acceptability of the intervention. The context combined with intervention components were found to trigger several mechanisms that mapped to constructs of diffusion of innovations and acted as catalysts for mechanisms of acceptability. The context in which the intervention was implemented changed leading to the triggering of mechanisms and an increase in the perceived value and acceptability of MCM use.

Strengths and limitations of this study

- ► This study contributes to a growing body of literature that seeks to understand the acceptability of family planning (FP) interventions in sub-Saharan Africa. It also describes the unique contextual factors that influence the successful implementation of FP interventions in a pastoralist community with long held social and cultural norms.
- ► This study uses a realist evaluation approach to explore how acceptability of FP interventions is influenced by contextual factors. Key themes were identified that encompassed context and mechanisms influencing acceptability of modern contraceptive methods (MCMs) across both time points of the evaluation.
- ► By mapping outcomes across published theories, this study presents context-acceptability theories that support understanding of the acceptability of FP interventions in different contexts.
- ► While this evaluation used qualitative methods to explore, understand and generate theories on changes over two time points in the delivery and uptake of an FP intervention, it would further benefit from a robust quantitative data collection component that tests these theories.
- ► While this evaluation included insights from several categories of stakeholders, discussions with additional stakeholders within each category may have yielded a broader range of opinions and perceptions of the mechanisms driving acceptability of MCMs.

INTRODUCTION

Interventions that use family planning (FP) to mitigate the negative impacts of short interpregnancy intervals, such as maternal death, third-trimester bleeding and anaemia in mothers, as well as preterm birth and low birth weight in infants,[1–3] contribute to the Sustainable Development Goal of reducing child mortality and improving maternal health.[4] Cultural and societal norms can influence acceptability of FP and act as barriers to the delivery and uptake of modern contraceptive methods (MCMs).[5] Studies have cited several factors including male partner opposition, religious opposition and myths about side effects as influencing uptake of MCMs in low-income and middle-income countries.[5–8] In Uganda, male partner support for MCMs

has been shown to be influenced by patrilineal traditions that place value on family size and favour large families, as children are seen as a sign of wealth and financial security.[9] The desire for large families and the influence of this on MCM uptake is echoed in research across sub-Saharan Africa.[10 11]

There is a wide body of literature that discusses the difficulties of promoting MCM use in contexts where cultural norms and traditional values support the use of natural methods of FP.[7 12 13] However, there is limited evidence about what influences these social and cultural norms, particularly in populations where traditional lifestyles and livelihoods may influence health seeking behaviours. Studies that have assessed links between rural pastoralist lifestyles in sub-Saharan Africa and health outcomes have found that livelihood practices are among the major social determinants influencing health seeking behaviours, yet these have rarely addressed MCM use.[14 15] A study from Ethiopia assessing access to tuberculosis treatment among pastoralist communities found that lack of access to formal health services was a barrier to treatment access and that traditional beliefs, leading to self-treatment, were barriers to seeking health services.[16] Research from Sudan suggests that health seeking behaviours among nomadic, pastoralist populations are influenced by the mobile lifestyle of nomads, low levels of education, gender norms and other beliefs and values, and suggests that existing healthcare services are ill-adapted to the nomadic lifestyle.[17] Given the influence of lifestyle on health seeking behaviour among these populations, it is important to understand if and how changes to nomadic and pastoralist lifestyles might lead to changes in health seeking behaviours, particularly in regard to FP and MCM use.

An intervention that integrated the delivery of FP with childhood immunisation services in Moroto, in Uganda's North-eastern region of Karamoja, presented an opportunity to interrogate the uptake and delivery of FP in a community comprised of pastoralist and non-pastoralist populations. An evaluation was conducted to understand (1) if and how prevailing contextual factors influenced the acceptability and use of MCMs in a pastoral community in Uganda, (2) what mechanisms were triggered by these contextual factors (3) if these contextual factors changed between two time points 4 years apart and (3) the impact of any contextual changes on mechanisms triggered and acceptability and use outcomes.

METHODS

This section is divided into six subsections which outline the methods for this study. First, we describe the context in which the study was conducted. We then describe the intervention on which this study is based. Subsequently, we describe the study design and components, including the data collection that took place, the use of realist evaluation approach and the theoretical frameworks that were used to guide our research. We then describe our approach to sampling and data collection, our data analysis procedures and also briefly describe ethical approvals that were obtained for this study.

Study context

Karamoja, is a vulnerable region of Uganda due to its large distance from urban centres and a harsh climate of low rain fall and periods of drought.[18] This, combined with the proximity and spacing of health facilities among communities has contributed to low access to health services in the region.[19] Moroto is a district in Karamoja, within which Moroto is the largest town. While Uganda as a whole has a food insecurity level classified as serious by the Global World Hunger Index,[18] the northern and eastern regions are particularly affected by food insecurity due to periods of drought, which impact agricultural crops. The poverty rate in Uganda has been steadily declining in recent years, but when coupled with rapid population growth, the number of people living in poverty has remained constant.[18] The decline in the poverty rate has been slower in Northern and Eastern regions of the country compared with others.[20]

Data from the 2016 Demographic and Health Survey (DHS) in Uganda demonstrate that use of FP in Karamoja is very low. While 98.4% of women and 90.4% of men had ever heard of an FP method (98.3% and 88.4% had heard of any modern method), only 7.3% of women in Karamoja were using any FP method and 6.5% were using a modern method.[21] These are the lowest rates of use in the country by far, followed by West Nile region, where 21.3% of women were using any FP method. In the urban capital of Kampala, 44.8% of women were using any FP method. In Karamoja, the unmet (Proportion of women who (1) are not pregnant and not postpartum amenorrhoeic and are considered fecund and want to postpone their next birth for two or more years or stop childbearing altogether but are not using a contraceptive method, or (2) have a mistimed or unwanted current pregnancy or (3) are postpartum amenorrhoeic and their last birth in the last 2 years was mistimed or unwanted.) need for FP, was 19.7% among married women and 10.3% among unmarried women.[21] To respond to the relatively low rates of FP uptake in the country, Uganda set an FP2020 Global Partnership target of increasing the national modern contraceptive prevalence to 50% and the reduction of the unmet need for FP to 10% by 2020.[22]

Intervention

Between January 2016 and December 2019, the International Rescue Committee supported the implementation of an intervention, which integrated FP and immunisations in government-run health facilities in Moroto District, including health facilities and hospitals. Three of these facilities were Catholic-founded facilities that only provided counselling on natural FP methods, such as lactational amenorrhoea and abstinence. The intervention aimed to increase access to, demand for and uptake of MCMs by strengthening FP services, improving referral pathways, supporting MCM supply provision and building

capacity among healthcare workers (HCWs). Broadly, the intervention contained several components including (1) training and mentoring of facility-based HCWs on FP counselling and MCM service provision; (2) increasing capacity of members of the Village Health Team (VHTs) to support HCWs in FP counselling; (3) improving immunisation defaulter tracing and (4) developing robust community engagement strategies that included the involvement of community leaders, HCWs and VHTs. The intervention promoted the use of natural FP methods as well as MCMs (condoms, oral contraceptive pills, injectables, implants, the intrauterine device and permanent methods such as tubal ligation and vasectomy). In this study, 'FP services' and 'FP counselling' refer to both natural FP and MCMs.

