APPLYING STATED-PREFERENCE METHODS TO HEALTH SYSTEMS PROBLEMS IN SUB-SAHARAN AFRICA

by

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Background: Sub-Saharan African country governments face challenges building robust health systems that can deliver essential and routine care consistently and well. Alongside the financial, logistical, and clinical challenges of delivering evidence-based interventions, planners and policymakers are increasingly pressed to be more responsive to stakeholders' values and preferences in their decisionmaking. For example, mortality from postpartum hemorrhage can be prevented and treated with uterotonic drugs; however, Kenyan stakeholders may disagree how best to strategically address threats to availability, safety, and effectiveness of providing these life-saving medicines. A national community-based health program could deliver essential services where skilled health workers are scarce in Tanzania; however, community health workers, the government, and beneficiaries may value the program's essential characteristics differently, including worker compensation, supervisory structures, training approaches to encourage retention, and which populations will be served. Systematically assessing preferences and priorities can be a valuable tool for health systems planners and policymakers for incorporating stakeholder voices into health programs.

Objectives: Characterize the range of quantitative stated-preference methods applications and approaches to health systems problems in sub-Saharan Africa through a systematic review of the scientific literature (Chapter 3); apply both qualitative and quantitative methods to two health systems problems in sub-Saharan Africa, 1) identify and prioritize strategies to promote uterotonic security in Kenya (Chapter 4); and 2) to identify, assess, and compare factors affecting stakeholders' preferences for a national community-based health program throughout Tanzania (Chapter 5).

Methods: Six databases were queried for peer-reviewed articles using quantitative stated-preference methods to evaluate a health systems-related trade-offs (Chapter 3). Two studies were undertaken. In Kenya, key informants were interviewed to identify potential strategic focal areas to improve uterotonic security. Priorities were assessed among national stakeholders using conjoint analysis. Survey responses were regressed using a linear probability model (Chapter 4). In Tanzania, qualitative research engaging community health workers, governing authorities, and recent clients in four districts in Morogoro Region identified potential program characteristics. Experts were engaged to refine the experiment to align with current policy concerns. Preferences were elicited from community health workers, their governing authorities, and community members throughout Morogoro Region using best-worst scaling techniques. Preference estimates were generated using mixed logit regression (Chapter 5).

Results: Seventy-seven articles published between 1996 and 2017 met review criteria. Methods were primarily choice-based. Trade-offs fell into six health systems "building blocks:" service features (n=27), workforce incentives (n=17), product features (n=14), system priorities (n=14), insurance features (n=4), and research priorities (n=1). Discrete-choice experiments were of highest quality (mean score: 3.36/5). Steps for attribute development were generally well described, and frequently included qualitative research (n=50, 65%). In Kenya, 23 informants were interviewed and 11 strategic focal areas were identified: polices and regulations, finance, advocacy and leadership, coordination, health supplies, human resource development, monitoring and evaluation, pharmaceutical quality assurance, service delivery, supply chain strengthening, and provider awareness. Survey respondents (n=66) included maternal health and pharmaceutical commodity

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experts from government, the public and private sectors. Pharmaceutical quality assurance ($p<0.01$) and supply chain strengthening ($p<0.05$) were the most prioritized areas. In Tanzania, interviews (community health workers, n=18; governing authorities, n=34) and discussions (client groups, n=8) yielded 19 potential program characteristics. Six attributes with three levels each were pre-tested and refined: incentives, supervision, eligibility, selection for training, services, and service venue. All survey respondents (community health workers (n=108), governing authorities (n=109), and community members (n=225) favored a community-based health program that provides a set salary ($p<0.001$), a package of services for the whole family ($p<0.001$), and disfavored requiring a Form 4 education ($p<0.001$). Governing authorities and community members preferred community health workers were bonded to service after training ($p<0.001$), while community health workers as a group were ambivalent.

Conclusions: Published stated-preference methods applications on sub-Saharan Africa health systems problems concerned primary health care for women, prevention and treatment of infectious diseases, and workforce development. Fewer studies concerned non-communicable diseases. In both the Kenya and Tanzania studies, a mixed methods approach demonstrated that identifying, assessing, and also comparing priorities using conjoint analysis or preferences using best-worst scaling techniques could be improved through qualitative research, pre-tests with relevant study audiences, and consultation with experts. Survey results from Kenya favor a uterotonic security strategy that emphasizes pharmaceutical quality assurance and supply chain strengthening above all other areas, reflecting ongoing concerns for both the quality and quantity of uterotonic drugs delivered. The national government should engage county governments to identify

compatible priorities and consider lessons learned from commodity security approaches for national HIV/AIDS, malaria, childhood immunization, and family planning programs. Survey results from Tanzania suggest similar preferences among the three stakeholder groups that provide for a community-based health program that provides a regular salary to community health workers, does not require community health workers to have a Form 4 education, provides more comprehensive services in public fora and client homes. Our findings provide a consistent picture of stakeholder preferences and clear guidance to health policymakers and planners to implement a national, community-based health program in Tanzania.

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Figures and Tables

Chapter 1: Introduction

Sub-Saharan African (SSA) countries face a considerable climb toward building robust and responsive health systems that can deliver essential and routine care consistently and well. SSA health systems decisionmaking frequently involves very limited human and financial resources to implement health programs. In these contexts, long-term planning to address stubborn problems like the HIV/AIDS epidemic can be quickly diverted to new and acute crises like the West African Ebola outbreak (1, 2). The concept of "people-centered health systems" has gained prominence to foster responsiveness to stakeholder values and preferences in the design and delivery of health care, in addition to more conventional improvements in health service coverage and quality (3). Systematically eliciting stakeholder preferences and priorities represents a first step towards building people-centered health systems by contextualizing health policy and planning with user voices. Better health policy and planning facilitates more efficient, effective, and responsive health programming, which can lead to better individual and population health outcomes. Eliciting stakeholder preferences has an important role to play in policymaking and planning, along with epidemiologic data and evidence-based interventions, toward addressing health and health systems problems (4).

Maternal mortality and uterotonic security in Kenya

Postpartum hemorrhage is a leading cause of maternal deaths in the world (5). Among the almost 1.8 million women estimated to have died from obstetric causes between 2003 and 2009, almost half a million women died from post-partum hemorrhage (PPH) (6). PPH can be successfully prevented and treated with a class of maternal health drugs called uterotonics, most notably oxytocin (7). A preventive dose of oxytocin

injected immediately following birth is recommended for the prevention of PPH for all laboring women, and an additional dose is recommended to treat severe bleeding as part of the active management of the third stage of labor (8, 9). The World Health Organization and the UN Commission on Life-Saving Commodities recognize uterotonics, especially oxytocin but also an alternative misoprostol, as essential medicines for preventing maternal mortality (8, 10, 11). Oxytocin is relatively inexpensive per dose, but its requirements for injection by a trained health worker and cold storage may limit delivering women's access to safe and efficacious drugs in low resource settings. Concern has also grown that the oxytocin that does reach delivering women is not of sufficient quality to prevent or treat PPH (12-15).

Pharmaceutical commodity security has been defined as "the ability to choose, obtain, and use health commodities when and where they are needed" (16-18). A corresponding definition for maternal health drugs to prevent PPH might be "the ability of a woman and her healthcare provider to choose, obtain, and use high-quality uterotonic medicines for labor and delivery." Kenyan women have not historically enjoyed good uterotonic security: not all health facilities in Kenya are equipped to provide obstetric care, adequate quantities of drug have not always been available in health facilities that deliver women, and many women continue to deliver at home and so do not receive these drugs' life-saving benefits (19-21).

The Kenyan government recognizes the importance of improving both access and quality of maternal health care to reducing maternal mortality. Kenya introduced free maternal health services in 2013, including antenatal, delivery and post-natal care. The Ministry of Health also introduced their first 3-year strategic plan in 2016 under the

Reproductive, Maternal, Newborn, Child, and Adolescent Health (RMNCAH) investment framework, which specifically targets the reduction of maternal mortality (22). Stakeholders must now decide how to implement their strategy.

Community-based health programs in Tanzania

Community-based health programs (CBHPs) are recognized for their potential to improve important health indices in low and middle-income countries by encouraging utilization of primary health care services such as antenatal care and childhood vaccination, but also critical health services like anti-retroviral therapy for HIV/AIDS (23, 24). CBHP planners intend that community health workers (CHWs) will motivate and mobilize their community in decisions regarding their collective health (25-30). In 1989, the World Health Organization adopted a definition for CHWs that recognized their unique link to the community as one that is supported by, not necessarily a formal part, of the national health system (26). CBHPs have become more prominent as a cost-effective means to deliver evidence-based health interventions as longer-term strategies are developed to address skilled health worker shortages (31).

Like many low-income countries with significant donor involvement, Tanzania struggles to coordinate health systems actors and competing priorities, while increasing primary health care coverage and improving standards of health service provision. Under the Primary Health Service Development Program (PHSDP)/ Mpango wa Maendeleo wa Afya ya Msingi (MMAM)(2007-2017), the Tanzanian Ministry of Health and Social Welfare (MOHSW) envisioned an ambitious expansion in both infrastructure and human resources for health (32). In 2014, the MOHSW issued National Community Based Health Program (NCBHP) guidelines under the PHSDP/MMAM, which laid out a broad

plan to consolidate primary health care programming, both privately and publicly

managed, into one national CBHP to be over-seen by local government authorities

(LGAs) (33). At the community-level, targets included increased training CHWs in 9,000

villages on the Integrated Management of Childhood Illness maternal, newborn and child

health service package (33).

The NCBHP guidelines highlight several key underlying problems with

independently led, volunteer CHW programs in Tanzania that a formal consolidation

might address (33). Without thoughtful coordination, LGAs struggle to create clear and

consistent plans for oversight of CHWs, particularly as it relates to supervision by and

referral to facility-based skilled health workers; volunteer cadres lack accountability for

their performance without a scheme for remuneration and retention. CHWs provide

limited health services of variable quality, which can be traced to a lack of standardized

training. Reporting on CHW activities is neither systematic, nor sufficient. MOHSW

policymakers must now decide how to engage community stakeholders in CBHP

decision-making (33).

Stakeholder engagement to understand preferences and priorities for health systems in sub-Saharan Africa

This dissertation research holds that research involving stakeholder engagement is

worthwhile especially when it gives shape to normative expressions of stakeholder

"voice" in the design and implementation of health policies and programs (3, 34, 35).

Further this research assumes that improved uterotonic security in Kenya and CBHPs in

Tanzania are desirable, and so the respective goals of the Kenyan and Tanzanian health

systems should be to understand *how* to optimize policies and programs, in part,

according to views and preferences of the stakeholder groups most concerned or affected.

This dissertation presents three studies concerning preferences and priorities for health systems decision-making in sub-Saharan Africa, embracing a mixed methods approach to research inquiry. Chapter 3 synthesizes the applications and approaches of stated-preference methods to health systems problems in sub-Saharan Africa in a systematic review of peer-reviewed literature. Chapter 4 identifies and prioritizes strategies to promote uterotonic security among national stakeholders in Kenya using conjoint analysis. Chapter 5 identifies, assesses, and compares factors affecting stakeholders' preferences for characteristics of a national community-based health program in Tanzania using best-worst scaling.

Chapter 2: Methods

Identifying and assessing stakeholder preferences and priorities are a first step to giving stakeholders a voice in health policy and planning. These efforts to integrate user voices can make programs more efficient, effective, and responsive, which can lead to better individual and population health outcomes. Stated-preference methods are ideal for measuring preferences for the particular attributes of health programs, products, or services which stakeholders value, but that may not yet exist (36). Stated-preference methods encompass a suite of methods and techniques designed to quantitatively elicit valuations of preference using an experimental framework, but increasingly incorporate and acknowledge the value of qualitative methods toward instrument development, attribute development, and the interpretation of survey results.

Stated-preference methods for preference elicitation and priority setting

Preferences have been defined as a latent concept associated with the value a person assigns to an alternative given a choice (37). Preference elicitation and priority setting research techniques draw from both qualitative and quantitative research traditions, but preference researchers differ on which quantitative methods shall be called stated-preference methods (38-40). There is also considerable cross-pollination of techniques in the literature, making a consistent typology difficult to establish. Among the quantitative methods, Ryan and colleagues group preference elicitation techniques into rating, ranking, and choice-based types (38). The Medical Device Innovation Consortium spear-headed by the U.S. Food and Drug Administration, counts six stated-preference methods: best-worst scaling (BWS), conjoint analysis (CA), discrete-choice experiments (DCE), direct preference assessment, threshold techniques, point allocation,

and ranking (39). Hauber and colleagues divide these techniques into direct methods (threshold techniques, rating and standard gamble) and conjoint analysis (graded pairs, ranking, and DCEs) (41). The International Society for Pharmacoeconomics and Outcomes Research Conjoint Analysis Task Force divides quantitative stated-preference methods into 1) methods that use rating, ranking and choice-based approaches to explore trade-offs between product attributes, and 2) methods that use direct elicitation of monetary values (contingent valuation, or willingness-to-pay) oriented toward characterizing demand for a product or service (42). Periodic inventories and assessments of methods applications can help to define best research practices, particularly with respect to particular health and health systems problems.

Systematic reviews

High-quality systematic reviews are needed to achieve topical mastery, assess the state of research evidence to create policy, and to find new areas for investigation (43). There is increasing openness to systematic reviews of qualitative evidence and non-clinical interventions (43, 44). Published applications of stated-preference methods are increasing in popularity, but there is a great deal of variety in their application and reporting quality, even in well-resourced contexts (45). Systematic reviews of these types of studies frequently concern a single health or health systems problem (e.g. health workforce policy, colorectal screening), a particular stated-preference method technique (e.g. BWS, CA), or an analytical perspective (e.g. patients, the public) (46-49). Researchers have recently synthesized the use of economic evaluation methods for health care priority setting in low and middle-income countries (LMICs), but without a specific focus on stated-preference methods or sub-Saharan Africa (SSA) (50).

Applications to health systems problems in sub-Saharan Africa

Applications of stated-preference methods in sub Saharan Africa have increased in the peer-reviewed literature for health product and service-related interventions, but also for health systems-related priority-setting (51-61). The United States Agency for International Development, the World Health Organization, and the World Bank were prompted by a proliferation of health workforce policy-related stated-preference methods studies to publish a guide in 2012 for conducting these studies among health care workers in LMICs to improve recruitment and retention in rural areas (62). Other stated-preference methods techniques have been applied to health systems in SSA. Bridges and colleagues examined determinants of demand for voluntary medical male circumcision among family members in South Africa using CA in 2011 (61). O'Hara and colleagues conducted a BWS experiment in 2015 on health care workers' preference for tuberculosis case finding also in South Africa (63). Research results described in Chapter 3 feature applications of stated-preference methods on health systems problems in SSA.

Mixed methods research for health systems problems

Mixed methods research is a research methodology, or an approach to research that provides for the ordered synthesis of qualitative research findings with quantitative research results to generate new knowledge (64). By integrating two lines of research inquiry, mixed methods research is marked for its ability to enhance the interpretation of results and compensate for weaknesses in either method (65). The exploratory-sequential mixed methods design is well-suited to attribute development and stated-preference methods, because it provides for a preparatory qualitative phase followed by a quantitative phase (64). Research activities described in Chapters 4 and 5 followed an

exploratory-sequential mixed methods study designs, to identify important attributes of a particular construct – "uterotonic security" and "community-based health programs" – using qualitative methods, for subsequent assessment using quantitative survey techniques (64).

Qualitative research for attribute development

Identifying potent attributes for preference elicitation is an important step in the design of stated-preference methods experiments, and especially choice-based tasks (42, 66). Attribute development can be particularly important to conducting a successful experiment with the community in LMIC settings because of lower literacy (67). Rigorous approaches can help ensure that attributes are salient to the intended survey audience, plausible within the health systems context, and capable of being traded (42). Preparatory steps for identifying attributes and levels can include literature reviews, qualitative research, consultation with subject matter experts, or pre-testing with the intended audience (42, 68-70). The attribute development process is under-documented in the literature, especially where qualitative methods have been used (68).

Phenomenology is concerned with the study of lived experiences, and promotes an approach to qualitative research that seeks a deep understanding of "life-worlds" (71). As qualitative researchers, interpretive phenomenologists gather explicit and lengthy descriptions of life practices, processes, or experiences from key informants in order to understand how that meaning affects individual choices (72). The primary data collection method for interpretive phenomenological analysis (IPA) of health-related lived experiences has been the semi-structured, in-depth interview using open-ended questions about the informant's relationship to the phenomenon under study, but has also included

focus group discussions (73). Interview questions are posed to interrogate particular aspects of a selected phenomenon with multiple informants; analysis re-combines and re-interprets those aspects into a theory of their experiences, or "phenomenology" (72).

IPA may require as few as three or four informants per phenomenon of interest because the emphasis is on extensive description to reach *saturation*, a point at which additional informant interactions provide little or no new information (71, 74). Descriptive phenomenological analysis and emergent qualitative research methodologies emphasize "bracketing out" prior knowledge or conceptions in order to isolate the commonalities of experience (75). Phenomenology makes no requirement for bracketing, holding instead that it is impossible to isolate either the informant or researcher from their respective contexts (71). IPA emphasizes iterative review through deep-reading of interview transcripts, iterative note-taking, and thematic analysis that reduces data through grouping and re-grouping of super-ordinate themes (73). IPA serves attribute development for quantitative stated-preference methods experiments well by distilling a set of discrete characteristics or factors that encompasses informants' lived experiences with a particular phenomenon, in this case "uterotonic security" in Kenya and "community-based health programs" in Tanzania.

Research results described in Chapter 3 feature applications of BWS, CA, DCE, ranking, and point-allocation type experiments in the peer-reviewed literature gathered via systematic review. Research presented in Chapters 4 employs semi-structured interviews with key informants and Chapter 5 employs both interviews and focus group discussions. Research presented in Chapters 4 and 5 employ CA and BWS survey techniques, respectively.