HCWs and VHTs worked in tandem to provide FP counselling to women and to support their decision-making around FP service uptake. At the community level, VHTs played a key role by leading health talks in the community and by providing counselling and referrals for FP services during household visits and by using expert clients. VHTs were supported by community leaders and role models who were members of the community who engaged with FP services.

In addition to FP counselling provided within the community, HCWs provided counselling in health facilities during antenatal care visits, at birth and during postpartum visits. Postpartum visits took place immediately after birth, 6 days after birth and 6 weeks after birth, and were used to discuss the importance of immunisation, and opportunities for immunisation and FP counselling were offered.

The intervention's routine monitoring data revealed a 42% increase over time in the number of women who accepted a referral for FP services when taking their child for immunisation. Between July 2016 and February 2018, a total of 8933 women took a child for immunisation within the study site. Among these women, 1246 (13.9%) accepted a referral for FP services and 1080 (86.7%) of the women who were referred took up a method on the same day. Between March 2018 and November 2019, a total of 7139 women took a child for immunisation. Among these women, 1711 (24.0%) accepted a referral for FP services and 1598 (93.3%) of the women who were referred took up a method on the same day. These data were collected across all health facilities, including Catholic-founded facilities were only natural FP methods were offered.

Study design and components

The intervention was evaluated using a realist evaluation at two time points (November 2017 and November 2019). The realist evaluation used qualitative methods to understand the mechanisms by which intervention components worked or did not work. This method of evaluation recognises the limitations of using experimental study designs to understand complex interventions in which multiple factors are at play. Realist evaluation seeks to understand what works, for whom and under what circumstances within a particular intervention, using context-mechanism-outcome (CMO) configurations.[23] In recognition of the impact that different actors and their reactions to intervention components have on intervention outcomes, the standard CMO configuration was expanded where relevant to include context-actor-mechanism-outcome (CAMO) or context-intervention-actor-mechanism-outcome (CIAMO) configurations; this methodology has been used previously to acknowledge the importance of actor reactions to intervention components.[24 25]

There is limited evidence about the use of qualitative research methods to understand changes over time. It has been suggested that the use of a theoretical framework and multiple methods of analyses can ensure the quality and integrity of longitudinal qualitative studies.[26] Grosshoeme and Lipstein (2006) suggest using a trajectory approach to understand changes over time at the individual level, noting that this allows for an understanding of an individuals' experiences over time, rather than looking at broad changes across entire populations. This, the authors argue, allows for important nuances to be captured. Looking at population level changes may yield few results, while individual analyses allow researchers to understand factors influencing decision-making or behaviours at the individual level.[27] The overarching or prevailing context in which an intervention is implemented influences mechanisms of acceptability.[25] A prevailing context is multidimensional, multilayered and fluid. Interventions and their components may also cause shifts in the prevailing context.

Research components

This evaluation employed seven research components (figure 1) used at two time points (round 1 and round 2), which included: (1) the development of an initial programme theory (round 1); (2) the analysis of qualitative data from round 1 in-depth interviews (IDIs); (3) the development of preliminary CMO configurations; (4) development of a revised programme theory (RPT); (5) the analysis of qualitative data from round 2 IDIs; (6) the development of round 2 CAMOs/CIAMOs and (7) the development of a RPT comprised of CAMO/CIAMO configurations ordered against relevant published theoretical frameworks and finally the development of context-acceptability theories (CATs).[25 28]

An initial programme theory (figure 2) was developed with implementing partners and described factors at the community-level and facility-level that were thought to drive the effective implementation of the intervention. These included the effective delivery of FP services at health facilities and the willingness of women in the community to engage with these services. The initial programme theory was used to inform the development of IDI interview guides.

IDIs with key stakeholders involved in the delivery and uptake of the intervention were conducted in each round to identify contextual factors that triggered mechanisms,

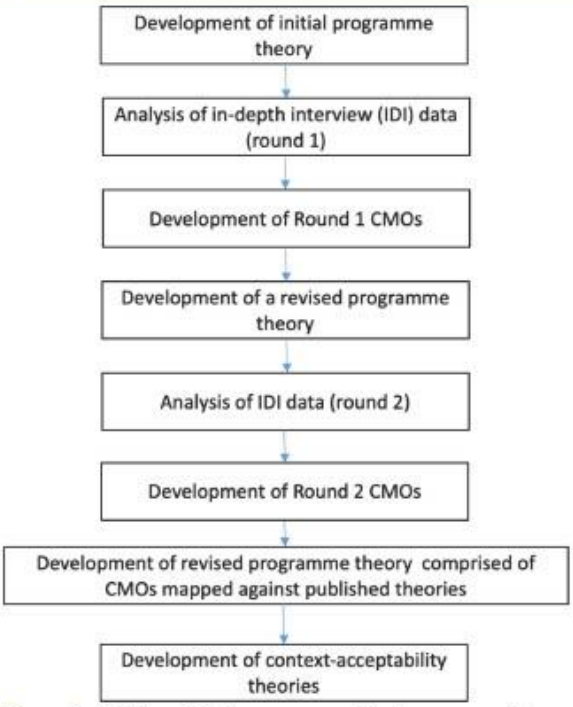

Figure 1 Outline of data sources and study components and process. CMOs, context-mechanism-outcome.

which led to intervention outcomes. All participants were provided a detailed information sheet about the study and signed an informed consent form before participating. The RPT developed at the end of round 1 provided the initial programme theory for round 2.