Chapter 3: Applying stated-preferences methods to improve health systems in Africa: A systematic review[1]

Introduction

Sub-Saharan African (SSA) countries face a considerable climb toward building robust and responsive health systems that can deliver essential and routine care consistently and well, within a context characterized by extremely limited resources and by acute public health crises like the West African Ebola outbreak and the longer-lived HIV/AIDS epidemic (1, 2). The concept of "people-centered health systems" has gained prominence to foster, alongside improvements in service coverage and quality, responsiveness to community and user needs, voices, values, and preferences in the design and delivery of health care (3). Eliciting stakeholder preferences and priorities represents a first step towards building people-centered health systems by contextualizing health policy and planning. Better health policy and planning facilitates more efficient, effective, and responsive health programming, which can lead to better health outcomes. Preference elicitation has a role to play, along with using epidemiologic data and favoring evidence-based interventions, in addressing health and health systems problems (4).

Stated-preference methods are economic evaluation survey tools that researchers, implementers, and policymakers use to understand the preferences and priorities of stakeholders for goods and services, and they have been used extensively in other development sectors (e.g. agriculture, environment) (40, 76-81). More specifically, stated

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preference experiments estimate the relative importance or value of the potential attributes of goods or services, which can help health systems planners to shape individual interventions for greater uptake, guide program implementation, and steer policy and investment decisions (82, 83). They are frequently used to assess specific health technologies, but their scope can extend to inform broader program and policy decision-making. Choice-based examples include discrete-choice experiments (DCEs), best-worst scaling experiments (BWSs), and conjoint analyses (CAs). Stated-preference methods can also include simple experimental designs like ranking and point allocation, which are more feasibly carried out by program evaluators. Applications to health systems problems in low and middle-income countries (LMICs) have emerged in the last decade especially DCEs concerning health workforce policy, but still lag behind global publication trends (47, 67, 84, 85).

Reviews of the application of stated-preference methods in health have frequently focused on the problems of non-communicable disease (NCD), which are emerging concerns in SSA (37, 41, 46, 49, 86-93). Few reviews have focused on the application of any economic evaluation method in LMICs for either preference elicitation or priority setting, and still fewer reviews concern the application of stated-preference methods for priority setting as distinct from preference elicitation (48, 50, 94, 95). Preference elicitation techniques are frequently blended with other economic evaluation techniques, which can make them difficult to parse as a distinct scientific literature (42, 96, 97). In 2012, the U.S. Agency of International Development (USAID), the World Health Organization, and the World Bank compiled recommendations to encourage national policymakers to conduct DCEs with a health workforce focus (62). Recommendations for

applications to other health systems "building blocks" have so far not been addressed (98).

A broad synthesis of this emerging literature on stated-preference methods in SSA is needed to raise awareness of its role as a potent formative research and preference assessment technique to engage stakeholders, but also to highlight the unique features of their applications to health systems problems in this region. This systematic review also assesses the quality of individual articles against peer-reviewed criteria for good stated-preference methods research practice using the PREFS checklist (37). Finally, the systematic review presents a brief cross-section of case studies to assess preferences for products and services for three different health system problem scopes, methods applied, country settings, and PREFS scores.

Methods
Eligibility criteria
This section discusses eligibility criteria for inclusion and exclusion (**Table 1),** database search strategy, data abstraction, and quality assessment. Only studies published in a peer-reviewed source in English and French were considered. No restrictions were placed on publication dates.

Inclusion criteria
Studies were eligible that elicited preferences and priorities quantitatively in a hypothetical (stated) context involving ranking, allocation, or choice-based approaches to a trade-off, especially DCEs, CAs, and BWS experiments. Articles that analyzed data from the same respondent samples on the same experiments were treated as distinct publications if they presented different analytical questions.

The review focuses on preference studies related to programs, services, and systems that promote, maintain, or improve health or health care services. To accommodate integrated health programs that address multiple health outcomes, studies were eligible that concerned choosing one health-related product, service, program, system, or policy attribute over another, or concerned choosing potential health components, interventions, or populations served over non-health-related options. Eligible interventions could include any health-related technologies, drugs, therapies, or messages. To accommodate multi-sectoral interventions for health and development, studies concerning programs designed to promote health and other non-health-related outcomes were included (e.g. a "kitchen garden" program intended to improve both malnutrition and household income). Similarly, studies of priority setting for policy that included at least one health-related priority were included. Studies that queried health care workers about workplace concerns were included. Studies were grouped according to the nature of the trade-off between attributes. Trade-off types were associated with one of six essential health system "building blocks": service delivery, health workforce, governance, interventions, financing and information (98, 99).

Preference studies were eligible if they were set in a SSA country or Sudan (100). Studies with a focus on the preferences of refugees or recent migrants that originate from SSA were also included. Studies were included that examined the preferences and priorities of populations with localized knowledge or specific vested interests, such as potential beneficiaries, patients, service providers, administrators, or policymakers selected because of their knowledge, expertise or decision-making role at the national level and below.

Exclusion criteria

To maintain a focus on choice-based techniques to evaluate attributes, studies that describe stated preferences solely in terms of a monetary value or through a decision analytic approach were excluded. Studies involving only contingent valuation (such as willingness-to-pay), health state valuation or health state utility studies (i.e. quality-adjusted life years, disability-adjusted life years), cost-effectiveness analysis, value of a statistical life, program budget and marginal analyses, multi-criteria decision analyses, and threshold techniques were excluded. Studies that presented only qualitative results, such as interviews or Delphi method, were excluded. Studies that employed ratings techniques in order to produce a ranking were excluded, because they did not involve a trade-off. The review excludes other literature reviews, articles focused solely on attribute development, survey design, and papers with a sole focus on methodological concerns, rather than a specific application of stated-preference methods on a health-related topic. Studies related solely to agriculture, botany, medicinal plants, veterinary medicine, or animal health were excluded. To maintain focus on the unique features of carrying out stated-preference methods research in SSA, studies that concerned only international key informant perspectives were excluded. Works not published in full were excluded.

Search strategy

In order to avoid duplication of effort and increase transparency, we developed a systematic review protocol in accordance with the PRISMA statement and registered the protocol with the PROSPERO database (ID# CRD42016035732) (101, 102). We searched six databases with different topical and methodological emphases: PubMed (records begin: 1966), Embase (records begin: 1947), CINAHL (records begin: 1937),

Ovid Global Health (records begin: 1973), EconLit (records begin: 1969), and Web of

Science Core Collection (records begin: 1900) in March and April 2016. After

constructing the keyword search set for PubMed, we developed and modified keyword

search sets for subsequent databases using their unique search algorithms. An example

keyword search set and filters appear in **Appendix 3.1**.

Collected titles and abstracts were reviewed for duplicates using EndNote® X7

citation management software (Thomson Reuters®, New York, NY). In the first phase,

two reviewers (LB, TL) screened all titles and abstracts for eligibility. Studies not clearly

excluded by both reviewers were adjudicated by a senior reviewer (JFPB). In the second

phase, two reviewers (LB, TL) read full text articles to confirm inclusion. Each

publication that conclusively met the criteria was abstracted. Screening results and

abstracted findings were tracked using Excel® spreadsheet software (Microsoft®,

Redmond, WA). Results were updated using the same search term sets and databases in

December 2016 and January 2017.

Data abstraction

Each full-text article selected for inclusion was abstracted on twelve dimensions:

method applied, health topic, trade-off, country setting, population, strategies employed

for attribute development, data collection tool, the presence of a research facilitator,

number of attributes, sample size, first author affiliation, and sources of financial support.

Each article was abstracted by one reviewer (LB, TL).

Quality assessment

There are no agreed-upon measures to assess risk of bias in stated-preference

method studies. The PREFS checklist was developed and has been applied as a quality

assessment tool of "good research practices" in studies of preference (37, 103, 104). We

used the PREFS checklist to assess quality of included articles according to compliance with five dimensions: 1) asserts a study purpose concerning stated preferences ("Purpose"), 2) presents evidence that responders and non-responders did not differ ("Respondents"), 3) presents the preference question posed in text or appendix ("Explanation"), 4) includes all respondents in analysis ("Findings"), and 5) reports tests of significance or measures of spread (p-values, confidence intervals, ranges, standard errors, means, or standard deviations) in relation to preference results ("Significance"). Every article assessed as having met a criterion garnered a score of "1." Those articles that did not clearly meet the criteria received a "0." Each article received a summative quality score, with five indicating the highest quality.

Results

Our search identified 2,058 references after filtering for publications in English or French that had at least an abstract. One additional article was found from hand searching and another from a journal not yet indexed through MEDLINE. 1,580 unique records remained after duplicates, books and book chapters, theses, and unpublished works were removed. We identified 185 eligible publications after title and abstract screening. Eighty-four articles were excluded because they didn't meet our definition of stated-preference methods applications, 14 were excluded that didn't concern human health or health care, two were excluded that didn't concern a population of SSA origin, and eight were excluded because they were not peer-reviewed. Seventy-seven references remained in the final analysis **(Figure 1). Table 2** summarizes the abstracted results. The earliest study was published in 1996, with the majority published between 2010 and 2017 **(Figure 2)**

Methods applied, sample size and choice sets

      Included studies were predominantly DCEs (n=46, 60%), ranking or point allocation approaches (n=21, 27%), CAs (n=7, 9%), and BWSs (n=3, 4%). Papers included analyses of 86 choice sets and presented 110 pooled analyses in SSA contexts (Data not shown). The median respondent sample size for all studies was 219 individuals (range: 30-3,003, IQR: 126-460). Thirty-four studies (44%) covering 51 pooled analyses presented analyses with 200 or fewer respondents (Data not shown).

Trade-offs in health

      Health topic areas were diverse, but generally addressed core concerns for essential health care delivery **(Table 3).** Studies were grouped into five key topic areas. Thirty-one papers (40%) concerned policy and planning broadly. Twenty-one papers (27%) concerned primary health care. Seventeen papers (22%) covered prevention, care, and treatment of infectious disease. The least prevalent topics were NCDs (6%) and other miscellaneous topics (4%). Articles most frequently concerned trade-offs between service features (n=27, 35%) followed by workforce incentives (n=17, 22%). Trade-offs among insurance features (n=4, 5%) as a financing concern were the newest trade-off type to be studied, with all articles published after 2012. Research priorities as a critical health systems input were the least studied trade-off (n=1, 1%). Topics and trade-offs intersected. Workforce incentives as a matter of policy and planning were the most frequently studied topic/trade-off combination (n=16, 21%), followed by preferred service features for maternal and reproductive health (n=12, 16%).

Setting and populations

The majority of studies were conducted in eight country settings: South Africa (n=11), Ghana (n=9), Malawi (n=9), Uganda (n=9), Tanzania (n=8), Ethiopia (n=7), Kenya (n=7), and Nigeria (n=7) **(Figure 3).** Nine studies (12%) included more than one country, five of which compared a SSA country to a country outside the region. Forty-five (58%) studies engaged study participants as potential or actual patients, beneficiaries, or consumers. Twenty-nine (38%) engaged study participants in their role as health care workers, or designated leaders, representatives, or experts. Three studies (4%) engaged both groups (Data not shown).

Attributes and attribute development

The most frequently reported strategy for developing attributes and levels was qualitative research, either interviews or focus group discussions (n=52), followed by pre- and pilot-testing (n=36), literature review (n=33), expert consultation (n=27) and other strategies (n=16). Authors frequently drew on more than one strategy to develop and refine potential attributes (n=54, 70%). Choice sets had a median and mode of six attributes (range: 2-24) (Data not shown).

Data collection and assistance

Fifty-eight studies (75%) mentioned administering the survey in-person to study participants in completing choice tasks (Data not shown). Twenty studies (26%) specifically indicated that respondents used paper and pen to complete the survey. Thirteen studies (17%) mentioned an electronic tablet or a computer or web-based interface as the data collection tool. Eight studies (10%) indicated another data collection tool, such as a game board, card sorting, voting, or other verbal assessment. Thirty-nine studies (51%) did not indicate the data collection tool used.

Authors and sponsors

Forty-three authors published at least two articles and fifteen authors published at least three articles meeting inclusion criteria. Kruk (n=9), Lagarde (n=6), Hanson (n=5), and Agyei-Baffour (n=4) were the most published authors, and were frequent co-authors with one another. Several analyses drew from the same sets of study participants (52, 54, 56, 60, 61, 105-113). Articles' first author affiliations were split between European (n=27), North American (n=27), and African institutions (n=19), with a few articles coming from researchers in Asia (n=3) and the World Bank (n=1) (Data not shown). Among those nineteen African first-authored articles, six were set in Nigeria, six were in South Africa, two were in Ghana, and one each came from Burkina Faso, Egypt, Ethiopia, Mozambique, and Zimbabwe. Forty-three studies (56%) cited receiving support from North American donors, funding agencies, universities, or research organizations, most especially the Bill and Melinda Gates Foundation (n=12) and USAID (n=8) **(Figure 4).** Twenty-one studies (27%) received support from European organizations, eight (10%) from multi-lateral organizations and initiatives, four from African (5%) and two (3%) from Asian organizations. Sixteen articles (21%) made no mention of financial support sources.

Quality

No study received a perfect PREFS score **(Table 4).** Twenty-eight articles received a score of "4," 19 articles received a score of "3," 23 articles received a score of "2," six received a score of "1," and one article received a score of "0" (Data not shown). DCEs were the highest quality (score = 3.36), followed by BWSs (score = 3.00), CAs (score = 2.75), and ranking and point-allocation types (score = 1.75). Most studies designated their purpose as assessing preferences ("Purpose," score = 0.88), instead of a

surrogate for preference (i.e. "importance," "perceptions," "satisfaction"). No studies

compared respondent with non-respondent characteristics ("Respondents" score = 0.00).

Most choice-based techniques presented an example choice task ("Explanation," DCEs

score = 0.74; BWSs, score = 0.67, CAs, score = 0.50). Choice-based techniques

performed better on response inclusion ("Findings"), although ranking (score = 0.50)

performed better than conjoint analyses (score =0.38). Most studies presented results with

tests of significance ("Significance" score = 0.77), although few ranking and point

allocation studies met that dimension (score = 0.35), because they tended to report results

as counts, percentages, or proportions only.

Applications of stated-preference methods

The following case studies represent a cross-section of methods, health systems

problems, settings, and PREFS scores found in the review. Case 1 is a health systems-

driven DCE on a very large respondent sample of current beneficiaries to assess a major

HIV/AIDS treatment program. Case 2 is a policy-driven CA on a large respondent

sample, using multiple data collection strategies to compare preferences for a

hypothetical male circumcision program across groups: parents versus sons and three

ethno-racial groups. Case 3 is a program evaluation-driven ranking/allocation experiment

on a small sample of stakeholders using a novel survey technique to assess refugee health

services. Case 4 is a policy-driven DCE on a cohort of junior doctors to assess

preferences for specialty training to increase retention.

Case 1: Retaining HIV positive women in care in Ethiopia and Mozambique

Kruk and colleagues undertook two DCEs concerning ongoing care and treatment

among HIV positive women (57). Their aim was to assess preferences to inform the

restructuring of an HIV care program to accommodate the significantly larger, and

potentially more preference-diverse, population eligible to receive services under the "Option B+" treatment approach implemented a year prior to the study. Option B+ recommends lifelong treatment for all pregnant and breastfeeding women.

The experiments assessed six attributes in each country (health facility type, provider attitude, non-HIV services, counselor support, cost, mother support groups (Ethiopia), and husband/family involvement (Mozambique)). Kruk and colleagues made thorough use of several attribute development strategies to arrive at each choice set: literature review, consultation with country and clinical experts, focus group discussions with HIV positive women already attending clinic, pre- and pilot testing. The authors did not publish the qualitative findings separately. The experimental design was produced using Sawtooth® (Sawtooth Software; Orem, UT, USA) which generated nine choice cards, each with two profiles.

The study provided hands-on assistance with DCE completion and offered visual aids with each level. Data were collected with an electronic tablet. Response rates among eligible participants were high in both countries (Ethiopia 97.8%, n=1,013; Mozambique 94.7%, n=1,020), making each DCE one of the largest stated-preference experiments in this review. Responses were analyzed using a mixed logit model in Stata® 12 (StataCorp LP; College Station, TX) to allow for taste heterogeneity. The most important attributes in both countries were provider attitude (Ethiopia, ß =1.78, SE=0.09, p<0.01; Mozambique, ß = 1.61, SE=0.08, p<0.01) and non-HIV service availability (Ethiopia, ß =2.31, SE=0.12, p<0.01; Mozambique, ß =1.06, SE=0.07, p<0.01). The authors also ran interacted models against pregnancy, anti-retroviral therapy, program participation, and age group statuses.

This publication met four PREFS quality assessment criteria by clearly stating its purpose as relating to identification of preferences, presenting an example task in an appendix, including all partial and complete responses in the estimation of utility weights (Ethiopia: 16,192 of the expected 16,208 observations; Mozambique 16,156 of the 16,320 expected observations), and presenting tests of significance (standard errors and p-values). Background analyses did not compare respondent to non-respondent characteristics nor to a target population.

Case 2: Shaping demand for medical male circumcision in South Africa

Bridges and colleagues conducted a conjoint analysis concerning the potential benefits of medical male circumcision as an HIV prevention intervention among young men and their parents in three racial-ethnic groups in South Africa (61). Their aim was to test whether preference for circumcision was motivated by a desire to avoid using condoms - a practice recommended to consistently prevent HIV infection - to inform a potential policy to promote national mass circumcision.

The choice experiment assessed seven attributes (STD prevention, HIV prevention, condom avoidance, enjoyable sex, cervical cancer risk reduction in women, manhood status, and personal hygiene) in three racial ethnic groups: whites (n=218), coloreds (n=202), and blacks (n=220). Bridges and colleagues made adequate use of attribute development strategies, including key informant interviews with circumcision experts, health care providers, parents and sons, and community leaders, followed by pilot testing. The authors did not refer to a separate publication detailing their qualitative findings. Each attribute was accompanied with a visual to aid comprehension. The experimental design was determined using an orthogonal array. The source of the array's design was not discussed in the article.

The study research assistants attended each survey interview, although the exact data collection tool was not mentioned. Response rates were not explicitly reported, although a visual sampling profile is presented as a figure showing a schedule of randomization, screening, recruitment, and survey completion. Colored and black respondents were drawn from household surveys, while white respondents were drawn from a convenience sample in a shopping mall. Results were analyzed using logistic regression to produce aggregated and stratified odd-ratios using Stata® 10 (StataCorp LP; College Station, TX). HIV risk reduction was the most broadly preferred benefit of male circumcision among the three groups (aggregated OR=1.195, test of ethnic-racial group interaction p=0.739). Surprisingly, black and colored respondents disfavored avoiding condoms as a benefit of circumcision, while white respondents did favor it (aggregated OR=0.837, test of ethnic-racial group interaction p<0.001). The authors also presented logistic regressions of preference for condom avoidance on male circumcision by wealth status, family member type, and fathers' circumcision status.

This publication met three PREFS quality assessment criteria by clearly stating the purpose of the article as relating to "determinants of demand," presenting an example task in the article body, and showing tests of significance (95% confidence intervals and p-values). Background analyses did not compare respondent to non-respondent characteristics nor a target population, and incomplete responses were expressly excluded from odds ratio estimations.

Case 3: Assessing refugee perceptions of health services in Kenya and Tanzania

Nelson and colleagues conducted a forced ranking exercise concerning the perceptions of refugees, community leaders and health workers toward health services in five refugee camps in Kenya and Tanzania (114). They undertook by-person factor

analysis, or Q-methodology, to discern distinct consensus profiles with perceptions to engage beneficiaries on ways to improve health services, as an alternative to typically qualitative program evaluation techniques.

The forced-ranking exercise asked respondents (n=81) to assign each of 23 attribute statements to a slot in a quasi-Gaussian game board, where a fixed number of slots were valued between 3 ("I strongly agree") and -3 ("I strongly disagree"). Nelson and colleagues derived their attribute statements from key informant interviews, focus groups discussions, and analysis of open-ended responses to prior questionnaires. A separate paper on qualitative results for instrument development was not mentioned.

Results from game board assignments were recorded and analyzed using PQMethod 2.11 software. Ninety-six percent of the 84 purposively selected respondents completed the exercise. In the Tanzania dataset, four distinct profile types were identified representing 32%, 14%, 14% and 9% of all respondents, respectively. Response profiles were presented for each profile type along with the average level of agreement for all participants to each statement. Corresponding demographic characteristics or proportions of respondent types for each profile were not presented.

This publication met one of the PREFS quality assessment criteria by presenting an example game board in the article body. The authors used a surrogate for preference in the study's purpose as "[collecting and assessing] beneficiary perceptions of refugee health services in Kenya and Tanzania." The authors did not present comparative background statistics with either non-respondents or a target population, and they did not present any significance tests of difference between groups. Only 81 of 84 respondents'

responses were included, and potential sources of bias from that exclusion were not discussed.

Case 4: Retaining doctors through specialty training in Malawi

Mandeville and colleagues conducted a DCE concerning specialty training among new doctors in Malawi. Their aim was to assess preferences for the features of specialty training opportunities that might persuade junior doctors to continue to live and practice in the country, and so inform national retention policies (115).

The experiment assessed five attributes: three concerning the required service before training, and two concerning the specialty training features themselves. Mandeville and colleagues made ample use of attribute development strategies, including a literature review, interviews with policy makers, educators in medicine, clinical specialists, and professional associations representatives followed by pilot testing to establish priors. The main effects experimental design was produced using Ngene version 1.1.1 (ChoiceMetrics Pty Ltd.; Sydney, Australia), which generated 16 choice tasks, each comparing two job profiles.

Research assistants supervised each survey respondent as they completed paper survey booklets in their place of work. One hundred forty-nine of the 153 eligible junior doctors participated. Results from the choice experiment were analyzed using Stata® 12 (StataCorp LP; College Station, TX) and NLOGIT 5.0 (Econometric Software, Inc.; Plainview, NY, USA) using mixed logit (latent class) models. Study results in the manuscript were confined to graphical presentations of willingness-to-pay estimates and membership proportions across four classes: "rich rejecters" (31%), "stubborn specialists" (31%), "money motivated" (16%) and "pliant patriots" (23%). Attribute-level coefficients and tests of significance appeared in an appendix.

While very thoughtfully conducted stated-preference methods research, this publication only met three of the PREFS criteria by clearly stating its purpose as identifying preferences, presenting an example task in the article body, and presenting tests of significance for multiple model iterations in an appendix. The authors did not include all responses from Year 2006 and 2007 graduates in the estimation of utility weights, although they represented a relatively small proportion of both the sample and the eligible target population. Even though background demographic analyses did not compare respondent to non-respondent characteristics, almost all eligible members of the cohort were represented in the final analysis.

Discussion

This systematic review contributes a holistic assessment of the range of stated-preference methods research applications to health and health systems problems in SSA. The increasing use of these methods indicates a growing awareness of and increasing capacity to use these techniques as powerful tools to systematically elicit stakeholder preferences and set priorities for the design and implementation of large-scale health programs. Studies coincided with established public sector and donor-funded strategic areas, especially workforce development, primary health care for women, and prevention and treatment of infectious disease especially HIV/AIDS. Choice-based techniques, DCEs specifically, were the most frequently applied stated-preference methods. DCEs received the highest PREFS scores for quality overall.

Choice-based techniques like those used in Case 1, 2 and 4 are more information-rich compared to ranking and point-allocation, but program evaluators and researchers may be discouraged by their complex experimental designs (66). Ranking and point-

allocation techniques used in Case 3 are more easily administered to study participants

and their results more intuitively interpreted, although they may be prone to ceiling and

floor effects and cultural biases (116). Both methods have a place in the preference

elicitation methods suite, especially as research-to-policy capacity grows among SSA

evaluators, implementers, and policymakers.

Published applications coincided with public sector and donor-funded strategic

areas. Comparatively more articles were published concerning incentives for rural

practice as a matter of health workforce policy than any other research area in this

review. This focus is explained by the importance of human resources for health and the

critical shortage of trained health workers willing to work in rural areas. Workers are also

more easily studied through surveys than patients and beneficiaries in LMICs, because

they are tied to particular institutions and have higher levels of formal education. Our

analysis also revealed an increasing focus on patient or beneficiary preference elicitation

of products and services for the purposes of making programs more attractive, acceptable,

or feasible. Many studies concerned the relative importance of attributes of maternal

health, family planning, sexual, and reproductive health products and services, which

reflects the origins of stated-preference methods as health technology assessment tools.

When combined, product and service attribute preference assessments represented over

half of all published articles in the review. Some of this trend may be explained by the

Gates Foundation's strong sponsorship of these studies and the foundation's affinity for

novel technology- and product-focused interventions to address global health challenges.

Despite their growing share of overall disease burden in SSA, very few stated-preference methods studies concerned NCDs and only one used a choice-based technique. The scope and nature of the NCD burden in SSA is understudied (117, 118). Much more neglected are studies of the health system approaches that are obscured by donor-driven infectious disease responses, but may improve service delivery through the slow-moving epidemiologic transition (119, 120). Preferences for the integration of services to treat HIV and non-communicable disease may be a good starting point (121, 122). In Case 1, for example, Kruk and colleagues have already begun by including availability of non-HIV services for cardiovascular disease management as an attribute in their HIV care and treatment focused DCE (57).

Studies were most frequently conducted in East and Southern Africa, where the prevalence of HIV/AIDS is highest on the continent and donor-funded global health initiatives and programs, such as the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) and the Global Fund to Fight AIDS, Tuberculosis, and Malaria (GFATM), are commensurately more active. Very few studies concerned countries or populations in the Sahel or in Francophone countries, and no articles were published concerning Central African countries.

The majority of studies engaged study participants as potential beneficiaries, particularly women of childbearing age and other socio-economically vulnerable populations. Low literacy, low numeracy, and rural location are recognized challenges to conducting cognitively complex preference experiments. Administering choice tasks face-to-face using culturally resonant visual aids like the survey instruments in Cases 1 and 2 is a solution, and this resource-intensive approach sets this literature apart from

similar preference research conducted in North America and Europe. The personnel needed to conduct in-person surveys will continue to limit the complexity and sample sizes of future studies even as digital technologies allow for more automated data collection.

We observed an encouraging trend toward more thorough approaches to attribute development particularly using qualitative studies undertaken to inform instrumentation despite their being more resource-intensive (68, 69). Many authors have taken the extra step to publish qualitative findings and choice set refinements alongside their quantitative results (52, 105, 123); (124, 125); (126, 127); (128); (129, 130); (106, 107, 131); (112, 113, 132); (133, 134); (51, 135). This trend is in line with larger efforts to make good research practices for choice experiments, especially attribute development, more transparent (42, 45, 70).

Authors based in North America and Europe published more articles than did authors based in SSA, and North American and European agencies supported the preponderance of published articles. Although many studies involved African co-investigators, more studies should be led by African scientific leaders and commissioned by African ministries of health and pharmaceutical regulators who are driven by a pointed need for preference data. Preference elicitation and priority setting are introspective research activities whose results' interpretation is enhanced by rich contextual understandings of community and population perspectives. African perspectives are already under-represented and under-resourced in health systems and policy research (136). African preference researchers may themselves value different theoretical frameworks and possess contextual insights that might better inform the way

stated-preference methods research, especially attribute development, is conducted, interpreted, and translated through implementation in SSA contexts. Further, preference researchers should formulate new theoretical frameworks that reflect uniquely African ways of valuing attributes and understanding preferences to inform implementation and policy decision-making.

We chose the PREFS checklist as a quality assessment tool that could be applied to the wide variety of experimental designs in the stated-preference methods suite we expected to be applied in SSA, but the checklist has limitations. PREFS was designed with choice-based techniques in mind, and so higher scores for DCEs, BWSs, and CAs were to be expected. Despite the checklist's flexibility, no article met the second criterion requiring a comparison of respondents with non-respondents' characteristics. Assessing non-response bias is a difficult task of any survey-based research, but this requirement may be unduly weighted against other good research practices, nor adequately address the concerns for representation or representativeness more unique to stated-preference methods research. In Case 4, for example, the article's "Findings" score was "0" for excluding later graduates over concerns of adequate representation, in a survey sample that is otherwise a complete cohort census of provider preferences in Malawi. Further, using the PREFS checklist, it was possible to satisfy the review's inclusion criteria but still accrue a "0" score because an article only met half of each criterion (e.g. the authors described a choice task in vivid textual detail but not visually). We urge researchers to interpret PREFS scores as indicative, but not determining a study's quality.

A more faceted checklist would better represent best practices for study

implementation, analysis, and publication unique to stated-preference methods research.

Future checklists could include additional criteria such as discussions of attribute and

instrument development, methods descriptions including the full experimental design,

considerations for design efficiency versus response efficiency, any attempts to address

bias, or investigations of preference heterogeneity. The International Society for

Pharmacoeconomics and Outcomes Research (ISPOR) Good Research Practices for

Conjoint Analysis Task Force made similar recommendations in their 10-part checklist

for reporting good research practices, but warned that the elements were so inter-related

that the checklist was not yet a substitute for good judgment when designing future

studies (42).

This review has other limitations. All included studies were published in English,

including the four studies conducted in Francophone countries. We also did not include

any Francophone databases in our search set. Other national languages (e.g. Portuguese,

Swahili, Amharic) were excluded from review, which may have excluded publications

otherwise eligible for inclusion. Although rating is an accepted stated-preference methods

technique, several articles that met inclusion criteria were later excluded because rating

was used to generate mean scores, which were then presented in rank-order. We elected

to exclude these publications, because this type of rating doesn't require a trade-off. This

selection bias may have excluded publications otherwise eligible. Similarly, we elected to

exclude contingent valuation methods because it is a monetary valuation technique, even

though willingness-to-pay (WTP) analyses are frequently combined with discrete-choice

methods. It is possible that choice experiment studies that emphasized WTP analysis in

their abstracts were excluded from this review. We must also consider the pressure of publication bias that sequesters or slows potential study results in program evaluation literatures. Indeed, none of the five African studies cited in Lagarde and Blaauw's 2009 review of DCEs for health workforce policy were peer-reviewed at the time of its publication, but some had been published in the systematic review update by Mandeville and colleagues in 2014.

Conclusions

More resources are needed to build capacity among researchers, implementers, and policymakers in the region to assess stakeholder preferences for a broadening sphere of available health interventions in sub-Saharan Africa. With greater capacity to conduct stated-preference methods research, health systems and program leaders could use these powerful formative research and preference assessment tools, where they have historically relied on qualitative methods or monetary techniques like contingent valuation or cost-effectiveness analysis, for priority setting.

Researchers should consider incorporating as many attribute development strategies as are feasible into their study designs to ensure that results better reflect real world choices in African contexts. Authors should more explicitly report findings from preparatory stages to identify and refine potential attributes, especially where they have engaged uniquely African perspectives through qualitative research, expert consultation, pre- and pilot testing.

In the next five years, readers can expect to see more stated-preference methods studies of infectious disease prevention drugs and services developed through and promoted by major global health initiatives and organizations like PEPFAR, GFATM and

the Gates Foundation, such as HIV pre-exposure prophylaxis (PrEP), isoniazid preventive therapy (IPT) for tuberculosis, or intermittent preventive therapy in pregnancy (IPTp) for malaria. We are aware of at least two studies eliciting preferences for PrEP features among female sex workers in Malawi and Tanzania, and one study on IPT delivery for pregnant women in South Africa either underway or recently completed.

Finally, preference researchers should combine and adapt lessons learned from these studies with those on NCD care and treatment in North America and Europe as the pressure to deliver more and better health services increases throughout SSA. Stated-preference methods research can contribute to meeting emerging expectations for more patient-centered health care across the dual burdens of disease.

Table 1 Inclusion and exclusion criteria for applications of quantitative stated-preference methods for health in sub-Saharan Africa, systematic review

Criterion	Inclusion	Exclusion
Population	Any stakeholders, including refugees and recent migrants from the specified country settings	Only international stakeholders and experts represented in the sample
Intervention	Human health or health care delivery through products, services, programs or policy	Veterinary medicine, agriculture/botany
Comparator	No restriction	None specified
Outcome	Methods application(s), health-related topic, trade-off, country setting, population, attribute development strategy, data collection tool, administered directly/researcher present, number of attributes, sample size, first author affiliation, financial support, quality assessment (PREFS score)	All other outcomes
Timing	No restriction	None specified
Setting	Sub-Saharan African country settings, Sudan, multiple countries if a sub-Saharan African country setting is represented in the set	Morocco/Western Sahara, Tunisia, Algeria, Libya, Egypt and all other country settings if a sub-Saharan African country is not also included in the set
Study design	Quantitative techniques for preference elicitation or setting, especially conjoint analysis, best-worst scaling, discrete choice experiments, point allocation, and ranking	Strictly qualitative, decision-analytic or monetary valuation techniques for preference elicitation or priority setting, (i.e., Delphi, cost-effectiveness analysis, contingent valuation, willingness to pay, health state valuation, (quality-adjusted life years, disability-adjusted life years), program budget and marginal analyses, multi-criteria decision analyses, threshold techniques).

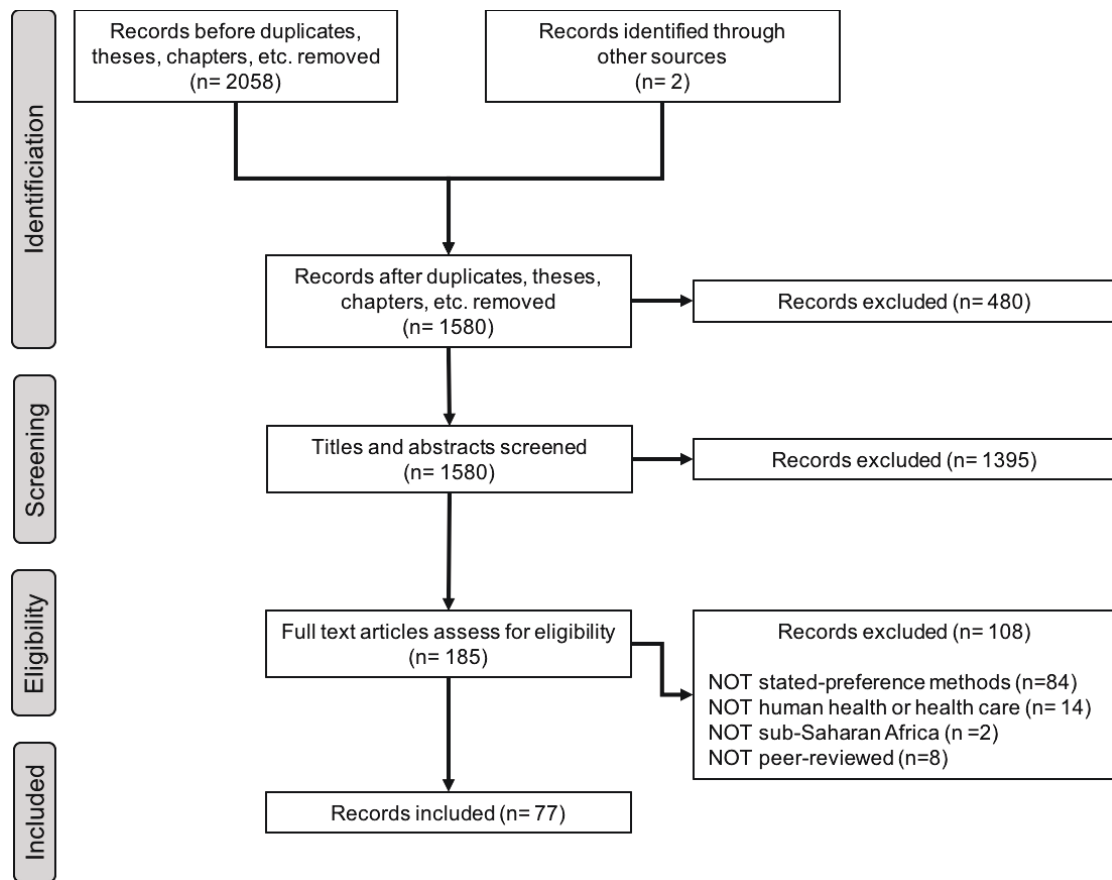**Figure 1 Identification and screening of peer-reviewed articles for inclusion**

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Table 2 Methods applications, health topic, trade, country setting, study population, and study characteristics (n=77)