We used two published theoretical frameworks to provide a structure against which findings could be ordered. These frameworks have been used previously to explore FP acceptability in Ethiopia.[24] The first of these was Roger's diffusion (and adoption) of innovations, which provides a framework for examining factors influencing how an intervention is adopted and diffused through a system. This framework consists of five constructs: relative advantage, compatibility, trialability, observability and complexity.[29] The second framework was an adaptation of the Theoretical Framework on Acceptability (TFA)[30] consisting of eight constructs including affective attitude, burden, perceived effectiveness, ethicality, intervention coherence, opportunity costs, self-efficacy and unintended consequences.[25] Definitions of these constructs are provided in table 1. These two frameworks were used to guide and structure the analysis of data with the aim of matching empirically identified mechanisms to constructs from the frameworks. These linked mechanisms and constructs would then act as middle range mechanisms[24] to aid in cumulation of findings. Such middle range mechanisms have recently been used to develop CATs, which theorise what intervention/s will work in what context to trigger mechanisms that increase acceptability.[25]

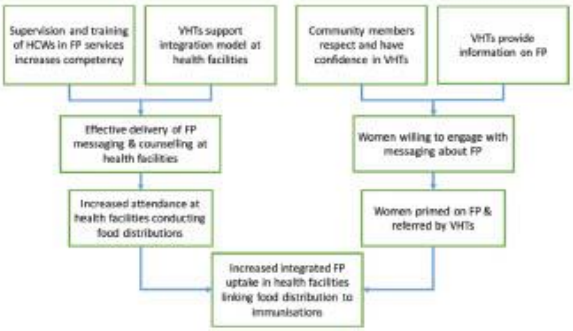

Figure 2 Initial programme theory. FP, family planning; HCWs, healthcare workers; VHTs, Village Health Team.

Table 1 Constructs of the diffusion of innovations framework and the theoretical framework of acceptability

Construct	Definition
Diffusion of innovations framework[29]	
Relative advantage	The degree to which an innovation is perceived as being better than the idea it supersedes.
Compatability	The degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters.
Trialability	The degree to which an innovation may be experimented with on a limited basis.
Observability	The degree to which the results of an innovation are visible to others.
Complexity	The degree to which an innovation is perceived as relatively difficult to understand and use.
Theoretical framework of acceptability[30]	
Affective attitude	How an individual feels about the intervention.
Burden	The perceived amount of effort that is required to participate in the intervention.
Ethicality	The extent to which the intervention has good fit with an individual's value system.
Intervention coherence	The extent to which the participant understands how the intervention works.
Opportunity costs	The extent to which benefits, profits or values must be given up to engage in the intervention.
Perceived effectiveness	The extent to which the intervention is perceived as likely to achieve its purpose.
Self-efficacy	The participant's confidence that they can perform the behaviour(s) required to participate in the intervention.

Sampling and empirical data collection

Purposive sampling was used to select key stakeholders for IDIs in both rounds of data collection. Stakeholders were selected if they were involved or had an interest in the intervention, which included implementing partners,

government officials, HCWs and community members, including women (both FP users and non-FP users). Sampling ensured a wide range of stakeholders and opinions were sought. HCWs and VHTs that were selected were all directly involved in the delivery of integrated FP and immunisation counselling or service provision. Health facilities were identified based on their performance according to monitoring data and to the implementing partners and included those where the intervention was performing more or less well. Different stakeholders were selected in each round of data collection. Stakeholders were independently selected for each round of data collection and therefore differed across the two rounds.

Interview guides were developed for IDIs. These included a range of themes such as: workload, sociocultural norms and healthcare access. Implementing partners were involved in the development of the interview guides for the first round of data collection. The findings from the first round of data collection informed the development of interview guides for the second round. In addition to questions that addressed key thematic areas described above, the interview guides in the second round of data collection included a presentation of CMOs developed from round 1. At the end of the IDI, each stakeholder was presented with CMOs that were relevant to them and were asked to confirm whether they believed the statement was true at the time of round 1 data collection and, whether it was true now, why or why not in each case.[31] This was followed by a discussion of each component of the CMO and their linkages. This was done to confirm previous CMOs and to gain a deeper understanding of each component of the CMO. It also allowed for an understanding of if and how participants perceived that these components linked together and whether they had changed between the two rounds of data collection.

Data were collected in English and Karamojong. All interviews were recorded, transcribed *verbatim* and translated into English when necessary. Interviews were conducted by a researcher from the London School of Hygiene and Tropical Medicine (LSHTM) and field-based research assistants, with oversight from a local study coordinator.

Data management and analysis

The IDI transcripts were imported into NVivo V.11.2 for coding and analysis. Quotes were anonymised, but the type of respondent attributable to each quote was retained to aid analyses. Coding and analysis were based on an initial framework of: interventions; actors; context; mechanisms; outcomes and initial CMO configurations. These categories were populated inductively with themes and subthemes as they were identified from the data. Key themes identified from the interviews were presented and supported by quotes from interview transcripts.

For both rounds of data collection, retroductive analysis was used incorporating both inductive and deductive reasoning to explore how outcomes were generated, the mechanisms of this causal generation and the influence of contextual factors. CAMO/CIAMO configurations were developed for each round of data collection and compared.[32] The empirical mechanisms identified were then linked to constructs from the diffusion of innovations framework and the adapted TFA and thus ordered within these frameworks. A RPT was developed from the CAMOs/CIAMOs, at the end of round 1, which then functioned as the IPT for round 2. Mechanisms were linked to framework constructs and CATs were ultimately developed.

Though the initial programme theory included service delivery factors that drove the intervention, this paper focuses solely on the community context.

Patient and public involvement

No patients were involved in this study.

RESULTS

This section includes three subsections. First, we highlight key findings from the analysis of stakeholder IDIs and describe the four broad themes that encompass the context and mechanisms perceived by stakeholders, supported with quotes. We then describe the CAMOs and CIAMOs developed and how the identified mechanisms were linked to constructs of published theories. This subsection is supplemented with a table that describes the CAMOs and CIAMOs in detail. Finally, we present a brief paragraph on the development of context-acceptability-theories, also supplemented with a detailed table.

Perceptions of stakeholders

Sixty-nine stakeholders were interviewed through both rounds of data collection (table 2). MCM uptake was influenced by several factors. Four key themes were identified as important in stakeholders' perceptions and acceptability of MCMs. These were: (1) fear of side effects of MCMs; (2) preference for natural FP methods; (3) pastoral lifestyles of men in the community and (4) food insecurity in Karamoja. We present data (quotes) from

Table 2 Stakeholder in-depth interview (IDI) summary

Type of participant	Number of round 1 IDIs	Number of round 2 IDIs
Woman (FP users and non-users)	5	15
Health worker	10	14
VHT	4	4
Implementer	2	2
Male community member	–	4
Member of the District Health Team	3	2
Community volunteer	3	1
Total	27	42

FP, family planning; VHT, Village Health Team.

each round of data collection relating to each of these themes.