Author, Year (Ref.)	Topic	Trade-off	Setting	Population	Development	Tool
Discrete choice experiments (n=46)						
Kohler, 2017 (133)	Breast cancer	SE	MW	Adult women	LIT, EXP, QUAL, PT	TA
Abiiro, 2016 (105)	Micro health insurance	IN	MW	Households	QUAL	TA
Kasteng, 2016(124)	Unpaid CHW incentives	WF	UG	Trained CHWs	LIT; QUAL	
Kruk, 2016 (57)	HIV treatment	SE	ET, MZ	HIV positive women	LIT; EXP; QUAL; PT	TA
Mandeville, 2016 (115)	Specialty training	WF	MW	Junior doctors	LIT; QUAL PT	PP
Obse, 2016 (137)	Social health insurance	IN	ET	Civil servants	LIT; EXP; QUAL; PT	PP
Shiratori, 2016 (138)	Community-based care	WF	GH	Community health officers	LIT; PT	PP
Takemura, 2016 (139)	Job preferences	WF	KE	Clinical officers	LIT; QUAL; PT	PP
A.-Baffour, 2015 (128)	Contraceptive use	PR	GH	Auto-artisanal mechanics	LIT; QUAL; PT	PP
Berhane, 2015 (140)	Hospital health care services	SE	ET	Patients from public hospitals	LIT; EXP; PT	
Brouwer, 2015 (141)	Drinking water filters	PR	KE	Households	EXP; QUAL; PT	
Honda, 2015 (142)	Rural placement	WF	MZ	Non-physician professionals	LIT; EXP; OT	PP; OT
Honda, 2015(143)	Public health sector	SE	ZA	Households	LIT; QUAL	
Larson, 2015 (144)	Delivery care	SE	TZ	Post-partum women	LIT; EXP; QUAL	
M.-Igbokwe, 2015(106)	S/RH/HIV services	SE	MW	Youth	LIT; QUAL; OT	
M.-Igbokwe, 2015(107)	Family planning providers	SE	MW	Youth	QUAL	
Ostermann, 2015 (113)	HIV testing	SE	TZ	Community residents; bar workers; porters	LIT; QUAL; PT	TA
Robyn, 2015 (145)	Rural retention	WF	CM	Dx; nurses; aides; medical, nursing students	LIT; QUAL; EXP	
Abiiro, 2014 (52)	Micro health insurance	IN	MW	Households	QUAL	TA
Bocoum, 2014 (146)	Rural retention	WF	BF	Health sector workers	LIT; QUAL; PT	
Brunie, 2014 (51)	Motivating CHWs	WF	UG	Volunteer CHWs	LIT; EXP; QUAL	
M.-Lara, 2014 (147)	Anti-malarial drugs	PR	MW	Households	QUAL; PT	
Ostermann, 2014 (112)	HIV testing	SE	TZ	Community members	LIT; QUAL; PT	TA
A.-Baffour, 2013 (148)	Midwifery practice location	WF	GH	Midwifery students	EXP; QUAL	CW
Lagarde, 2013 (109)	Malaria interventions	PR	GH	Antenatal clinic workers	QUAL	
T.-Prestholt, 2013(130)	HIV prevention	PR	ZA	Women	QUAL; PT	PP
Meenakshi, 2012(149)	Demand for orange maize	PR	ZM	Rural Zambians	PT; OT	
Mirelman, 2012 (150)	Criteria for national policies	ST	UG +4	Policymakers; experts; professionals	LIT; QUAL	PP
Paczkowski, 2012 (111)	Obstetric care w/ PTSD	SE	ET	Women enrolled in GGGD Study	LIT; EXP	
Robyn, 2012 (151)	Community health insurance	IN	BF	Health facility workers	EXP; QUAL; PT	PP
Rockers, 2012 (59)	Rural practice	WF	UG	Medical, nursing, pharm., and lab. students	LIT; EXP; QUAL; PT	CW
Takama, 2012 (152)	Fuel switching, stove choice	PR	ET	Households	EXP; PT; OT	
Diaby, 2011 (153)	Reimbursed drugs selection	PR	CI	Physicians	LIT; QUAL	PP
Kolstad, 2011 (154)	Rural practice	WF	TZ	Clinical officer students	LIT; QUAL; PT	PP
Kruk, 2011(58)	Rebuilding health systems	ST	LR	Household representatives	LIT; EXP; QUAL; PT	TA
Lagarde, 2011 (108)	Malaria interventions	SE	GH	Antenatal clinic workers	EXP; QUAL; PT	
Blaauw, 2010 (155)	Rural practice	WF	ZA, KE +1	Nursing graduates	EXP; LIT; QUAL; PT	PP
Hanson, 2010(156)	Rural practice	WF	ET	Doctors, nurses	EXP, QUAL	
Kruk, 2010 (56)	Obstetric care	SE	ET	Women enrolled in GGGD Study	QUAL; PT	
Kruk, 2010 (54)	Rural practice	WF	GH	Medical students	QUAL	CW
Kruk, 2009 (55)	Place of delivery	SE	TZ	Parous women	LIT; QUAL; PT	

Author, Year (Ref.)	Topic	Trade-off	Setting	Population	Development	Tool
Mangham, 2008 (157)	Public sector nursing	WF	MW	Nurses	QUAL	
Baltussen, 2006 (158)	Public spending	ST	GH	Health policymakers	LIT; EXP	
Baltussen, 2006 (159)	Intervention selection criteria	ST	GH	Health policymakers	LIT; EXP	
Christofides, 2006 (160)	Services after rape	SE	ZA	Women previously raped; facility caregivers	EXP; QUAL	
Hanson, 2005 (161)	Hospital quality	SE	ZM	Community members	QUAL; PT; OT	
Author, Year (Ref.)	**Topic**	**Trade-off**	**Setting**	**Population**	**Development**	**Tool**
Ranking and point-allocation types (n=21)						
Hartter, 2016(162)	Life, lifestyle, livelihoods	ST	UG	Households near national parks	OT	
Ludwick, 2014 (163)	Volunteer CHW retention	WF	UG	CHWs	OT	
Powell, 2014(164)	End-of-life care	ST	NA	General population	PT; OT	
Tolley, 2014(165)	Injectable contraceptives	PR	KE, RW	Potential users; providers; opinion leaders	OT	OT
Wilunda, 2014(166)	Labor in facilities	SE	UG	Parous women, partners	OT	
A.-Khalil, 2013 (167)	Diabetes control	ST	ZA +4	Physicians	LIT; EXP	PP
Oketade, 2013 (168)	Dental practice	SE	NG	Dental patients	QUAL; PT	PP
Ajayi, 2012 (169)	Dental care utilization	SE	NG	Individuals in hospital waiting rooms	PT	PP
Hearst, 2012(170)	HIV prevention messages	ST	UG	Individuals, ages 20-39	OT	
Parker, 2012 (171)	NCD health promotion	SE	ZA	NCD patients	OT	
Abanobi, 2011 (172)	Onchocerciasis control	PR	NG	Treated adults		
Johnson, 2011 (110)	Rural practice	WF	GH	Medical students	QUAL; PT	CW
Pfeiffer, 2011 (173)	"Good" and "bad" doctors	SE	MZ	Medical students; community members	PT	
Nelson, 2010 (114)	Refugee health services	SE	KE, TZ	Refugees in camps	EXP; QUAL; OT	OT
Uguru, 2010 (174)	Malaria treatment	SE	NG	Female caregivers	PT	OT
Sharan, 2009 (175)	Mental health research	RS	114 LMICs	Researchers; stakeholders	LIT; EXP	PP
Uzochukwu, 2007 (176)	Tropical diseases	ST	NG	Female caregivers	EXP	
Onwujekwe, 2006(177)	Malaria treatment	SE	NG	Households	PT	
Rosato, 2006 (178)	Maternal health issues	ST	MW	Women's groups	QUAL	OT
Ogbeiwi, 1999 (179)	Leprosy settlement needs	ST	NG	Leprosy community residents	QUAL; OT	OT
Siziya, 1996 (180)	Schistosomiasis control	ST	ZM	Head teachers		PP
Conjoint analysis (n=7)						
Alcaide, 2016 (127)	Intravaginal practices	PR	ZM	HIV positive women	QUAL	CW
Masozera, 2013 (181)	National park investments	ST	TZ	Village representatives; district officials	QUAL; PT	OT
v.Rijsbergen, 2013 (182)	Delivery care	SE	TZ	Parous women	LIT; QUAL; PT	PP
Eisingerich, 2012 (183)	HIV PrEP	PR	ZA, UG, BW, KE +3	FSWs, SDCs, MSM, IDUs, young women	EXP; PT	OT
Bridges, 2011 (61)	Male circumcision	PR	ZA	Parents, sons	QUAL; PT	
Bridges, 2010 (60)	Male circumcision	SE	ZA	Uncircumcised men, parents	QUAL	
Opuni, 2010 (184)	ART provision	SE	ZA	Adult PLHIVs; households	QUAL	
Best-worst scaling (n=3)						
O'Hara, 2015 (63)	Active TB case finding	SE	ZA	Health care workers	QUAL	PP
Lagerkvist, 2014(185)	Personal sanitation	PR	KE	Individuals living in slums	LIT, EXP; QUAL	
Torbica, 2014 (53)	Maternal health service fees	ST	West Africa	Policy entrepreneurs	LIT; QUAL; PT	CW; PP

Key: *IN* insurance features*; PR* product features*; RS* research priorities; *SE* service features*; ST* system priorities; *WF* workforce incentives*; BW* Botswana; *BF* Burkina Faso; *CI* Cote d'Ivoire; *CM* Cameroon; *ET* Ethiopia; *GH* Ghana; *KE* Kenya; LMIC low and/or middle income country/ies; *LR* Liberia; *MW* Malawi; *MZ* Mozambique; *NA* Namibia; *NG* Nigeria; *RW* Rwanda; *TZ* Tanzania; *UG* Uganda; *ZA* South Africa; *ZM* Zambia; *CW computer/web; PP paper-pen; TA tablet; EXP* expert consultation; *LIT* literature review; *OT* other; *PT* pre-test and/or pilot test; *QUAL* qualitative research**.**
Other abbreviations: *ART* antiretroviral therapy; *CHW* community health worker; *Dx* doctor(s); *FSW* female sex worker, *GGGDS* Gilgel Gibe Growth and Development Study; *HIV* Human immunodeficiency virus; *IDU* intravenous drug use(r); *MSM* men who have sex with men; *NCD* non-communicable disease; *PLHIV*; people living with HIV; *PrEP*: Pre-exposure prophylaxis; *PTSD* post-traumatic stress disorder; *Q.A.* quality assessment; *SDC* serodiscordant couples; *S/RH* sexual/reproductive health; *TB* tuberculosis

Figure 2 Distribution of articles by publication year of stated preference studies for health in sub-Saharan Africa (n=77)
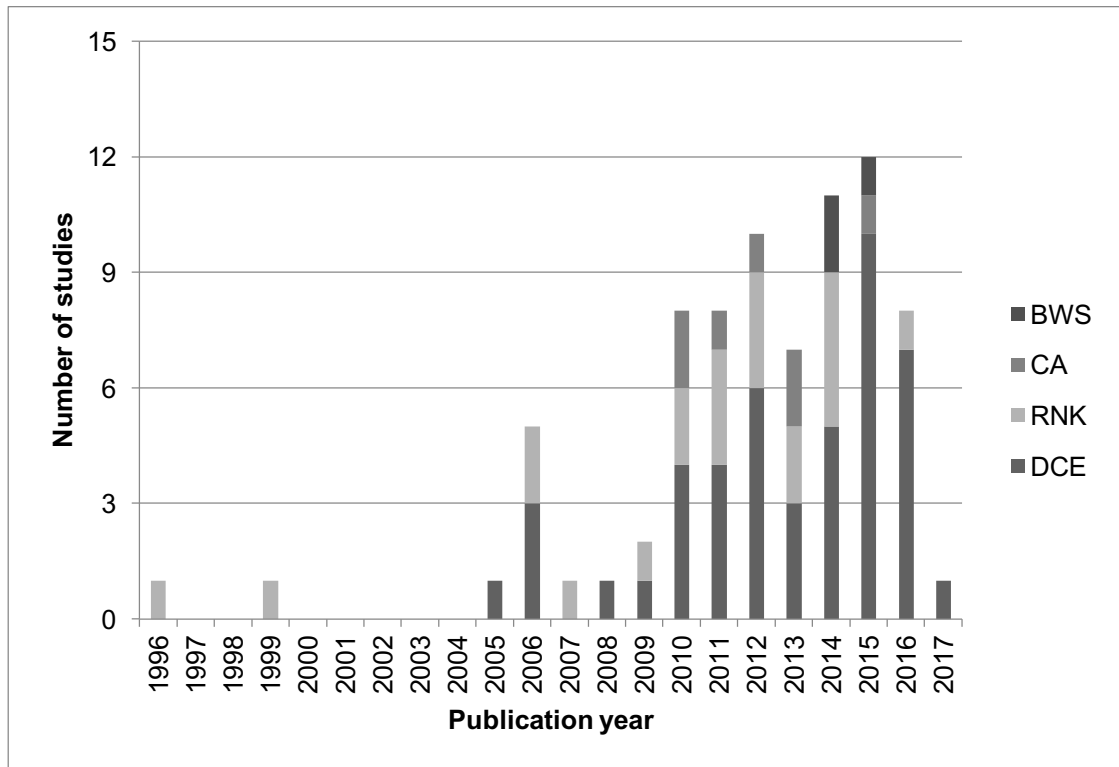
Key: *BWS* Best-worst scaling; *CA* conjoint analysis; *DCE* discrete-choice experiment; *RNK* ranking/point-allocation

Table 3 Distribution of articles examining health system trade-offs, by health topic area (n=77)

Building block		Service delivery	Health workforce	Governance	Interventions	Financing	Information	
Trade-off		Service features	Workforce incentives	System priorities	Product features	Insurance features	Research priorities	**Total**
Health topic area	Policy and planning	4	16	6	1	4	-	30
	FP; MH; S/RH; PHC	12	1	2	6	-	-	21
	HIV/AIDS; ID	8	-	4	5	-	-	17
	NCDs	2	-	2	-	-	1	5
	Other	1	-	-	2	-	-	3
	Total	27	17	14	14	4	1	77

Key: *FP fa*mily planning; *HIV/AIDS* human immunodeficiency virus/acquired immune deficiency syndrome; *ID* infectious disease; *MH* maternal health; *NCD* non-communicable disease*; PHC* primary health care, *S/RH* sexual and reproductive health.

Figure 3 Distribution of articles by country setting (n=75)
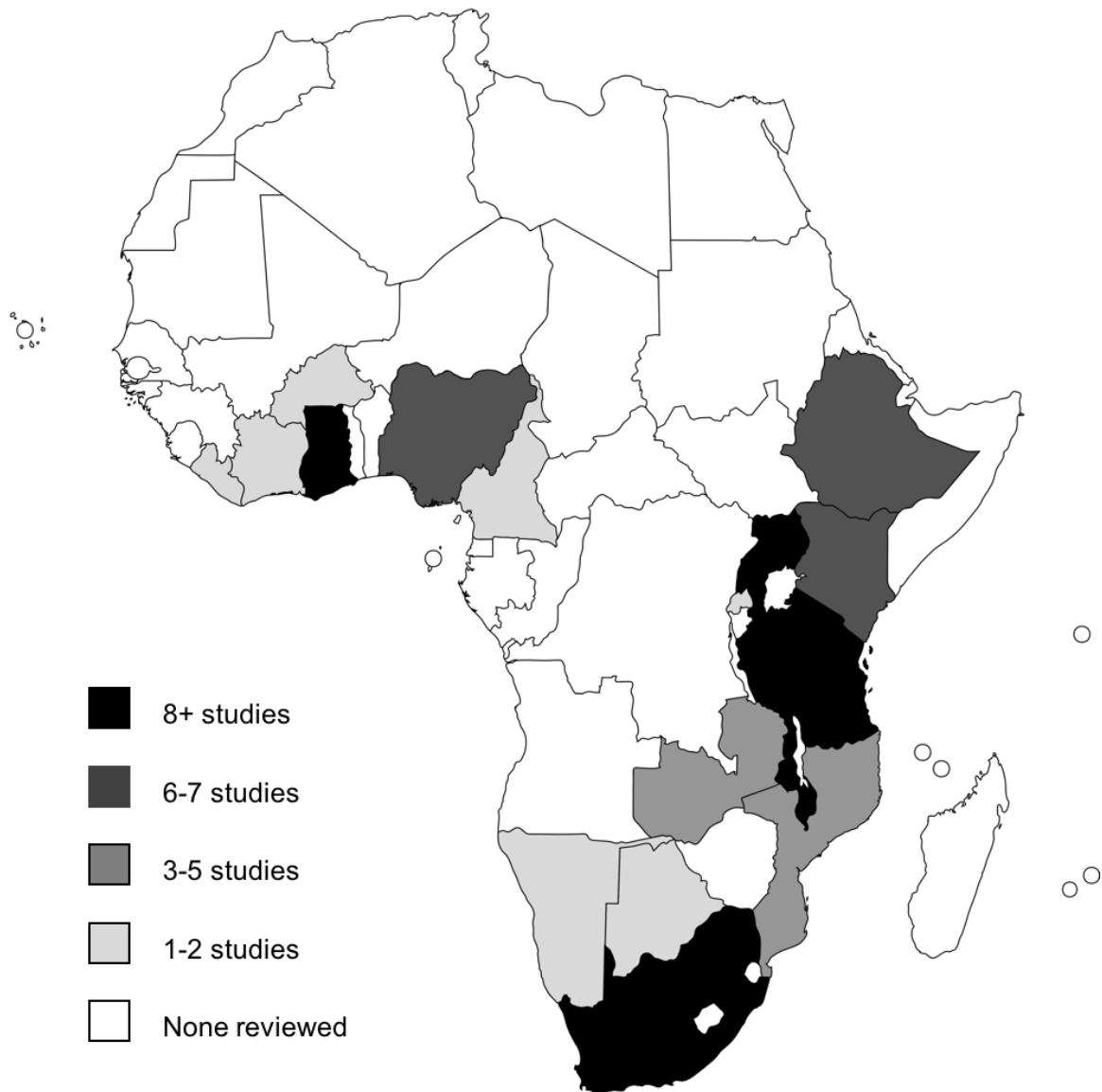
Articles comparing multiple sub-Saharan African countries are counted for each country represented. Articles with regionalized results excluded (n=2).