Theme: fear of side effects of MCMs

Round 1: In round 1, fear of side effects, embedded in cultural beliefs, was a clear barrier to MCM uptake. Some women reported hearing stories from other women in the community about excessive bleeding or pain caused by MCMs and this caused fear. These fears led to a reluctance to use MCMs. Hearing about side effects from peers was powerful, and it influenced women's beliefs about MCM side effects. HCWs acknowledged these fears and reported that they could be mitigated if women knew that side effects could be managed. Some women feared that MCMs would lead to several physical side effects:

> They talk and say that the medicine is bad it will kill you. They say that the body will shrink, you will become thin and again there is headache and you will die. Then again if you are not careful the headache will disturb you and… the stomach will pain you. Yes, if not the chest will pain you all the time and you will be over bleeding. So that is what we found as rumours. Woman FP user_1_round 1

Round 2: Data from round 2 indicated that, among women interviewed, fear of side effects was reducing. HCWs reported feeling confident that when women told them about their fears of side effects, they could convince them that side effects were minimal and could be managed. Women's knowledge and belief that side effects could be managed empowered them to make choices about MCM uptake:

> I also wanted to join family planning like my friends who have joined. I had fear for side effects but I got courage. I discussed and agreed with my husband before I came to get a family planning method. Woman FP user_1_round 2

Theme: preference for natural FP methods

Round 1: In round 1, there were strong beliefs in the effectiveness of natural FP methods, which fit with the pastoral lifestyle in Karamoja. In addition, it was perceived that women felt that spacing between births should occur naturally, which reinforced their preference for natural methods of FP:

> When you ask them, they say…they just don't want to block their uterus…And to them they feel that is compatible with their… natural lifestyle. Health worker_2_round 1

Round 2: This reliance on and preference for natural methods was less evident in round 2, where it was perceived that fears of side effects of MCMs were less prominent:

> Others use the modern methods… Because now they prefer it more than those other natural ones especially the learned people… Because with the modern, they know in case of any side effects, it can be managed and it can [space births] for some good time but [for] natural [methods], it is short time… just below 2 years. Health worker_2_round 2

Decreased reliance on natural methods was also influenced by changes to pastoralist lifestyles which meant that men were spending less time in the *kraal* (the field), and more time in the home. Some participants discussed the fact that spending less time in the *kraal* meant that the traditional method of abstinence no longer worked for some couples. Natural birth spacing that occurred when men spent months or years away from the home was no longer reliable, thereby increasing the need for MCMs:

> Previously when men are pastoralist, even the woman would delay to more children… children are spaced well, but now because the cows are just within, the place is dry, now you see women are getting a lot of children, you get another one before the other one is even one year, family planning…the natural one is getting affected, that is why we need to emphasize on the artificial one so that they can also have some time to space. Health worker_4_round 2

> The natural method they use to say is that when a woman… delivers a man is supposed to stay away for two to three years before they have sex with a woman until the child first runs in the compound that's when they think a woman is now ready to meet with the man and in that process the man is either is in the [kraal] there very far… now they are interfaced with a scenario where they're always with a man, woman and man in the same place, they're no longer very distant they have a negative thinking about the modern methods so we see baby after a baby. Member of District Health Team_1_round 2

> … at least some people have embraced family planning and they find it good for them…those years, the only family planning method was to disappear from the home and go to the kraal up to when again the child is like two years so that at least with now with the advantages of family planning that we have told them, I think they are really embracing. Male partner_1_round 2

Theme: pastoralist lifestyles of men in the community

The fact that men in the community were spending less time in the *kraal* carrying out pastoral work meant two things: (1) natural methods of birth spacing that relied on men's absence from home were no longer effective, and (2) men were at home more and observed the need for and benefits of FP. Both of these factors influenced uptake of MCMs.

Round 1: Lack of male support for MCM use was commonly reported as a barrier to MCM uptake by participants in round 1. It was perceived that men in the community believed that it was a woman's duty to produce children and that having a large family and many children was a source of pride among men. Men

believed that, by having a wife, they had the opportunity to produce children and that they should not limit the number of children they had:

> They were really very negative about it [FP]. They were like, if God has given me that chance to produce why don't I produce? Why are you telling me about family planning? Health worker_5_round 1

Round 2: In round 2, as mentioned above, many participants noted that men were spending less time in the *kraal* doing pastoral work. Participants discussed how this meant that men could now see the health and economic impacts of having a large family and how it influenced their acceptability of MCMs. This meant that the lack of male support for MCMs seen in round 1 was not as strong, because despite beliefs about family size and the pride associated with having many children, it was perceived that men could see that there were negative impacts of not being able to manage or take care of a large family:

> Anyway those days, men used to move they come at night but now since they are seated there together, you find a man also sees, they are very many children, this one is crying, the other one has diarrhoea…this one is what, so that one alone in his mind and say, why don't I take this woman for family planning, because now over producing, there is no food there is no what. At least those days men could move and they could comeback when children are sleeping but now they can stay for some time even they come a bit not so late they first stay with their women and see how the family is so, it has helped somehow. Health worker_2_round 2

Spending less time in the *kraal* also meant that men were able to be engaged in decision-making about FP and MCM use. Because men were in the home more, they could engage in dialogue with their wives about FP and they could benefit from messaging about FP in the community:

> It has influenced family planning because right now the family can sit together and they decide maybe we have to have this number of children than us having very many now you see there is poverty, we have few cows, we cannot afford, that means they can share information and you find that people now are trying to embrace family planning. Health worker_3_round 2

Theme: food insecurity in Karamoja

Round 1: The influence of food insecurity was particularly evident from the responses of participants in round 1. Food insecurity influenced health seeking behaviours among women that were interviewed in different ways. Some people sought FP services out of fears they would not be able to feed all their children:

> [I] was not going for family planning before [we] had enough animals…had enough cows but because of the rains so they came and raided all [the] cows they stole all [the] cows so when the cows were over now [I] should go for family planning because now there is nothing that [I] can use for feeding the family. Woman FP user_2_round 1

Others chose to access health services at health facilities that were distributing food rations from the World Food Programme (WFP). Some health facilities that were providing WFP rations were not providing FP services, and so women accessing rations were not receiving FP counselling. HCWs perceived this to mean that uptake of FP services was influenced by women's decisions to access rations.

> Yeah it affects very well because when that food is there we have the highest number [of women accessing the health facility] when the food is not there you can get like two mothers for the whole month you can get like 30 and yet when the food is there we can get like two hundred mothers in a month, so you find …. it affects so much and when we don't have food they go to the facility that has food. Health worker_3_round 1

Round 2: In round 2, participants reported that changes to the WFP in Karamoja meant that the provision of food rations at health facilities was less frequent and as such did not have the same level of influence on facility choice as noted previously. At the same time, the lack of access to food rations meant that food insecurity was an even more obvious problem in round 2, and VHTs and District Health Team members perceived that this made it clear to women that managing a large family was a challenge:

> Now the food is reducing, they are now realizing that health is very important, them immunising their children is very important and does not mean that there is food because they keep on health educating them that what about tomorrow when that food is not there, will you not take your child for immunisation or won't you go for a service before anything is given. They are trying to pick up now. Member of the District Health Team_2_round 2

> Poverty has forced the communities to accept family planning because it has become hard to feed many children. Managing families has become a challenge. There is rapid shift from old cultural practices towards modern family planning. VHT_1_round 2

CAMOs/CIAMOs

CAMOs/CIAMOs were developed for each round of data collection across each of the four themes (table 3). A RPT was then developed to describe changes in the four key themes and how these changes led to different CAMOs/CIAMOs across rounds (figure 3). The RPT describes if and how the intervention was perceived to have contributed to changes in context and mechanisms of acceptability of MCMs. The two theoretical frameworks were useful in understanding the mechanisms that

Table 3 Context-(intervention)-actor-mechanism-outcome configurations across two time points

Round 1	Round 2
Theme: fear of side effects of MCMs	
CAMO1_R1 Women hear rumours of side effects of modern FP methods (C) and women (A) fear side effects of MCMs (M) so they choose natural methods for birth spacing and have reduced uptake of MCMs (O)	**CIAMO1_R2** Where rumours about the side effects of MCMs persist (C), side effects are managed by healthcare workers providing FP services (I) and women (A) understand and believe that side effects can be minimised and managed (M) and choose MCMs (O)
Intervention components that contributed to changes: management of side effects by healthcare workers	
Theme: preference for natural FP methods	
CAMO2_R1 Women have peers who use natural methods of birth spacing (C) women (A) trust natural methods for birth spacing (M) such that women choose natural methods for birth spacing and have reduced uptake of MCMs (O)	**CIAMO1_R2** Where rumours about the side effects of MCMs persist (C), side effects are managed by healthcare workers providing FP services (I) and women (A) understand and believe that side effects can be minimised and managed (M) and choose MCMs (O) **CAMO1_R2** Men spend more time in the home than in the *kraal* (C) and men and women (A) understand and believe that traditional methods for birth spacing no longer work (M) so they choose MCMs over natural FP methods (O)
Intervention components that contributed to changes: management of side effects by healthcare workers	
Theme: pastoralist lifestyles of men in the community	
CAMO3_R1 Male partners oppose the use of MCMs (C) and women (A) are reluctant (M) to take up MCMs which leads to low MCM uptake (O)	**CAMO2_R2** Where pastoralist lifestyles are changing and male partners spend more time in the household (C), men (A) can see the impact of having too many children and believe that MCMs will have a positive impact (M) and support their wives in uptake of MCMs (O)
Intervention components that contributed to changes: N/A	
Theme: food insecurity in Karamoja	
Round 1 context **CAMO4_R1** WFP offers food distribution at some health facilities linked to child immunisations (C) and women (A) feel food rations are an immediate priority (M); therefore women attend health facilities that distribute food and may not offer FP services (O)	**Round 2 context** **CAMO2_R3** Where food insecurity influences health seeking behaviour (C), women (A) can see the need to limit their family size in order to be able to provide food for all their children (M) and they therefore choose to take up MCMs (O)
Intervention components that contributed to changes: N/A	

CAMO, context-actor-mechanism-outcome; CIAMO, context-intervention-actor-mechanism-outcome; FP, family planning; MCMs, modern contraceptive methods; N/A, not applicable; WFP, World Food Programme.

drove intervention uptake; however, they were found to perform different functions with constructs of the diffusion of innovation acting as catalysts that triggered the acceptability mechanisms.

The intervention was perceived to have directly influenced or changed the context in terms of fear of side effects and preference for natural FP methods. By demonstrating to women that side effects could be managed, the intervention was able to contribute to shifting beliefs about potential dangers of MCMs. Furthermore, due to contextual changes that resulted in men spending more time at home, it was possible to demonstrate the usefulness of MCMs in a context where natural FP methods could no longer be relied on. In both cases, women could observe the management of side effects by HCWs, which aligned with the diffusion of innovations construct of observability.

With fears of side effects being allayed, and with men spending more time in the home, women and men perceived the relative advantage of MCMs over natural methods. They also perceived that MCMs were compatible with their lives, aligning with the diffusion of innovations constructs of relative advantage and compatibility. In both cases, these constructs acted as catalysts for triggering acceptability constructs. Observing the management of side effects led women to feel more positive about

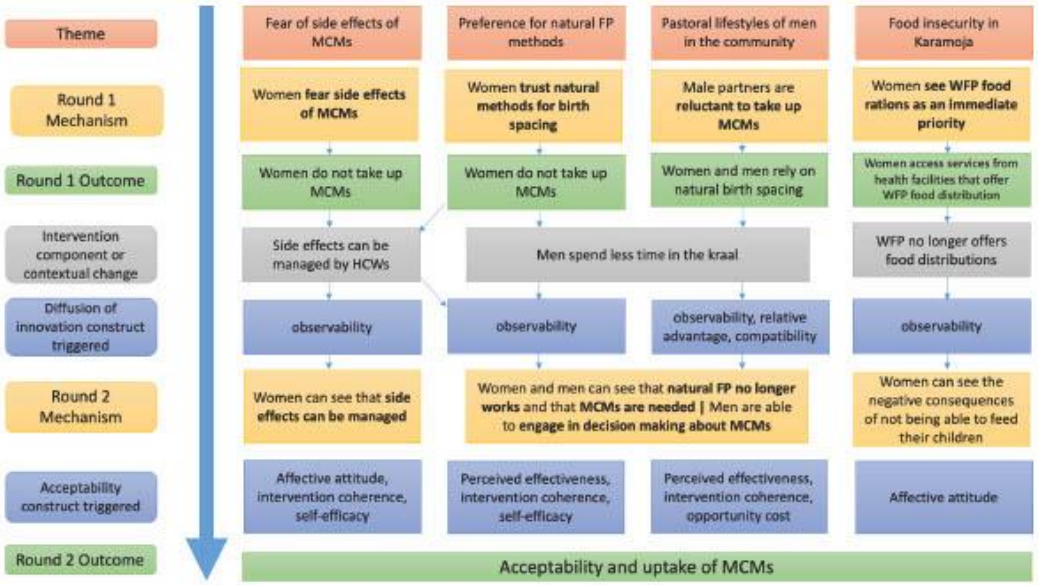

Figure 3 Revised programme theory. Contextual factors influenced intervention outcomes in round 1. Intervention components or contextual changes (in grey) led to the triggering of diffusion of innovation constructs that acted as catalysts for mechanisms of acceptability. FP, family planning; HCWs, healthcare workers; MCMs, modern contraceptive methods; WFP, World Food Programme.

MCMs and gain confidence in their ability to choose MCMs. This greater confidence aligned with the acceptability constructs of affective attitude and self-efficacy. Women were able to observe and understand how MCMs could assist them with birth spacing and achieving smaller family sizes. This shift in their perception of MCMs as useful aligned with the acceptability construct of intervention coherence. Furthermore, both women and men believed that natural birth spacing was no longer a reliable method of FP and could see how MCMs 'fit' (or were coherent with) their FP needs given the changed household context. This, combined with the knowledge that side effects could be managed, meant men and women were confident, or felt a high level of self-efficacy, in their ability to use MCMs.