Table 4 Quality of stated-preference methods applications using mean PREFS scores

	Discrete-choice experiments (n=46)	Best-worst scaling (n=3)	Conjoint analysis (n=7)	Ranking, allocation (n=21)	Overall (n=77)
P	1.00	1.00	1.00	0.55	0.88
R	0.00	0.00	0.00	0.00	0.00
E	0.74	0.67	0.50	0.35	0.61
F	0.67	0.67	0.38	0.50	0.60
S	0.96	0.67	0.88	0.35	0.78
Total	3.36	3.00	2.75	1.75	2.86
Range	2-4	2-4	2-4	0-4	0-4

Key *P* Purpose; *R* Respondents; *E* Explanation; *F* Findings, *S* Significance

Figure 4 Distribution of sources of financial support
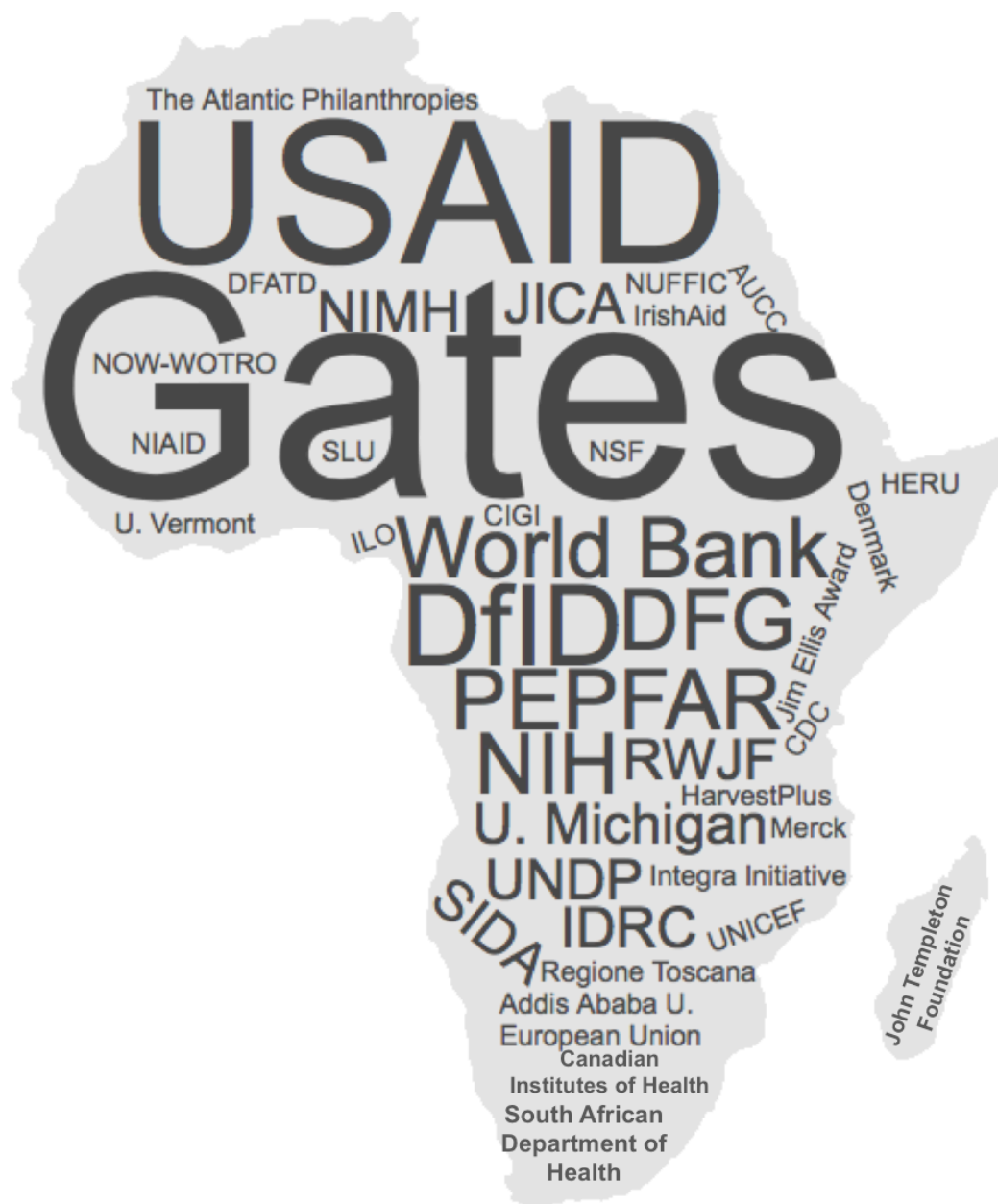
Key: *AUCC* Association of Universities and Colleges of Canada; *CIGI* Centre for International Governance Innovation, Canada; *DFATD* Department of Foreign Affairs, Trade and Development Canada; NIMH National Institutes of Mental Health; *DFG* "German Research Foundation;" *DfID* Department for International Development; *HERU* Health Economics Research Unit/U. Aberdeen; *IDRC* International Development Research Centre; *ILO* International Labour Organisation; *JICA* Japanese International Cooperation Agency; *NIAID* National Institute of Allergy and Infectious Diseases; *NIH* National Institutes of Health; *NOW-WOTRO* "Netherlands Organisation for Scientific Research – Science for Global Development; *NSF* National Science Foundation; *NUFFIC* Netherlands Universities' Foundation for International Cooperation; *PEPFAR* U.S. President's Emergency Plan for AIDS Relief; *RWJF* Robert Wood Johnson Foundation; *SIDA* Swedish International Development Cooperation Agency; *SLU* "Swedish University of Agricultural Sciences;" *UNDP* United Nations Development Programme; *UNICEF* United Nations Children's Fund; *USAID* United States Agency for International Development. **Does not appear:** South African Research Chairs Initiative, South African Medical Research Council, The Leprosy Mission International, the Norwegian Agency for Development Cooperation, the Government of France, NIH Fogarty Global Health Fellows Program, Harvard Cancer Prevention Fellowship.

Appendix 3.1: Keyword search strategy

Database: PubMed
Search date: March 18, 2016

Filters
- Abstract available
- French, English language articles only

Results
- With filters: 907
- Without filters: 914

Concept #1 Health, heath care, health systems

Health
"health" [tw] OR

Health care delivery
"Delivery of Health Care"[tw] OR "Delivery of Health Care"[Mesh] OR "Healthcare Delivery"[tw] OR "Deliveries, Healthcare"[tw] OR "Delivery, Healthcare"[tw] OR "Healthcare Deliveries"[tw] OR "Health Care Delivery"[tw] OR "Delivery, Health Care"[tw] OR "Contraceptive Distribution" [tw] OR "Contraceptive Distributions"[tw] OR "Distribution, Contraceptive"[tw] OR "Distributions, Contraceptive"[tw] OR "Delivery of Dental Care"[tw] OR "Dental Care Delivery"[tw] OR "Delivery, Dental Care"[tw] OR "Health Care Systems"[tw] OR "Health Care System"[tw] OR "System, Health Care"[tw] OR "Systems, Healthcare"[tw] OR "Nonclinical Distribution"[tw] OR "Distributions, Nonclinical"[tw] OR "Nonclinical Distributions"[tw] OR "Distribution Nonclinical"[tw] OR "Non-Clinical Distribution"[tw] OR "Non Clinical Distribution"[tw] OR "Distribution, Non-clinical"[tw] OR "Distribution, Non Clinical"[tw] OR "Distributions, Non-Clinical"[tw] OR "Non Clinical Distributions"[tw] OR "Community-Based Distribution"[tw] OR "Community Based Distribution"[tw] OR "Distribution, Community-Based"[tw] OR "Distributions, Community-Based"[tw] OR "Distributional Activities"[tw] OR "Activities, Distributional"[tw] OR "Activity, Distributional"[tw] OR "Distributional Activity"[tw] OR "Health Care"[tw] OR "Care, Health"[tw] OR "Healthcare"[tw] OR

Integrated health care
"Delivery of Health Care, Integrated"[Mesh] OR "Integrated Health Care Systems" [tw] OR "Integrated Delivery Systems" [tw] OR "Delivery System, Integrated" [tw] OR "Delivery Systems, Integrated" [tw] OR "Integrated Delivery System" [tw] OR "System, Integrated Delivery" [tw] OR "Systems, Integrated Delivery" [tw] OR "Integrated Health Care" [tw]) OR "Integrated HealthCare" OR

Patient acceptance of care
"Patient Acceptance of Health Care"[Mesh] OR "Health Care Utilization"[tw] OR "Utilization, Health Care"[tw] OR "Patient Acceptance of Healthcare"[tw] OR "Healthcare Patient Acceptance"[tw] OR "Healthcare Patient Acceptances"[tw] OR "Acceptor Characteristics"[tw] OR "Acceptor Characteristic"[tw] OR "Characteristic, Acceptor"[tw] OR "Characteristics, Acceptor"[tw] OR "Acceptors"[tw] OR "Acceptors, New"[tw] OR "Acceptor, New"[tw] OR "New Acceptor"[tw] OR "New Acceptors"[tw] OR "Acceptors, Repeat"[tw] OR "Acceptor, Repeat"[tw] OR "Repeat Acceptor"[tw] OR "Repeat Acceptors"[tw] OR "Program Acceptability"[tw] OR "Acceptability, Program"[tw] OR "Method Acceptability"[tw] OR "Acceptability, Method"[tw] OR "Nonacceptor Characteristics"[tw] OR "Characteristic, Nonacceptor"[tw] OR "Characteristics, Nonacceptor"[tw] OR "Nonacceptor Characteristic"[tw] OR "Nonacceptors"[tw] OR "Nonacceptor"[tw] OR "Acceptability of Health Care"[tw] OR "Health Care Acceptability"[tw] OR "Acceptability of Healthcare"[tw] OR "Healthcare Acceptabilities"[tw] OR "Healthcare Acceptability"[tw] OR "Health Care Seeking Behavior"[tw] OR

Technology Assessment
"Technology Assessment, Biomedical"[Mesh] OR "Biomedical Technology Assessment"[tw] OR "Technology Assessment, Health"[tw] OR "Assessment, Health Technology"[tw] OR "Assessments, Health Technology"[tw] OR "Health Technology Assessment"[tw] OR "Health Technology Assessments"[tw] OR "Technology Assessments, Health"[tw] OR "Assessment, Biomedical Technology"[tw] OR "Assessments, Biomedical Technology"[tw] OR "Biomedical Technology Assessments"[tw] OR "Technology Assessments, Biomedical"[tw] OR "Technology Assessment"[tw] OR "Assessment, Technology"[tw] OR "Assessments, Technology"[tw] OR "Technology Assessments"[tw] OR "Consumer Participation"[Mesh] OR "Participation, Consumer"[tw] OR "Consumer Involvement"[tw] OR "Consumer Involvements"[tw] OR "Involvement, Consumer"[tw] OR "Public Participation"[tw] OR "Participation, Public"[tw] OR "Community Action"[tw] OR "Action, Community"[tw] OR "Actions, Community"[tw] OR "Community Actions"[tw] OR "Community Participation"[tw] OR "Participation, Community"[tw] OR

Health care financing
"Healthcare Financing" [Mesh] OR "Financing, Healthcare" [tw] OR "Financings, Healthcare" [tw] OR "Healthcare Financings" [tw] OR "Health Financing" [tw] OR "Financing, Health" [tw] OR "Financings, Health" [tw] OR "Health Financings" [tw] OR

Health care organizations
"Health Maintenance Organizations"[Mesh] OR "Prepaid Group Health Organizations" [tw] OR "HMO" [tw] OR "Organizations, Health Maintenance" [tw] OR "Group Health Organizations, Prepaid" [tw] OR "Health Maintenance Organization" [tw] OR "Organization, Health Maintenance" [tw] OR

Health planning
"Community Health Planning"[Mesh] OR "Community Health Planning"[tw] OR
"Community Health Plannings"[tw] OR "Health Planning, Community"[tw] OR "Health
Plannings, Community"[tw] OR "Planning, Community Health"[tw] OR "Plannings,
Community Health"[tw] OR "Population-Based Planning"[tw] OR "Planning,
Population-Based"[tw] OR "Plannings, Population-Based"[tw] OR "Population Based
Planning"[tw] OR "Population-Based Plannings"[tw] OR "Community Health
Systems"[tw] OR "Community Health System"[tw] OR "Health System,
Community"[tw] OR "Health Systems, Community"[tw] OR "System, Community
Health"[tw] OR "Systems, Community Health"[tw] OR

Health Information Systems
"Health Information Systems"[Mesh] OR "Health Information Systems" [tw] OR "Health
Information System" [tw] OR "Information System, Health" [tw] OR "Information
Systems, Health" [tw] OR "System, Health Information" [tw] OR "Systems, Health
Information" [tw] OR

Community Health
"Community Health Services"[Mesh] OR "Community Health Services"[tw] OR "Health
Services, Community"[tw] OR "Community Health Service"[tw] OR "Health Service,
Community"[tw] OR "Service, Community Health"[tw] OR "Services, Community
Health"[tw] OR "Community Health Care"[tw] OR "Care, Community Health"[tw] OR
"Health Care, Community"[tw] OR "Community Healthcare"[tw] OR "Community
Healthcares"[tw] OR "Healthcare, Community"[tw] OR "Healthcares, Community"[tw]
OR

Health Planning Technical Assistance

"Health Planning Technical Assistance"[Mesh]

AND

Concept #2: sub-Saharan Africa

African Country names
Angola[tiab] OR Benin[tiab] OR Botswana[tiab] OR Burkina Faso[tiab] OR Burkina
Fasso[tiab] OR Upper Volta[tiab] OR Burundi[tiab] OR Urundi[tiab] OR Cameroon[tiab]
OR Cameroons[tiab] OR Cape Verde[tiab] OR Central African Republic[tiab] OR
Chad[tiab] OR Comoros[tiab] OR Comoro Islands[tiab] OR Comores[tiab] OR
Mayotte[tiab] OR Congo[tiab] OR Zaire[tiab] OR Cote d'Ivoire[tiab] OR Ivory
Coast[tiab] OR Djibouti[tiab] OR French Somaliland[tiab] OR "Equatorial Guinea"[tiab]
OR Eritrea[tiab] OR Ethiopia[tiab] OR Gabon[tiab] OR Gabonese Republic[tiab] OR
Gambia[tiab] OR Ghana[tiab] OR Guinea[tiab] OR "Guinea-Bissau"[tiab] OR
Kenya[tiab] OR Lesotho[tiab] OR Basutoland[tiab] OR Liberia[tiab] OR
Madagascar[tiab] OR Malagasy Republic[tiab] OR Malawi[tiab] OR Nyasaland[tiab] OR
Mali[tiab] OR Mauritania[tiab] OR Mauritius[tiab] OR Mozambique[tiab] OR

Namibia[tiab] OR Niger[tiab] OR Nigeria[tiab] Rwanda[tiab] OR Ruanda[tiab] OR Sao Tome[tiab] OR Senegal[tiab] OR Seychelles[tiab] OR Sierra Leone[tiab] OR Somalia[tiab] OR Sudan[tiab] OR Swaziland[tiab] OR Tanzania[tiab] OR Togo[tiab] OR Togolese Republic[tiab] OR Uganda[tiab] OR Zambia[tiab] OR Zimbabwe[tiab] OR Rhodesia[tiab] OR

African Country demonyms
Angola*[tiab] OR Benin*[tiab] OR Botswana*[tiab] OR Batswana*[tiab] OR Motswana*[tiab] OR Burkina*[tiab] OR Burundi*[tiab] OR Cameroon*[tiab] OR Verde*[tiab] OR "Central African*"[tiab] OR Chad*[tiab] OR Comor*[tiab] OR Mahoran*[tiab] OR Congo*[tiab] OR Zaire*[tiab] OR Ivor*[tiab] OR Djibouti*[tiab] OR "Equatorial Guinea*"[tiab] OR Equatoguinea*[tiab] OR Eritrea*[tiab] OR Ethiopia*[tiab] OR Gabon*[tiab] OR Gambia*[tiab] OR Ghana*[tiab] OR Guinea*[tiab] OR Kenya*[tiab] OR Basotho*[tiab] OR Mosotho*[tiab] OR Liberia*[tiab] OR Malagasy*[tiab] OR Malawi*[tiab] OR Mali*[tiab] OR Mauritania*[tiab] OR Mauriti*[tiab] OR Mozambi*[tiab] OR Namibia*[tiab] OR Niger*[tiab] OR Rwand*[tiab] OR "Sao Tome*"[tiab] OR Santome*[tiab] OR Senegal*[tiab] OR Seychell*[tiab] OR "Sierre Leone*"[tiab] OR Somali*[tiab] OR "South Africa*"[tiab] Sudan*[tiab] OR Swazi*[tiab] OR Tanzania*[tiab] OR Togo*[tiab] OR Uganda*[tiab] OR Zambia*[tiab] OR Zimbabwe*[tiab] OR

African Country name Mesh terms
Angola[Mesh] OR Benin[Mesh] OR Botswana[Mesh] OR Burkina Faso[Mesh] OR Burundi[Mesh] OR Cameroon[Mesh] OR Cape Verde[Mesh] OR Central African Republic[Mesh] OR Chad[Mesh] OR Comoros[Mesh] OR Congo[Mesh] OR Cote d'Ivoire[Mesh] OR Eritrea[Mesh] OR Ethiopia[Mesh] OR "Equatorial Guinea"[Mesh] OR Gabon[Mesh] OR Gambia[Mesh] OR Ghana[Mesh] OR Guinea[Mesh] OR Guinea-Bissau[Mesh] OR Kenya[Mesh] OR Lesotho[Mesh] OR Liberia[Mesh] OR Madagascar[Mesh] OR Malawi[Mesh] OR Mali[Mesh] OR Mauritania[Mesh] OR Mauritius[Mesh] OR Mozambique[Mesh] OR Namibia[Mesh] OR Niger[Mesh] OR Nigeria[Mesh] OR Rwanda[Mesh] OR Senegal[Mesh] OR Seychelles[Mesh] OR Sierra Leone[Mesh] OR Somalia[Mesh] OR South Africa[Mesh] OR Sudan[Mesh] OR Swaziland[Mesh] OR Tanzania[Mesh] OR Togo[Mesh] OR Uganda[Mesh] OR Zambia[Mesh] OR Zimbabwe[Mesh] OR