In terms of pastoralist lifestyles and food insecurity, changes unrelated to the intervention influenced acceptability of MCMs in the community. The fact that men in the community were spending less time in the *kraal* meant that they could observe the challenges associated with having a large family and were receptive to the idea that MCMs would have a positive impact on managing family size and thus reducing the financial burden. This observability acted as a catalyst, which led to the triggering of the acceptability construct of affective attitude, as this influenced the way that men felt towards MCMs. Food insecurity also changed across rounds of data collection. When WFP food distributions were no longer available in round 2, it was perceived that women could see the consequences of not having enough food to feed their family even more than they could when rations were available, and the need to limit their family size in order to be able to provide food for all their children. Again, the fact that women could observe these consequences acted as a catalyst and led to the triggering of the acceptability constructs of perceived effectiveness, intervention coherence, and opportunity cost. Women could see that (1) there was an opportunity cost to not using MCMs; and (2) that MCMs were more effective than natural FP methods at limiting family size.

Context-acceptability theories

By mapping study findings against published theoretical frameworks, this study identified several CATs (table 4). Eight CATs were developed when describing acceptability of FP interventions in five African countries by linking the empirically derived mechanisms of acceptability to TFA constructs.[25] One of the middle range theories described in the current study matches with one of these CATS and relates to the acceptability mechanisms of affective attitude, intervention coherence and self-efficacy. This study contributes three new CATs in addition to those that have previously been developed to understand FP acceptability.[25] These CATs involve the acceptability constructs of perceived effectiveness, intervention coherence and self-efficacy (theory 2), intervention coherence and affective attitude (theory 3) and perceived effectiveness, intervention coherence and opportunity cost (theory 4) and were triggered by changes in the prevailing context. Two of these CATs relate to changes in pastoralist lifestyles; the other CAT relates to the prevailing context of food insecurity.

Table 4 Context-acceptability theories

	In contexts where there are rumours or experience of MCM side effects women need to feel (understand and believe) that they can manage potential side effects. Ensuring that there are trained HCWs and community health workers that women can talk to about potential side effects will lead to women's acceptability of MCMs. **Diffusion of innovation catalysts of acceptability:** observability
Theory 1	**Acceptability constructs triggered:** affective attitude, intervention coherence, self-efficacy
Theory 2	In contexts where there is a preference for natural FP methods but traditional practices of men being away from home are changing, men are more present within the household. Men's understanding and belief that traditional methods for birth spacing no longer work will lead to their acceptability of MCMs. **Diffusion of innovation catalysts of acceptability:** relative advantage, compatibility, observability **Acceptability constructs triggered:** perceived effectiveness, intervention coherence, self-efficacy
Theory 3	In contexts where traditional practices of men being away from home are changing, men are more present within the household. Men being able to see the negative impacts of having several children will lead to their willingness to engage in dialogue about MCMs with their partners, and will lead to their acceptability of MCMs. **Diffusion of innovation catalysts of acceptability:** observability, relative advantage **Acceptability constructs triggered:** affective attitude, intervention coherence
Theory 4	In a context of food insecurity, women's perceived need to limit their family size in order to provide food for all their children will lead to increased acceptability of MCMs. **Diffusion of innovation catalysts of acceptability:** observability **Acceptability constructs triggered:** perceived effectiveness, intervention coherence, opportunity cost

FP, family planning; HCWs, healthcare workers; MCMs, modern contraceptive methods.

DISCUSSION

This evaluation highlights the key mechanisms that drove the implementation of an intervention of integrated childhood immunisation and FP services in Moroto, Uganda and explores how these changed over time. By developing and testing an initial programme theory, refining this theory and then retesting it, this evaluation provides a unique opportunity to understand how prevailing contextual factors change over time and how this influences the acceptability of an intervention. This evaluation contributes to the studies that have sought to understand uptake of FP services.[38–39] It discusses the influence of social and cultural norms on the acceptability of MCMs. It also discusses how acceptability can shift over time in response to changes in sociocultural norms and to targeted intervention components that address underlying mechanisms of acceptability. Overall, the qualitative data demonstrated that stakeholders perceived an increase in acceptability of MCMs over time. This is reflected in the intervention monitoring data which show an increase in uptake of FP referrals.

Changes over time

Four key themes, which encompassed context and mechanisms, were noted across the two rounds of data collection. These included (1) community-level factors that could be influenced and changed by the intervention itself, and (2) over-arching prevailing factors that affected the delivery and uptake of the intervention. In one case, the combination of the intervention and the prevailing context together resulted in shifting the acceptability of the intervention. These themes, together with constructs of acceptability and diffusion of innovations, led to the development of CAMOs/CIAMOs which help to understand the changes that occurred over time.

First, at the community level, in both rounds of the evaluation, strong sociocultural norms and beliefs influenced the way women viewed MCMs. In the first round, women had strong fears of side effects. Evidence demonstrating fear of side effects and its role as a barrier to MCM uptake is common in the literature. Studies from India, Nepal, Nigeria, Uganda and the Philippines all show that fear of side effects can be a major barrier to MCM uptake.[40–43] Studies that have assessed community myths about MCMs and how they lead to fears about side effects and resistance to MCMs have suggested that social norms play a large role in influencing individual-level choices about MCM use. In a study assessing MCM use in communities in Kenya, Nigeria and Senegal where negative myths about MCMs persisted, it was found that beliefs in myths, which were embedded within social norms, were negatively associated with MCM use.[44] An analysis of 2005–2009 DHS data from 21 African countries showed that contraceptive use was associated with community-level fertility and gender norms, and health knowledge,[45] again demonstrating the important relationship between social norms and choices about FP. This evaluation found that fears about side effects were less prominent in the second round of data collection and that stakeholders perceived the intervention as having contributed to changes or shifts in the context within the community in terms of the management of side effects.

Understanding how and why this shift occurred is complex. Evidence that community attitudes, particularly those relating to MCMs, can shift over time has focused primarily on the use of mass communication, messaging, and dialogue between partners as catalysts for change.[46 47] *Gueye et al* (2016) suggest that programmes that encourage community-level discussions of myths

related to contraceptive use are needed to overcome fear of side effects.[44] Findings from studies in Nepal and Uganda demonstrate that interventions that focus on repeated exposure to messages and mass media can increase interpersonal communication and encourage positive changes in attitudes regarding FP.[46 47] The intervention in Karamoja included counselling and messaging to women about FP, which aligns somewhat with the evidence cited above that exposure to messaging can shift attitudes towards FP. However, the intervention also showed women that the side effects of MCMs could be managed. Observing the effective management of side effects meant that women felt confident to use MCMs. Knowing that they could manage symptoms, is what ultimately led women to accept MCMs. This suggests that the provision of information alone is unlikely to cause a meaningful change and that mechanisms of acceptability can be successfully triggered by observing the intervention in action and by addressing underlying reasons for non-acceptability, in this case, fear of side effects. Indeed, other interventions beyond counselling and clinical management of side effects may be effective in promoting MCMs in a context where fears of side effects persist.

Second, there was a strong preference among women in the community for natural methods of FP which was linked to fears of side effects of MCMs. These natural methods, including lactational amenorrhoea and abstinence, were promoted by Catholic health facilities in the study community, and are often used in pastoralist communities because they are compatible with the lifestyle of men spending months and years away from the home.[48–50] Because preference for these methods was influenced somewhat by fears of side effects, women's ability to see that side effects could be managed contributed to increased acceptability of MCMs over natural FP methods. However, preference for natural FP methods was also influenced by the fact that natural FP methods fit with the pastoralist lifestyle and that men spending time in the *kraal* meant that birth spacing occurred naturally. Decreased time in the *kraal* meant that the previously relied on methods of abstinence were no longer feasible and that in order to space births, or limit family size, MCMs would need to be considered. While there is very little evidence on abstinence as a method of FP among married couples in sub-Saharan Africa, McCadden *et al*[49] describe that the change in lifestyle and level of interaction between couples in Karamoja has changed gender roles and dynamics. In their studies the authors found that both women and men reported the need for self-discipline and the need to establish physical separation in order to avoid sex,[48] given the increased level of interaction. This suggests that MCMs may be perceived as more effective given the changing lifestyle that many pastoralist communities are facing, including the fact that men and women may be spending more time together in the home, and that this need led to increased acceptability of MCMs in the study community. Other important issues such as potential increases in violence in the home, or women spending time out of the home working in order to supplement household income could be explored in future research.

Furthermore, with the shift in pastoralist lifestyles, men were spending more time at home and were therefore able to observe the challenges associated with having many children. They were also able to receive FP messaging in the community and to engage with their wives in decision-making about FP and MCM use. Evidence suggests that increased dialogue between couples about MCMs can shift social norms surrounding their use. An evaluation of an intervention that promoted community dialogue about MCMs and gender in Kenya found that such interventions can lead to increased uptake of MCMs by shifting social norms, and enabling communication and decision-making among couples.[51] This was similar to conclusions from other studies in Nigeria and Egypt, which stressed the importance of engaging partners and spouses in dialogue about MCMs.[52 53] While the current study findings align with other evidence on this topic, it is also clear that multiple factors are likely required to facilitate change. In this study, for women to choose MCMs over natural FP methods and to feel confident in being able to choose them, they needed to (1) see that side effects could be managed, (2) perceive that MCMs were more effective in achieving their desired birth spacing and (3) have engagement and support from male partners who recognised the value of MCMs. Again, observability acted as a catalyst for mechanisms of acceptability.

Finally, the broad, over-arching theme of food insecurity, and changes in access to food, was also perceived to drive implementation and uptake of the intervention in the study community. In the first round of data collection, food insecurity influenced the health seeking behaviour of community members. Women often chose to access health services from facilities that were offering food rations even if these facilities did not provide FP services. In this case, food insecurity directly influenced or mediated the effective implementation of the intervention and may have influenced the overall level of FP uptake. There is wide body of evidence that demonstrates links between food insecurity and health seeking behaviour.[54–57] Much of the evidence focuses on adherence to HIV treatment. One study looking at if and how food insecurity influenced ART adherence found that the competing demands between costs of food and medical expenses led people either to default from treatment, miss clinic visits or give up food and wages to get medications.[56] Another study found links between food insecurity and ART adherence that were influenced by the exacerbation of hunger or ART side effects in the absence of adequate food and competing resource demands.[57] This evaluation found that during the second round of data collection, when the WFP had stopped food distributions, lack of access to food meant that community members could see the direct economic impacts of having a large family. This convinced them of the benefits of MCMs. While not directly a change in social norms, the lack of food

distributions changed the context in the community, with some participants perceiving that this highlighted the challenge of food insecurity even further. Looking across both rounds, the findings demonstrate the important role that food insecurity can play in mediating the implementation of FP interventions. They highlight the need for interventions that acknowledge food insecurity and include intervention components that address it.

Context-acceptability theories

By linking the derived mechanisms from the CAMO/CIAMO configurations with acceptability constructs from the TFA, this study contributes to the literature on the use of CATs as applied to FP acceptability.[25] This study found one CAT described in previous research relating to FP.[25] By deriving three more CATs, this study contributes to a growing body of applicable theories that can be used to describe how context influences the acceptability of FP interventions.

Limitations

While this evaluation provided a unique opportunity to explore changes over time in the delivery and uptake of an FP intervention, it would have been augmented by a robust quantitative data collection component to help describe changes in the uptake of MCMs. Timing constraints made it impossible to carry out quantitative data collection within this study. It might have also been useful to return to the same participants across both rounds of data collection, potentially allowing for the observation of changes within the exact same respondents over time.

Furthermore, while this evaluation included insight from a range of different stakeholders, discussions with additional stakeholders within each of the stakeholder categories might have yielded a broader range of opinions and perceptions of the mechanisms driving implementation and uptake of the intervention.

CONCLUSION

This study sought to understand the key contextual factors that influenced the implementation and mechanisms of uptake of an intervention promoting FP and immunisations and examined if and how these changed over two time points. This evaluation adds to the evidence base on the implementation of FP interventions in sub-Saharan Africa, and particularly in resource limited rural settings. Beyond this, it describes the unique contexts and mechanisms that influence the implementation and outcomes of FP interventions in pastoralist communities with long held social and cultural norms.

In this study, social and cultural norms played a strong role in influencing acceptability of the intervention. Key contexts identified were: strong social and cultural beliefs that favoured natural FP methods over modern ones, changing lifestyles among pastoralist communities which shifted norms within the home and high levels of food insecurity which influenced health seeking behaviour. Within these contexts, the implementation of intervention components was found to trigger several mechanisms which were mapped to constructs of diffusion of innovations and acted as catalysts for mechanisms of acceptability including affective attitude, intervention coherence, self-efficacy, perceived effectiveness and opportunity cost. The context in which the intervention was implemented changed leading to the triggering of different mechanisms and an increase in the perceived value and acceptability of MCM use.