African Regional terms
Africa[Mesh:NoExp] OR Africa, Northern[Mesh:NoExp] OR Africa South of the Sahara[Mesh:NoExp] OR Africa, Central[Mesh:NoExp] OR Africa, Eastern[Mesh:NoExp] OR Africa, Southern[Mesh:NoExp] OR Africa, Western[Mesh:NoExp] OR "Atlantic Islands"[Mesh:NoExp] OR "Commonwealth of Independent States"[Mesh:NoExp] OR "Indian Ocean Islands"[Mesh:NoExp] OR "Southern African Development Community"[all fields] OR "East African Community"[all fields] OR "West African Health Organisation"[all fields] OR "Sub Saharan Africa"[all fields] OR "SubSaharan Africa "[all fields] OR "Atlantic Islands"[tiab] OR "Commonwealth of Independent States"[tiab] OR "Indian Ocean Islands"[tiab]

Concept #3 Stated Preference

State preference
"stated-preference method*" [tw] OR "stated preference method*" [tw] OR "stated-preference*" [tw] OR "stated preference*" [tw] OR "stated-choice*" [tw] OR "stated choice*" [tw] OR **Patient preference**
"Patient weighting" [tw] OR "Patient rating" [tw] OR "Patient ranking" [tw] OR "Patient perspective" [tw] OR "Patient priorities" [tw] OR "Patient preference" [MeSH] OR "Patient Preference*" [tw] OR "Preference*, Patient" [tw] OR "Preference*, Patient" [tw] OR "Preference-based approach*" [tw] OR "Preference-based method*" [tw] OR

Preference key words
trade-off*[tw] OR compositional[tw] OR decompositional[tw] OR rank*[tw] OR

Best-worst scaling
best-worst[tw] OR worst-best[tw] OR "best-worst scaling"[tw] OR "best worst scaling"[tw] OR "worst-best scaling"[tw] OR "worst best scaling"[tw] OR "best-worst scale"[tw] OR "worst-best scale"[tw] OR "best worst scale"[tw] OR "worst best scale"[tw] OR "object scaling"[tw] OR BWS[tw] OR WBS[tw] OR "maximum difference scaling"[tw] OR "maxdiff scaling"[tw] OR "maximum difference"[tw] OR maxdiff[tw] OR "max diff"[tw] OR

Discrete choice experiment
"discrete-choice experiment*" [tw] OR "discrete choice experiment*" [tw] OR "discrete-choice*" [tw] OR "discrete choice" [tw] OR "DCE" [tw] OR

Conjoint analysis
"conjoint analys*" [tw] OR

Point allocation
 "allocation of point*" [tw] OR "point allocation*" [tw] OR "budget allocation*" [tw] OR "magnitude estimation*" [tw] OR "pairwise choice*" [tw] OR "paired comparison*" [tw] OR "self-explicated method*" [tw] OR "self explicated method*" [tw] OR "self-explicat*" [tw] OR "self explicat*" [tw]

Direct assessment
"direct assessment" [tw] or "direct preference assessment" [tw]

Chapter 4: Prioritizing strategies for uterotonic security in Kenya: a mixed methods approach[2]

Introduction

Maternal-related causes are responsible for eight thousand women's deaths in Kenya every year (186). Obstetric hemorrhage is the leading direct cause of maternal mortality in Kenya (25.0%), sub-Saharan Africa (SSA) (24.5%) and low and middle income countries (LMICs) (27.1%) (6, 187). Postpartum hemorrhage (PPH) is excessive blood loss within the 24 hours following delivery (PPH: >500 ml; severe PPH: >1000 ml) (8). About 80% of maternal deaths from obstetric hemorrhage in Kenya and 60% in SSA can be classified as PPH (6). Reducing PPH is an important problem to address in the effort to reduce overall maternal mortality in Kenya.

PPH can be prevented and treated with the timely administration of an uterotonic drug as a part of the active management of the third stage of labor (AMSTL) (9, 188, 189). Injectable oxytocin is the most recommended, but misoprostol and ergometrine are recommended if oxytocin is not available (7, 190). The 2016 Kenya Essential Medicines List (EML) includes all three uterotonics as a part of the Kenyan Essential Package for Health in accordance with the World Health Organization (WHO) recommendations for provision of essential medicines (11, 191).

Continuous provision of safe and effective pharmaceutical commodities to delivering women can be undermined by weak "commodity security" (12-15). Commodity security has been defined as "the ability to choose, obtain and use affordable,

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[2] Scientific contributors include Shannon Egan, Brenda Onguti, Wangui Muthigani, Deepti Tanuku, and John FP Bridges

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quality health commodities when and where they are needed" (16, 192). In the 2010

Kenya Service Provision Assessment conducted, only 71% of surveyed health facilities

had the necessary oxytocic drugs stored in delivery room areas (193). The 2013 WHO

Service Availability and Readiness Assessment Mapping found that only 51% of

surveyed health facilities had injectable oxytocin on hand, ranging from 28-76%

availability across Kenya's 47 counties (194). In 2012, the United Nations Commission

on Life-Saving Commodities (UNCoLSC) called for a specific focus on maternal health

commodities (10, 195). Stronger uterotonic commodity security could be achieved using

similar approaches used to ensure the supply of reproductive health commodities for

family planning and anti-retroviral drugs to treat HIV/AIDS as a part of large-scale health

programs in LMICs (16-18, 192). Policymakers took a major step in 2013 toward

reducing maternal mortality in Kenya with the introduction of free maternity services

(antenatal, delivery and post-partum care) in government-run health facilities and early

evidence suggests that women are availing themselves of these services (196). Health

systems policymakers and planners still worry that the increased demand will overwhelm

the already stretched health system and skilled birth attendants' current capacity to offer

quality health services, particularly the correct application of uterotonics even if they are

safe, efficacious, and available in health facilities (197-199).

Prioritizing investments and stakeholder actions that promote women's access to

uterotonic drugs as part of maternal health services is an important step toward

effectively addressing maternal mortality from PPH in Kenya (22). Our study engaged

diverse stakeholders to identify and prioritize strategies to promote uterotonic security at

every point in the Kenyan health system that might help ensure both continuous provision

in health facilities and correct application by skilled health workers. Our results will interest health systems planners and policymakers, especially maternal health program implementers and pharmaceutical regulators, in Kenya and where poor uterotonic security and PPH are similarly persistent.

Methods

The study was initiated by the U.S. Agency for International Development Accelovate program, a multi-year partnership led by Jhpiego to develop, introduce, and support the scale-up of tools and technologies for health in low-resource settings. The Accelovate program worked in cooperation with the UNCoLSC to leverage evidence, resources, and expertise on essential medicines to reduce maternal deaths. The study followed a mixed methods approach to identifying potential strategic focal areas through qualitative research and prioritizing those areas using a survey **(Figure 5)** (64). Our approach incorporated both semi-structured interviews of key informants and survey-based conjoint analysis (38, 42, 68, 69). The project received a "not human subjects research" determination from the Johns Hopkins University Bloomberg School of Public Health institutional review board.

Qualitative methods

Key informant interviews were conducted to identify and characterize the organizations, roles, activities, processes, and systems in Kenya for improving uterotonic safety and effectiveness, with an emphasis on threats to oxytocin quality. Informants were eligible to participate if they were considered experts or authorities in pharmaceutical regulation and quality assurance; pharmaceutical research, development or production; pharmaceutical procurement and financing; supply chain management and

distribution; or maternal health care service delivery working in Kenya. Respondents were invited to be interviewed by an Accelovate representative. Three research team members conducted interviews in December 2015 and January 2016. Interviews were conducted in private settings in English and digitally recorded with the aid of a semi-structured interview guide. Researchers debriefed daily and shared notes. All interview recordings were transcribed, and transcripts were thematically coded. Thematically connected textual passages were analyzed informant-by-informant to capture context and perspective, and then synthesized through memo-writing exercises.

Following guidance for conducting qualitative research in the design of stated-preference methods experiments, our qualitative findings revealed informants' concerns were not limited to the intrinsic quality of oxytocin products, but extended to more systemic threats to the continuous provision and correct application of all uterotonics, or uterotonic security (68, 69, 72). The Maternal Health Commodity Security framework, styled as a socioecological model, provides a useful schema for understanding how diverse stakeholders perceive the interactions between health systems components that affect pharmaceutical commodity provision to women during labor and delivery to prevent and treat PPH (192). We identified 11 supply-side obstacles to the continuous provision of uterotonic drugs in Kenya from our qualitative findings, and modified the framework's focal areas by replacing "population awareness" and "patient and family behavior, communication, and decisionmaking" with "provider awareness" as the sole micro-level health system obstacle **(Figure 6).** The modified framework forms the basis of the qualitative analysis.

Instrument development

Based on the qualitative findings, we developed preliminary labels and definitions for 11 candidate strategic focal areas. We used a main effects orthogonal array to generate 12 hypothetical strategy profiles. Each strategy profile was paired with its complement, such that each paired profile contained mutually exclusive and exhaustive sets of the 11 strategic focal areas. Respondents were asked to choose the more preferred strategy profile for implementation in Kenya, assuming that resources to implement either strategy were equal. **Figure 7** shows an example task with four strategic areas and its complement with the remaining seven. A definition of uterotonic security - the ability of a woman and her healthcare provider to choose, obtain, and use high-quality uterotonic medicines for labor and delivery - was provided with the survey.

The draft survey was pre-tested with global experts and professionals in delivery of maternal and newborn health programs in LMICs in a structured discussion session following recommended practices for stated-preference methods attribute and instrument development that embrace a mixed methods approach (68, 70). Pre-testers worked at Jhpiego headquarters in Baltimore, MD and were invited through a general notice for a lunchtime seminar. Pre-testers emphasized the importance of all of the strategic focal areas to improving maternal health outcomes in the long term, while also emphasizing the need to choose given limited resources in the short term. We added the assumption of a five-year implementation window to the survey vignette to better approximate a real strategy development or resource allocation exercise. Feedback on the focal area labels and definitions was also incorporated into the final instrument (**Table 5)** (200).

Quantitative methods

We conducted a survey using conjoint analysis as a part of a facilitated group

exercise guided by recommendations for good practices in quantitative stated-preference

methods applications in low-income countries (42, 67). Technical experts and authorities

in pharmaceutical regulation and quality assurance; pharmaceutical research,

development or production; pharmaceutical procurement and financing; supply chain

management and distribution; or maternal health care service delivery working in

government, public, and private organizations were invited to a day-long meeting in

Nairobi, Kenya in April 2016. The meeting was hosted by the Jhpiego-led Accelovate

program, in collaboration with the Kenyan Ministry of Health's Division of Family

Health, Reproductive and Maternal Health Services Unit, the Pharmaceutical and Poisons

Board (PPB), and the Kenya Medical Supplies Agency (KEMSA). Respondents were

oriented to the paired-profile choice task format and definitions of each strategic focal

area. The research team provided clarification if requested as respondents completed the

survey.

Survey responses were entered into a database for statistical analysis using Stata

13 (StataCorp©, College Station, TX). The primary outcome was the set of strategic focal

areas selected (i.e. Did the respondent choose Strategy A or B) where the dependent

variable was coded "0" if the respondent chose Strategy A (left-hand side) and "1" if the

respondent chose Strategy B (right-hand side). Responses were analyzed against the

orthogonal array using ordinary least squares regression with effects coding. Huber-

White standard errors were used to account for potential heteroscedasticity of responses.

Parameter estimates indicate a strategic focal area's deviation from average, where

positive values indicate an above average priority and negative values indicate a below

average priority. Since the expected utility of each profile is set equal by using a balanced experimental design, respondents who answered at random or inconsistently were assumed to bias parameter estimates toward the null. Coefficient estimates were evaluated for statistical significance at $\alpha=0.05$.

Results

Interview findings

Twenty-three key informants were interviewed from 17 government agencies, public and private organizations in Kenya. We identified 11 supply-side obstacles to continuous provision and correct application of uterotonic drugs in Kenya from our qualitative findings. The strategic focal areas were policies and regulations, finance, advocacy and leadership, coordination, supply chain strengthening, service delivery, health supplies, human resource development, pharmaceutical quality assurance, monitoring and evaluation, and provider awareness.

Key informants described the key obstacles to improving uterotonic security as stemming from political and clinical challenges in Kenya. The first set of challenges related to the universal requirements for handling oxytocin as a cold chain drug. The second set of challenges related to constitutional reforms enacted in 2010 and the subsequent devolution of health service provision responsibilities to the 47 newly recognized and semi-autonomous county governments in 2013. Informants described a stronger national maternal health program, modeled after other successful national health and disease control programs, as the best way to ensure uterotonic security by redirecting responsibility and funds for maternal health back to the Ministry of Health as the best way to ensure uterotonic security. Representative quotes appear in **Table 6.**

Policies and regulations

The complicating role that Kenya's devolved health systems plays in national policy making and regulation was a recurring theme throughout key informants' responses. While the national government has retained responsibility for health policymaking, many respondents described the reality as a much more bilateral approach requiring proactive and prolonged engagement between Ministry of Health and county health management team (CHMT) representatives before broad dissemination of policies. A nursing services expert working in government (Informant #6) especially noted CHMTs' resistance to receiving advice or direction from the national government without consideration or discussion with those most directly affected: health care workers.

The PPB's regulatory authority at the sub-national level was also described as curtailed, particularly in public health facilities in rural areas where the absence of alternative pharmacy outlets made strict enforcement not feasible. A quality assurance expert working in government (Informant #19) described it this way:

> *... We're focused more on the private sector at the expense of the public*
> *sector, so you can imagine I go to Mbagathi [district hospital] and I find*
> *that they are not storing their anti-TB medicines the way they're supposed*
> *to be stored. If I close down that hospital the hue and the cry will be too*
> *much, or I go to Kangundo [district hospital] and the only government*
> *facility there does not meet certain requirements. If we shut it down then*
> *people start making waves, as opposed to when you go to a chemist and*
> *only this one chemist has a problem, then when you close it down it will*
> *have less impact, but they now want to focus more on the public also so*
> *that they also meet the requirements...*

Pre-market regulatory activities such as drug registration, quality control testing, and

importation, however, were seen as following a transparent and rigorous standard of operation.

Finance

Respondents frequently mentioned meeting the expectations of "free delivery" as the key challenge for maternal health service financing. Procuring uterotonics, and oxytocin specifically, were widely recognized as the current responsibility of CHMTs. Respondents mentioned the notable lack of outside support for maternal health commodity purchases from external donors, when compared to commodities purchases for other national programs, especially antiretroviral and antimalarial drugs. Several respondents described government funding for commodities as "hazy" or complex since devolution: county governments are allowed to re-allocate budgets and procure commodities from private pharmaceutical outlets as they see fit, but are encouraged and many indeed continue to procure essential drugs not provided by national health and disease control programs through the quasi-governmental KEMSA.

Respondents described the flexibility given to CHMTs through devolution to decide how to spend their health budgets as also allowing for different management approaches of commodity procurement, which has also introduced greater uncertainty into procurement forecasting and warehousing needs, especially for KEMSA. A procurement and financing expert working in government (Informant #16) explained it this way:

> *Counties, however, have a leeway to increase the budget should they find*
> *that their requirement is, for essential medicines, higher than the budget*
> *set aside by the national government. They have a leeway of mobilizing*
> *the whole funds at the county level, to supplement what the government*
> *has provided… depending on how they prioritize health, you have counties*

> *[that] are allocating 15 percent, others just making due with what has*
> *been given by the national government. So, basically, the management at*
> *the county level is diverse.*

The focus of respondents' concerns for financing were primarily with fostering more efficient procurement processes, such as bulk procurement.

As with health policy making, several respondents described a recent scenario where changes in procurement policies aimed at improving quality and safety of uterotonics, had inadvertently and negatively affected their availability through constrained financing **(**Informant # 12). Many respondents recalled a recent regulatory ban issued by the PPB, which directed facilities to revert to using a refrigerated, brand name oxytocin product, which was five times as expensive as the room temperature stable, generic oxytocin product over quality concerns. The ban was seen as having been particularly problematic, because it required CHMTs to absorb an unexpected price increase, on top of removing a valuable intervention option.

Advocacy and leadership
Advocacy and leadership were considered important for ensuring uterotonic security. Many respondents mentioned maternal mortality reduction as a national goal, referring specifically to the Kenyan First Lady's "Beyond Zero Campaign" launched in 2014 to informally engage county governments through governors' spouses to prevent maternal mortality in the most underserved areas. Respondents with a clinical or programmatic background in reproductive and maternal health especially mentioned a new three-year investment framework to reduce maternal mortality that included a focus on medicines. Respondents contrasted the focused attention given to anti-retroviral, anti-tuberculosis, and anti-malarial commodities through their respective control programs (e.g., the National AIDS and STI Control Program (NASCOP), the National Malaria

Program (NMP)) with the comparatively and historically diffuse attention given to

maternal health medicines (Informant #11). Several respondents mentioned strong

advocacy efforts to keep procuring contraceptive commodities for family planning at the

national level after devolution as an example of this special status, and many favored a

similar approach for uterotonic commodities.

In addition to advocacy, a maternal health programs expert working in

government (Informant #7) desired a clearly delegated leadership structure that would

create reporting systems and more accountability for managing maternal health

medicines. She found particular fault with the division of responsibilities under

devolution – service delivery at the county level and policy, standards, and quality at the

national level – and how this shaped leadership interactions between the ministry and

CHMTs:

> *I think we just need to keep monitoring the commodity supplies, the*
> *quality, and that would need a lot of data… having a system that can*
> *collect this data, having a group that can analyze this data, and having a*
> *feedback system that would be neutral... There always has to be a way,*
> *and I think it would need that you bring the counties together, make*
> *everybody feel like their place is cemented, like no one here is fighting for*
> *prominence; this is more about commodities.*

She perceived this split of duties to create feelings of competition and distrust between

the two levels of government, which she saw as rewarding charismatic champions

working under politically stressful conditions, instead of establishing clear roles oriented

toward routine work and transparent expectations for performance.

Coordination

Coordination was described as a necessary habit to reduce competition among

multiple health systems actors in order to make uterotonic security more achievable. A

reproductive health programs expert working in government described his liaising role as consolidating drug-specific concerns to avoid redundancy or conflict with existing policies, like the Kenya Essential Medicines List (Informant #13).

Respondents characterized good coordination at the national level as ensuring all programmatic perspectives were represented in decisionmaking. A pharmaceutical regulatory expert working in government (Informant # 9) perceived strong coordination between national health and disease control programs as having assured better program performance:

> *There is no arm of government that can say they are working in isolation… we have so many programs…We have the malaria program. We have the national AIDS control program. We are really working in terms of product that really affect the little baby used in their program. We have the maternal and child health program. We have the vaccines program. And these are programs that now we actually also work together in terms of linkages, in terms of making sure that the product that we are approving will also be aligned with what is best practice in a program.*

While coordination at the national level was thought by many respondents to be relatively strong, a maternal health programs expert working in government (Informant #7) characterized the depth of engagement between national and county governments as varying much more:

> *Some counties are. Some counties not. And I think that just has to be a reality we come to terms with. Because there's some that are hungry for a lot of good change. Some faster. Some get onto the bandwagon… Some wait to see <laughs> what's happening with the other counties, then they jump onto the bandwagon… Others are just rebels, like, 'Psshh. We don't care about that!'.*

Respondents described the variation in the level of coordination as concurring generally

with that county government's apparent commitment to and success in reducing maternal

mortality.

Supply chain strengthening
Many pharmaceutical supplies experts described their greatest challenge and their

major career goal as avoiding commodity stock-outs. One respondent described wanting

to foster a strong "culture" of pharmaceutical supply chain management among their

peers, subordinates, and organizations throughout the supply chain as "a matter of life

and death." Despite their own motivation, almost all respondents described CHMTs as

the new drivers of drug commodity purchasing under the devolved health system.

Intermediate stocking at the regional and national levels was viewed as struggling to

respond to this new dynamic. Some respondents cited prioritizing improvements to

"quantification" and "forecasting" exercises with CHMTs as a way to improve oxytocin

quality, and not just to avoid stock-outs. Some respondents were optimistic that

devolution would allow county governments to respond more flexibly to their observed

health needs (Informant #4). However, most respondents expressed concerns that

CHMTs were essentially ill-equipped, both in terms of infrastructure and technical

capacity, even if they did choose PPH and uterotonic security as a problem to be

addressed.

Many respondents cited reservations about the adequacy of cold chain equipment

below the county level (too few fridges, fridges too small, poor placement in the facility,

not robustly powered, etc.) as a major supply chain strengthening concern; however,

many cited the success of the Kenya Expanded Program on Immunization (KEPI) as

evidence that cold chain products could be delivered successfully and that provision of

maternal health medicines should be integrated into that program. Other respondents

noted health care providers' past anxieties over mixing vaccine and non-vaccine

commodities (e.g. oxytocin, insulin) in KEPI fridges that would introduce medication

errors. Another respondent described health care providers as having initially resisted

policy from the Ministry of Health to store refrigerated oxytocin in KEPI fridges based

on historic understandings of fridge management procedures. Even overcoming that,

KEPI fridge placement in health facilities was still seen by respondents as problematic. A

nursing services expert working in government (Informant #6) described it this way:

> *If you didn't have the Syntocinon [oxytocin] near you, by the time you go*
> *to Outpatient [clinic], because that is where the KEPI fridge is, and you*
> *come back with the Syntocinon. <laughs> It would be maybe 10 minutes*
> *or so. And you know that our standard is that you should give this*
> *Syntocinon within one minute of the delivery. So those are some of the*
> *challenges that we have of storing the Syntocinon in KEPI fridge, which is*
> *not within the maternity [ward].*

Clinical and programmatic experts saw the provision and placement of fridges in

maternity wards, and even dispensaries, as one of the last major obstacles to providing

AMSTL specifically, and delivering basic obstetric care generally.

Service delivery

Delivering obstetric care by a skilled birth attendant in a health facility was seen

as the essential endpoint of uterotonic security. Many respondents felt health facilities

and health care providers had the most important role to play in promoting uterotonic

security and, in doing so, reducing maternal mortality from PPH. A sexual and

reproductive health programs expert working in the public sector (Informant #4)

described it this way:

There's the actual competency of the service providers; their actual hands-on people; their improvement of health systems especially for referral or for emergency cases from the lower- to the higher-level cases, and basically improvement of the infrastructure equipment-wise as well as having good access to comprehensive emergency obstetric care. But, I think the main focus is improving basic obstetric care, making sure as many of the health facilities actually offer obstetric care and that it's of good quality.

Several respondents described procurement under devolution, particularly the selection of outlets to supply the product, as carried out by health care workers with competing clinical duties, making product quality susceptible to compromises that were seen as having already been addressed under the former, centralized health system (Informant #13). Several respondents acknowledged that many births in Kenya do not take place in health facilities, nor are they attended by a skilled birth attendant, and so the protection of uterotonics did not extend as far as possible anyway. An obstetric care expert working in research (Informant #15) described uterotonic coverage for the entire country as incomplete:

And we do know that it's not 100 percent of postpartum hemorrhage that gets prevented by use of uterotonics. We do know that some percentage-- we know it's about 66 percent that gets reduced, but we also know that in the country there are still a substantial number of deliveries that occur at home or outside of facilities, and they do not have uterotonic coverage, and for them I think that the ministry looks into what other avenues there are.

Respondents mentioned pilot projects on community-based distribution of misoprostol during antenatal care visits for home delivery, but were also skeptical that broad use

would be authorized beyond specialty physicians, and that misoprostol was still inferior

to injectable oxytocin to prevent and treat PPH.

Health supplies

Complementary health supplies were indirectly acknowledged as important to

ensuring uterotonic security. Respondents noted that administering injectable oxytocin

was complex, specifically that skilled birth attendants must be provided with gloves,

syringes, and safe disposal procedures. Again, several respondents mentioned

misoprostol tablets as being better adapted to rural settings and home deliveries, but that

misoprostol was not the "gold standard" for treatment of PPH. Carbetocin, a more dose-

efficacious oxytocin analog, was mentioned by an obstetric care expert working in

research (Informant #15) as an alternative, but she acknowledged it was expensive and

still required gloves, syringes, and a trained health care worker to administer.

A nursing services expert acknowledged the role of designated "commodity

nurses" in government facilities to influence ordering of non-pharmaceutical

commodities to better suit patients and health care workers' needs (Informant #6). An

obstetric care expert working in the public sector and private sectors (Informant #5)

suggested that health care workers should collectively and formally set minimum

expectations with their leadership to equip clinics in order to deliver quality obstetric

care. She described clinical care situations she hoped to avoid, where:

> *… if I'm going to do hypertensive disease management and I've got to*
> *dance around for a blood pressure machine, for this what, that*
> *what…When I need it most, it will probably not be there...I'm giving my*
> *best, but I'm also getting the best stuff in to give my best.*

Specifically, she hoped that health care providers would come together in the name of

"patient safety" to draft a health professionals charter outlining standards in the same way

that patient rights charters had also been developed in Kenya.

Human resource development

Weak human resource development, both the quantity of personnel and the level of training, were described as a threat to uterotonic security in Kenya. Several respondents mentioned especially the additional burden placed on skilled birth attendants and other maternal health care providers since the introduction of free delivery services in 2013. In the absence of any additional information about the situation of uterotonic security in Kenya, training or "capacity building" for the consistent handling of refrigerated, injectable oxytocin among health care workers was frequently mentioned as the most important priority for addressing uterotonic security (Informant # 14).

Several respondents cited the advantage of injectable oxytocin as the preferred uterotonic, because nurses were already trained and permitted to use injectable oxytocin in health centers, while only obstetricians and gynecologists were authorized to prescribe misoprostol. Other respondents saw persisting skills and knowledge deficits in current handling and delivery practices among nurses, even before considering alternatives to injectable oxytocin. A maternal health programs expert working in government (Informant # 7) described past efforts to oversee the health workforce, while imperfect, were weakened by devolution:

> *There used to be a very strong kind of supervision. Like when I was*
> *practicing and you'd see the national level stuff... people from the*
> *headquarters would come and-- not, per se, watch over you, but they'd just*
> *randomly pick files and figure out what you're doing. They'd also come*
> *and check if you have access to guidelines, if there are knowledge gaps.*
> *Then, if there were, you'd get trainings, like on-job trainings, stuff, and*
> *maybe avail the guidelines... Now, it's a very weird kind of system... So*

now you need to get 47 counties together. Then, you need to disseminate.

Then, [the CHMTs] follow up [with the Ministry of Health].

The respondent described the initiators of quality improvement under devolution as the

CHMTs and their appointed quality improvement teams (QITs).

Quality assurance

Pharmaceutical quality assurance of cold chain drugs was viewed as multi-

faceted, multi-step, resource-intensive, costly, and particularly challenging in Kenya.

"Pharmacovigilance," or the requirements for verifying quality among manufacturers and

distributors, was described almost universally as adherence to good manufacturing

practices, good distribution practices, and standard operating procedures, all involving

site visits to manufacturers, distribution warehouses, and clinic settings for verification,

and refrigerated trucks equipped with temperature loggers. Pharmaceutical regulatory and

industry experts also mentioned self-reporting of drug failures from health care providers,

but mostly as an "underutilized" passive surveillance mechanism. Almost all respondents

characterized the PPB and their medical logistics partner, KEMSA, as adequately

"vigilant" in the registration, procurement, and distribution of uterotonic drugs.

Pharmaceutical regulatory experts favored using WHO-prequalified manufacturers as the

next undertaking to improve oxytocin quality, while pharmaceutical supplies experts

favored training on proper handling by pre-qualified subnational distributors. Both

groups agreed that each tactic was important, but disagreed over which would contribute

more toward quality at the point of use.

Consistent cold chain management of oxytocin at lower-level health facilities like

health centers and dispensaries was seen as particularly difficult to achieve. Maintaining

oxytocin's temperature, using a continuously powered and calibrated fridge that is

advantageously placed in the health facility, was the foremost concern. Many respondents indicated their preference for procuring a room temperature stable oxytocin product if the heat stability of the product could be assured. Respondents varied in their confidence that such a product could be developed for a Kenyan market even in the longer term, citing the variation in average temperatures and climate across Kenya, and the resources required to develop a product intended for poor women. Many respondents saw proceeding to invest in cold chain infrastructure and refrigerated, injectable oxytocin as the most reasonable short-term option, as well as a time-tested one. A pharmaceutical supplies expert working in the private sector (Informant # 23) reasoned:

> *I wouldn't go that route -- the room temperature product -- because when you say 'room temperature,' what do you mean? Room temperature, here we say 25 degrees. So, is it below 30 degrees? Not above 30 and not below 20, or what does it mean?... Now, yes, if it is possible to manufacture oxytocin that can be classified in that category that would be brilliant, but then you would have to be sure that that's the case.*

When compared to other possible uterotonic options, refrigerated, injectable oxytocin was held up as the best option unless and until an alternative could be made available, despite the considerable resources required to assure its quality.

Many respondents cited the benefits of "targeted" post-market surveillance programs to ensure drug quality. A quality assurance expert working in government regarded active surveillance of antiretroviral and antimalarial drugs under the NASCOP and the NMP to have been particularly successful (Informant #1). The same respondent, however, questioned the PPB's capacity for "effective governance" to adequately monitor all drug categories in a timely way for lack of resources.

Monitoring and evaluation

Monitoring and evaluation, especially baseline assessments and root cause analyses, were frequently described as a critical first step to establishing precise threats to uterotonic security. Almost all respondents thought paying additional attention to monitoring the handling practices of suppliers, but especially health care workers, would be worthwhile. Respondents were particularly interested in data gathering that would report on the availability and the effectiveness of uterotonics distributed to health facilities (Informant # 20).

Respondents with clinical and programmatic backgrounds were more forthcoming about weak reporting that might belie differences in handling practices between facilities and counties, lack of available drugs measured as stock-out days, and heterogeneity in drug activity levels. An obstetric care expert working in the public and private sectors (Informant #5) noted the complete absence of an adverse event or incident reporting form for uterotonic drugs. Moreover, she emphasized that CHMTs rarely conducted the analyses of their own facilities needed to draw attention to uterotonic security problems:

> *Because I know one thing in a lot of our counties is how much operational research is really going on when it comes to commodities-- I'll say it's a gap. Right from knowing "This is when I should stock in. This is when I'm close to stock-outs. This is when the expiry date is coming close." And the pharmacy and the maternal health, from my experience, work in silos. It's not been that cohesive. So, I think there is a lot of room for 1) collaborative cohesion within the facilities, and then the bigger picture within the county, and conducting of operational research that will actually inform us on a lot of these aspects, which I would comfortably say I'm yet to hear much... maybe in very small pockets.*

She further described stocking as being heavily "health provider-driven" rather than by an independent process, standard, or rubric. A quality assurance and standards expert working in government corroborated her sentiment, emphasizing the national government's strictly consultative role to set service provision goals and priorities with county and health facility QITs.

Provider awareness

Increasing provider awareness was seen as somewhat important after equipment needs had been addressed, especially the provision of fridges. Some respondents worried that health care workers were ill-equipped to act as good stewards of cold chain drugs, citing a lack of pre-service or in-service training on medicines management and especially when compared to national and international bodies (e.g. manufacturers, KEMSA, private distributors, etc.) (Informant #14). A pharmaceutical supplies distribution expert described carelessness with cold chain drugs by any type of handler as "natural," or a default behavior to be overridden through sensitization. The same respondent thought empowering health care workers with a sense of consumer self-advocacy would give them the confidence to reject products that didn't meet cold chain standards by assuring them that they would not bear the financial risk of accepting compromised products**.**

Other respondents described health care worker behaviors around oxytocin handling, not as indicative of a lack of training, but instead as compensating to save time for poor placement of fridges relative to labor and delivery spaces, especially KEPI fridges. In order to be able to meet the expectations of administering oxytocin in the "golden minute" following delivery under AMSTL, many respondents described health care providers as carrying refrigerated drugs with them throughout the day, rather than

retrieving them just before delivery. A pharmaceutical regulatory and assurance expert

working in the private sector (Informant #8) described a typical scene in maternal health

clinics this way:

> *There are all the mothers with all the babies crying and all everything*
> *else, so you have only the staffed nurses there. She has got to give to all*
> *these people. What does she do? Takes them from the fridge, puts them on*
> *the tray so that she can save on time. Then the question is, when did she*
> *take from the fridge and when did she administer? It may be that she took*
> *in the morning, but the last patient she's giving is at 4 p.m. How long has*
> *it been outside the fridge?*

Respondents repeatedly emphasized the need to provide adequate cold chain

infrastructure where labor and delivery services are provided to mitigate risks to

uterotonic effectiveness.

Survey results

Of 115 maternal health and commodity security stakeholders invited to the

workshop, 79 registered at the workshop (68.6% participation rate) and 66 respondents

gave complete or partial responses (57.4% response rate) with a total of 791 completed

choice tasks of the 792 expected. Survey instruments were either not successfully

retrieved or empty for remaining respondents. These responses formed the analytical

sample. The characteristics of respondents appear in **Table 7**. The sample was balanced,

with slightly more women responding than men among those respondents who indicated

a sex (56.3%). The sample had high levels of formal education with the vast majority of

respondents indicating having achieved a college-level education or higher (88%). Over

50% of respondents considered their technical expertise to include maternal health. Of

the respondents who indicated a primary affiliation, 43.4% of respondents indicated

working for an organization charged with health service provision in the public sector. Although the study did not specifically target them, nine respondents indicated an affiliation with county governments.

Figure 8 presents results with parameter estimates for priority weights and standard errors from a linear probability model. A positive coefficient indicates that respondents were more likely to prioritize a strategy containing that focal area. Coefficient size is an indication of the strength of the priority relative to the average of all observations. Coefficient estimates for linear and logistic probability models were highly correlated (Pearson's r: 0.99 (p<0.01); Spearman's r: 0.95 (p<0.002); See **Appendix 4.1** for numeric results of models).

Survey respondents prioritized an uterotonic security strategy that emphasized targeting pharmaceutical quality assurance (ß =0.219, SE= 0.03) and supply chain strengthening (ß =0.100, SE=0.04) above all other focal areas. Respondents indicated that policies and regulations (ß =0.012, SE=0.03), health supplies (ß =0.007, SE=0.03) would be prioritized, although their parameter estimates did not statistically differ from an average priority. Similarly, service delivery (ß =-0.001, SE=0.03), advocacy and leadership (ß =-0.016, SE=0.03), and finance (ß =-0.031, SE=0.04) would be de-prioritized, but did not differ significantly from average. Respondents de-prioritized coordination (ß =-0.059, SE=0.02), monitoring and evaluation (ß =-0.074, SE=0.03), provider awareness (ß =-0.077, SE=0.03), and human resource development (ß =-0.079, SE=0.03) relative to all other areas to a statistically significant degree.

Discussion

Estimates of maternal mortality in Kenya vary, but remain uncomfortably high (186, 201). Kenya has a comparatively welcoming policy and regulatory environment for the prevention and treatment of PPH: multiple uterotonics have been approved in the EML, public health services have embraced AMSTL as national policy and authorized more cadres of skilled birth attendant to administer oxytocin, and community-based distribution of misoprostol for home deliveries has been piloted (202). Kenyan policymakers have also removed an important demand-side barrier to safe motherhood by introducing free maternity services in 2013; however, key challenges remain to providing the high-quality care women were promised, especially adequate protection from PPH (203). Even where uterotonic coverage is high, maternal deaths from PPH may still be higher than expected in low resource settings. A survey of almost 275,000 women found that disparities in PPH deaths persisted in countries with lower development indices despite apparently good uterotonic coverage (204). The authors speculated that variation in drug availability, drug quality, timing of injection, and the necessity of intervening not revealed by the survey might explain these disparities, which point to ongoing uterotonic security concerns.

Stated-preference methods have a rich and recent history of applications to patient preferences concerning pregnancy and obstetric care in North America and Europe (205-215). Guidance is emerging for applying stated-preference methods in LMICs to inform policy, planning, and program approaches (62, 67). Although stated-preference methods have been used to study patient preferences related to obstetric care in SSA to our knowledge, this study is the first mixed methods study to elicit the priorities of national stakeholders toward ensuring that uterotonic commodities are safe, available, and

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effective to use for delivering women. Our mixed methods approach allowed a deeper investigation into stakeholders' experiences and understandings of uterotonic "commodity security" as a way to identify potential priorities before systematically ranking them using a quantitative survey technique (40). Calls to prioritize investments on particular health products and technologies that prevent PPH have focused on their unique features and how health systems planners and policymakers might speed their introduction across many different contexts (216, 217). This study focuses instead on crafting a multi-dimensional uterotonic security strategy considering the Kenyan context that does not favor one product from the outset. Using conjoint analysis requires assessing a trade-off that may reveal more distinct differences in how stakeholders value the attributes of a particular strategy better than simple rating or ranking (218). Forced trade-offs may also better mimic the resource-constrained policymaking in LMIC health systems (53).