Contributors SK and JW conceived the idea for this research, wrote the first draft of the study tools and developed the study design and sampling approach with inputs from JKH, JH and NS. SK, ABA, CA and JM oversaw the data collection activities in Uganda with advice from JW, JKH and NS. The data analysis was carried out by JW, JH and SK. SK drafted the manuscript. SK is that guarantor of the paper. All authors made substantial and important contributions to revising the manuscript and provided final approval of the version to be published.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval This study involves human participants and ethics approval was obtained from the Mildmay Uganda Research Ethics Committee (approval numbers 0409-2017 and 0705-2019) and the ethics committee of the London School of Hygiene and Tropical Medicine (approval numbers 14432 and 16188). The study was registered with the Uganda National Council for Science and Technology in Uganda. Participants gave informed consent to participate in the study before taking part.

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Proforma describing student's contributions to papers

Paper 1: KRISHNARATNE S, HENSEN B, Cordes J, Enstone J, HARGREAVES JR; Interventions to strengthen the HIV prevention cascade: a systematic review of reviews. The lancet HIV (2016) 3 (7), e307-e317

I am the lead author of this paper. I conducted this work as part of a team of researchers, led by the study Principal Investigator, and paper writing responsibilities were shared. I contributed to the conception or the design of the paper and analysed and interpreted study data within a team. I led the writing and revising of this paper, submitted the paper for peer-review, and led the process of responding to peer reviewer comments, and finalizing the paper for publication.

Signed: _____ Date: ____15/04/23_____

Lead author (Shari Krishnaratne)

Signed: _____ Date: _____21/4/23_____

Principal Investigator (James Hargreaves)

Paper 2: KRISHNARATNE S, BOND V, Stangl A, PLIAKAS T, Mathema H, Lilleston P, Hoddinott G, Bock P, AYLES H, Fidler S, HARGREAVES JR; Stigma and Judgment Toward People Living with HIV and Key Population Groups Among Three Cadres of Health Workers in South Africa and Zambia: Analysis of Data from the HPTN 071 (PopART) Trial. AIDS patient care and STDs (2020) 34 (1), 38-50

I am the lead author of this paper. I conducted this work as part of a team of researchers, led by the study Principal Investigator, and paper writing responsibilities were shared. I contributed to the conception or the design of the paper and analysed and interpreted study data within a team. I led the writing and revising of this paper, submitted the paper for peer-review, and led the process of responding to peer reviewer comments, and finalizing the paper for publication.

Signed: _____ Date: ____15/04/23_____

Lead author (Shari Krishnaratne)

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Principal Investigator (James Hargreaves)

Paper 3: KRISHNARATNE S, HAMON JK, Hoyt J, CHANTLER T, Landegger J, Spilotros N, Demissie SD, Mohammed S, WEBSTER J; What mechanisms drive uptake of family planning when integrated with childhood immunisation in Ethiopia? A realist evaluation. BMC Public Health (2021) 21 (1), 99

I am the lead author of this paper. I conducted this work as part of a team of researchers, led by the study Principal Investigator, and paper writing responsibilities were shared. I contributed to the conception or the design of the paper and analysed and interpreted study data within a team. I led the writing and revising of this paper, submitted the paper for peer-review, and led the process of responding to peer reviewer comments, and finalizing the paper for publication.

Signed: _____ Date: ____15/04/23_____

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Paper 4: KRISHNARATNE S, Hoyt J, HAMON JK, Ariko AB, Atayo C, Morukileng J, Spilotros N, WEBSTER J; Acceptability of family planning in a changing context in Uganda: a realist evaluation at two time points. BMJ open (2022) 12 (4), e054277

I am the lead author of this paper. I conducted this work as part of a team of researchers, led by the study Principal Investigator, and paper writing responsibilities were shared. I contributed to the conception or the design of the paper and analysed and interpreted study data within a team. I led the writing and revising of this paper, submitted the paper for peer-review, and led the process of responding to peer reviewer comments, and finalizing the paper for publication.

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Lead author (Shari Krishnaratne)

Signed: _____ Date: ____15/04/23_____

Principal Investigator (Jayne Webster)

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Appendices

Appendix 1: Learning objectives

This portfolio of work, including my four papers and this analytic commentary, demonstrates that I have met the key learning objectives for the PhD by Prior Publication. Below I outline the four learning objectives and how I have achieved each one within this portfolio of work:

My lead authorship on these four papers demonstrates that I have been involved in **the creation and interpretation of new knowledge, through original research or other advanced scholarship.** For all of the papers I am submitting, I conducted my work as part of a robust team of researchers within which paper writing responsibilities were shared. For each paper, I contributed to the conception or the design of the paper and analysed and interpreted study data within a team. These papers were based on new research that I was directly involved in. I also led the writing and revising of each paper, submitted each paper for peer-review, and led the process of responding to peer reviewer comments. These papers are all based on original research undertaken by research teams which I have been part of.

The systematic acquisition and understanding of a substantial body of knowledge – Acquiring and understanding a body of knowledge was an essential step of the writing process for each of the papers included in this portfolio. A thorough understanding of the literature pertaining to each study described in my papers was essential for informing the development of the study protocols, as well as the background and discussion sections of each subsequent publication. Moreover, Paper 1 presents a very large systematic review of reviews which required me to systematically identify evidence and succinctly summarize this evidence.

The ability to conceptualise, design and implement a project for the generation of new knowledge, application or understanding at the forefront of the discipline, and to adjust the project design in the light of unforeseen problems – As part of a team, I have played a key role in the conceptualisation, design, and implementation of research that has formed the basis for my four publications. During my work on the HPTN 071 (PopART) trial, and on a

Pfizer Foundation funded evaluation of the integration of family planning and immunisations, I led or contributed to the protocol development, questionnaire development, field-based data collection, and analyses that have fed into several publications that I have led and co-authored. During work for the Bill and Melinda Gates Foundation, I led on all aspects of a large systematic review of reviews to inform the Foundation's HIV Prevention platform. In all cases, I had to be adaptive to changes in study implementation throughout the research process, and I had to engage regularly with partners and stakeholders across different disciplines, organizations, and countries. I also led or contributed to securing approval from ethical review boards at LSHTM, the National Institutes of Health, national ethical review boards in the countries where research was being implemented, and other collaborating institutions, which required me to respond to comments from reviewers and adjust components of the study protocols as needed. The work I undertook to generate data for these publications shows my ability to conceptualise, design, and implement a project for the generation of new knowledge.

A detailed understanding of applicable techniques for research and advanced academic enquiry – This analytic commentary clearly outlines my understanding of applicable techniques for research by demonstrating the different steps I have undertaken to conduct my research. As stated above, during my work on the HPTN 071 (PopART) trial on the integrated family planning and immunisations intervention, I led or contributed to the protocol development, questionnaire development, field-based data collection, and analyses that have fed into several publications that I have led and co-authored. The papers presented in this commentary all use a range of different quantitative and qualitative study methods, applied in unique ways, demonstrating my knowledge and understanding of research techniques.