Interviewed informants saw uterotonic drugs as presenting familiar commodity security challenges that have been individually tackled by other national health and disease control programs in Kenya – cold chain management (childhood immunization), continuous provision (antiretroviral drugs for HIV/AIDS, contraceptives for family planning) – but the drugs' features combined in new ways to vex health systems actors. Barriers to continuously providing injectable oxytocin were remarked as including refrigeration, providing supportive health supplies, and needing a skilled birth attendant to administer the drug on continual basis. However, informants still acknowledged that using oxytocin as a part of AMTSL is and should be the standard of care. Mentions of delivering women using misoprostol for home deliveries on their own aroused concerns

for misuse and backsliding on quality of care, even if the potential for universal uterotonic coverage might be higher than relying solely on oxytocin. Viewed optimistically, key informants saw Kenya's recently devolved health system as freeing CHMTs and health care workers to budget and procure uterotonic commodities more responsively to local health needs. Viewed with caution, informants saw CHMTs as more vulnerable to price changes that might affect the availability, effectiveness, or safety of uterotonics where they are needed most. Our qualitative findings also agree with our quantitative results that national government functions such as policy and regulation, financing, and advocacy and leadership are of intermediate importance, but represent more settled affairs that inspire feelings of greater trust and confidence compared to county governments, even if resources currently allocated to these national activities are thought to be suboptimal.

The facilitated group survey results revealed that national stakeholders want to focus on enhancing pharmaceutical quality assurance and supply chain strengthening to put adequate quantities of safe and efficacious drugs directly into the hands of health care workers. The national government is still responsible for setting quality standards, maintaining the supply of drugs ordered by county health facilities through KEMSA, and leading national health and disease control programs (219). Even though national stakeholders' saw their ability to provide direct oversight as curtailed by constitutional reforms, quality assurance and supply chain strengthening were grey areas that may provide the most politically acceptable way to promote uterotonic security while respecting county government autonomy. The survey results also suggest that

stakeholders view quality and quantity as intertwined. As an obstetric care expert put it: "*How can I have quality without quantity?*"

Despite very little discussion during interviews, health supplies ranked highly among survey respondents. This result might be partially explained by the overriding fear of stock-outs over improper handling, meaning, if no syringes are available, even properly-handled commodities were essentially never delivered. Although respondents discussed the importance of in-service training and capacity building at great length, human resources development ranked relatively low as a strategic focal area for ensuring uterotonic security. This result may be somewhat explained by the major benefit of oxytocin that health care workers, particularly nurses, are already authorized and trained on its use. Respondents may have also considered refresher trainings or sensitization exercises, as part of quality assurance or supply chain strengthening measures, rather than human resource development. National stakeholders placed a relatively lower priority on coordination, monitoring and evaluation, and provider awareness, both in interviews and in the survey. Stakeholders may not necessarily have found these focal areas categorically unimportant, but rather needing relatively fewer resources or attention compared to other focal areas.

Survey results suggest that respondents were able to prioritize certain strategic focal areas over others to a statistically significant degree; however, it is possible we omitted an important area by limiting the scope to supply-side attributes of the current standard of care: administration of refrigerated, injectable oxytocin by a skilled birth attendant in a health facility. "Behavior/communication of patients and families" and "population awareness" are important demand-side factors toward ensuring uterotonic

security, although they are more related to drugs that women can administer themselves (i.e. misoprostol distributed during antenatal care visits for home delivery) (192, 195). Further research is needed on the role of women's preference in ensuring uterotonic security, in the same way that patient preferences for contraceptives have been explored (128, 220, 221). Stated-preference methods studies concerning obstetric care in Tanzania, Ethiopia, and Malawi are an important starting point for future investigations (54, 111, 144, 178, 182).

The assumption of equivalent resources to implement a fixed five-year strategy does not perfectly approximate priority setting procedures in Kenya. New sources of financial support earmarked by donors for particular maternal health program activities may serve to adjust stakeholders' future assessments of priority interventions. In the intervening months between conducting interviews and the survey, the broader Kenya RMNCAH investment framework was released by the Ministry of Health, which prioritized funds toward underserved counties and populations, to address both supply and demand-side factors for uterotonics (22). As such, parameter estimates from our study should be viewed as indicative rather than predictive of *how* or *where* maternal health commodity security investments will be focused in the future. The most important limitation of our study is that the sample was targeted at national stakeholders, which is a fundamentally small population and may not represent the priorities of all Kenyan stakeholders concerned with uterotonic security. A larger sample drawing from county stakeholders and health care workers throughout Kenya would have allowed for segmented or stratified analyses to assess preference heterogeneity. Future research on priority setting for an uterotonic security strategy must account for the priorities of

CHMTs. Our qualitative findings emphasized the need to defer to CHMTs before putting any national strategy into action. The generalizability of our survey results to stakeholder priorities outside Kenya or other LMICS is limited, but this project and the workshop brought together stakeholders from very diverse disciplines and backgrounds. These results may still inform policymakers seeking to set strategies to reduce maternal mortality, particularly in the East African Community, where registration harmonization projects for essential medicines are underway.

Conclusions

Our study demonstrates that a mixed methods approach can be used to identify and prioritize focal areas of an uterotonic security strategy in a Kenyan health setting. Survey respondents prioritized uterotonic security strategies that emphasized quality assurance and supply chain strengthening above all other areas, suggesting ongoing concerns for both the quantity and quality of drugs delivered. Despite frequent mentions and emphasis placed on its importance by national experts and authorities during interviews, survey respondents de-prioritized human resource development as a focal area for improving uterotonic security. Mentions of complementary health supplies like gloves, syringes, and other diagnostic equipment and devices were sparse, but ranked as more important to implement in the next five years than many other strategic focal areas. The generalizability of these results to the priorities of county-level stakeholders and their peers outside Kenya's recently devolved health system is limited, but could inform priority setting in other LMICs. As the national government, implementing partners, and donors consider efforts to reduce maternal mortality, they should engage county governments to identify compatible priorities and consider lessons learned from other

national health and disease control programs approaches to addressing poor commodity

security, especially HIV/AIDS, malaria, immunization, and family planning.

Figure 5 Summary of study phases, stages, methods, and outputs

Study stage	Methods	Outputs

Phase I: December 2015 – January 2016

Nairobi, Kenya

Qualitative data collection → KIIs w/ maternal health and pharmaceutical commodity experts (n=23)

Qualitative data analysis → Memo'ing and de-briefing → Priorities identified

Phase IIa: January-March 2015

Baltimore, MD

First version of survey instrument ready for testing → Experimental design selected

Pre-testing → Global MNCH program experts surveyed → Priorities revised

Phase IIb: April-June 2016

Nairobi, Kenya

Survey instrument finalized

Quantitative data collection → Maternal health and pharmaceutical commodity experts surveyed (n=66) → Survey completed

Quantitative data analysis → Priorities estimated → Results available

Phase III: July 2016 – Onward

Nairobi, Kenya

Interpretation and dissemination → Qualitative findings with quantitative results compared and contrasted → Priorities assessed

MH Commodity Security Taskforce convened

Key: KII = key informant interview, MNCH = maternal, newborn, and child health, MH = maternal health

Figure 6 Uterotonic security framework
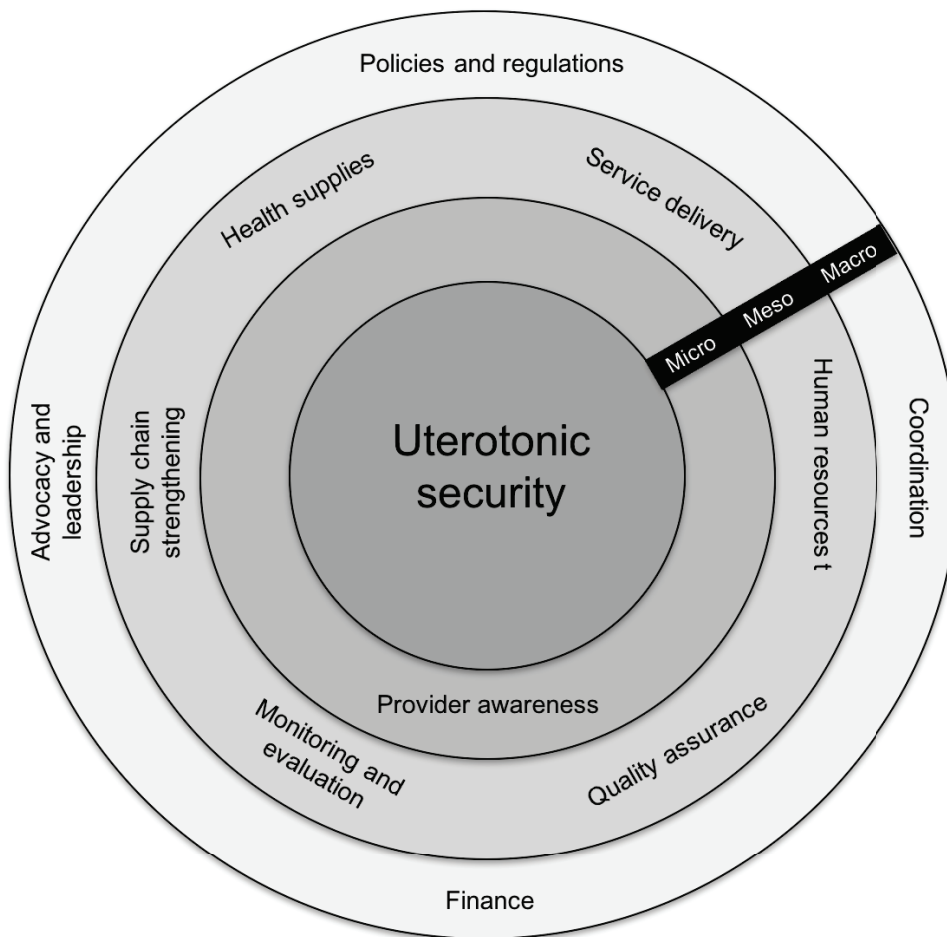
Adapted from Maternal Health Commodity Security Framework; JSI 2014 (192)

Figure 7 Example choice task

An uterotonic security strategy could include a combination of focal areas. We will consider two potential strategies at a time and ask you to select the set of areas you would choose to implement in the next five years. Assume that the resources to implement either Strategy A or Strategy B are the same. Which strategy would you select?

Task 3

Strategy A includes a focus on:	Strategy B includes a focus on:
Provider awareness	Quality assurance
Finance	Monitoring and evaluation
Policies and regulations	Service delivery
Human resources	Health supplies
	Advocacy and leadership
	Supply chain strengthening
	Coordination
I prefer Strategy A ☐	**I prefer Strategy B** ☐

Table 5 Strategic focal areas in an uterotonic security strategy, by health system level

Level, area label		Area definition
Macro	**Policies and regulations**	Government principles, standards, rules, and directives that influence, either directly or indirectly, the availability, quality, and affordability of uterotonic medicines
	Finance	Adequate and sustainable government funding mechanisms for the procurement of uterotonic medicines
	Advocacy, leadership	Sponsors who raise awareness and engage stakeholders to increase uterotonic security by addressing gaps in global and national plans, policies, and initiatives that influence the availability, quality, and affordability of uterotonic medicines
	Coordination	Mechanisms to facilitate cooperation across stakeholders from different sectors to facilitate information flow, the efficient use of resources, and the effective implementation of policies and regulations
Meso	**Supply chain strengthening**	Contextually specific activities focused on streamlining and standardizing processes at all levels and functional areas of the supply chain to address system problems and overcome challenges to uterotonic access
	Service delivery	The provision of maternal health services for health promotion, disease prevention, diagnosis, treatment, and disease management at all levels and sites of care within the health system
	Health supplies	The availability of complementary consumable health supplies necessary for the safe and effective administration of uterotonics
	Human resources	The availability of trained, motivated and competent health care workers in sufficient numbers to fulfill the essential roles required for the delivery of maternal health services
	Quality assurance	Measures to improve and ensure the quality, safety, and effectiveness of uterotonics as established and implemented by regulatory agencies, producers, distributors and other stakeholders involved in medicines management
	Monitoring, evaluation	The regular collection, analysis, and use of programmatic and population data for planning and decision-making to increase uterotonic security
Micro	**Provider awareness**	Awareness-raising campaigns and behavior change communication targeted at health care providers to further improve and ensure the availability and quality of uterotonics at the point-of-care

Table 6 Strategic focal areas identified to address uterotonic security, by health system level

Level, area label		Quote
Macro	**Policies and regulations**	"These days, we don't just push policies. We have to discuss it into the counties. Before, when we issue a circular, before devolution, it is actually a policy, in a way… Before, you know what "circular" means? A Director of Medical Services would write a note to all facilities that 'You should do this.' That one is no longer there. Now if there's something like-- Syntocinon [needing to be] stored in KEPI fridge? You have to call the counties, tell them, 'This is what we want to do. And this is the direction we want to take.' And then now you issue a policy direction." *– Nursing services expert, government (Informant #6)*
	Finance	"The [oxytocin] that was heat-stable was… cheaper, like all generics tend to be. Cheaper than the brand or original, and the cold-chain one is the branded one, Syntocinon. The price difference is almost more than five times difference in price. Sometimes you may find that since the counties now do not get these commodities for free, they have to buy them from us, because with the onset of devolution the funds available for commodities… are no longer with the Ministry." *– Supplies distribution expert, government (Informant #12)*
	Advocacy, leadership	"…maternal health products and commodities are lumped together with the other products. So, there's no specific focus like what you'd find in malaria or HIV and TB where they have specific programs that really focus in that." *- Regulatory expert, private sector (Informant #11)*
	Coordination	"I'm the link between now the unit, Reproductive Health and the Department of Pharmacy… if there any specific issues regarding reproductive and maternal health commodities, I need to be factored in to the overall pharmaceutical policy… That is how it works, and that's why we do not have a specific policy for the maternal health commodities, because the link is already there… *– S/RH programs expert, government (Informant #13)*
Meso	**Supply chain strengthening**	"I think the opportunity with the devolution is that the counties are coming to take care of the issues directly. They have this better linkage between the county health management teams and the sub-counties and the facilities. So, it might be a better chance of achieving than when things were being reported to the national level…"*– FP programs expert, public sector (Informant #4)*
	Service delivery	"Now, in the devolved system, counties are procuring from distributors... But now that they are procuring from private wholesalers, private chemists, local distributors, now we do not know exactly how things are operating between the main distributor… that's an area we need to work with the counties to see how we can sensitize them on the-- what kinds of selection of appropriate suppliers, and even how to maintain the quality of the products within their systems, because now it has gone to their system." *- S/RH programs expert, government (Informant #13)*
	Health supplies	"For the last two years, nurses have been involved in community commodity management, because we've found that we left it to the pharmacy people, when it comes to [quantification] and predictions, they go wrong…This commodity nurse would do the rounds, would take the workload off the hospital and, depending on the workload, depending on which non-pharmaceuticals [were] moving faster, then she would be able to advise on what quantities to enter. So, they are very important in terms of quantification and even the quality." *- Nursing services expert, government (Informant #6)*
	Human resources	"I would prioritize capacity building for health providers, because you can do so much in terms of ensuring the quality. From the manufacturing point, it's well observed, and distribution point is well monitored, but at the facility, if there's a gap, then that gap would translate to the patient. The effect to the patient is what matters, [the major] objectives that we have." *– Supplies distribution expert, public sector (Informant #14)*
	Quality assurance	"I think you have a system where you have certain manufacturers prequalified, prequalified for the supply of this… So, I think if we had similar systems for other classes of drugs, not antiretrovirals. I mean that's been a success story… Because regardless of them having a very good system of obtaining drugs and qualified suppliers, they still have a very good system for doing, is it post distribution surveillance?" *– Quality assurance expert, government (Informant #1)*
	Monitoring, evaluation	"First of all, I think what is important is do an assessment and see what is being practiced. What else, in terms of those intervention which are there, works? In terms of efficiency, which one is more efficient or effective intervention? You have to do a suggestion analysis, including maybe right from the procurement. We've seen that, or heard of [something happening], but what is actually happening? First, how are people procuring? Are there stock challenges? How much is allocated? Where do they procure their commodities? And then, how do they store their commodities? *–S/RH programs expert, public sector (Informant #20)*
Micro	**Provider awareness**	"I would start from the facilities, and check with them first, they have the product. If they do, how are they using it? Do they know how to administer the product? Then how are they storing the product? Are they storing it at the recommended storage or handling conditions? Then just capacity build, based on the needs that I've identified. Capacity build healthcare providers, the manufacturers and distributor." *– Supplies distribution expert, public sector (Informant #14)*

Key: FP family planning, S/RH sexual and reproductive health

Table 7 Respondent characteristics (n=66)

Characteristic	*n*	*%*
Age (years), median, IQR	42.8	35 - 51
Sex (n=64)		
Female	36	56.3%
Highest level of education (n=58)		
Graduate	36	62.1%
Undergraduate	15	25.9%
Diploma	3	5.2%
Could not be determined from response	4	6.9%
Tenure in current position (years); median, IQR	3.2	1.8 - 6
Technical expertise* (n=64)		
Health topic area		
Maternal health	35	54.7%
Reproductive health	29	45.3%
Non-communicable disease	6	9.4%
Health systems		
Health systems strengthening	29	45.3%
Service delivery	27	42.2%
Administration	23	35.9%
Clinician training	20	31.3%
Policy and regulations	16	25.0%
Research	16	25.0%
Programming	11	17.2%
Pharmaceutical provision		
Distribution	13	20.3%
Medicines management (clinical)	11	17.2%
Procurement	11	17.2%
Quality assurance	9	14.1%
Manufacturing	6	9.4%
Other	8	12.5%
Primary affiliation* (n=53)		
Health care provision		
Public	23	43.4%
Private	11	20.8%
Government		
National	11	20.8%
County	9	17.0%
Supporting organizations		
Academic institution	13	24.5%
NGO	10	18.9%
Technical organization	10	18.9%
Donor organization	3	5.7%
Faith-based organization	3	5.7%
Pharmaceutical provision		
Distributor	6	11.3%
Public medicines supplier	3	5.7%
Private medicines supplier	2	3.8%
Manufacturer	2	3.8%
Other	6	11.3%

*respondents allowed multiple responses
Key: IQR interquartile range, NGO non-governmental organization

Figure 8 Priority strategic areas for Kenya (n=66)
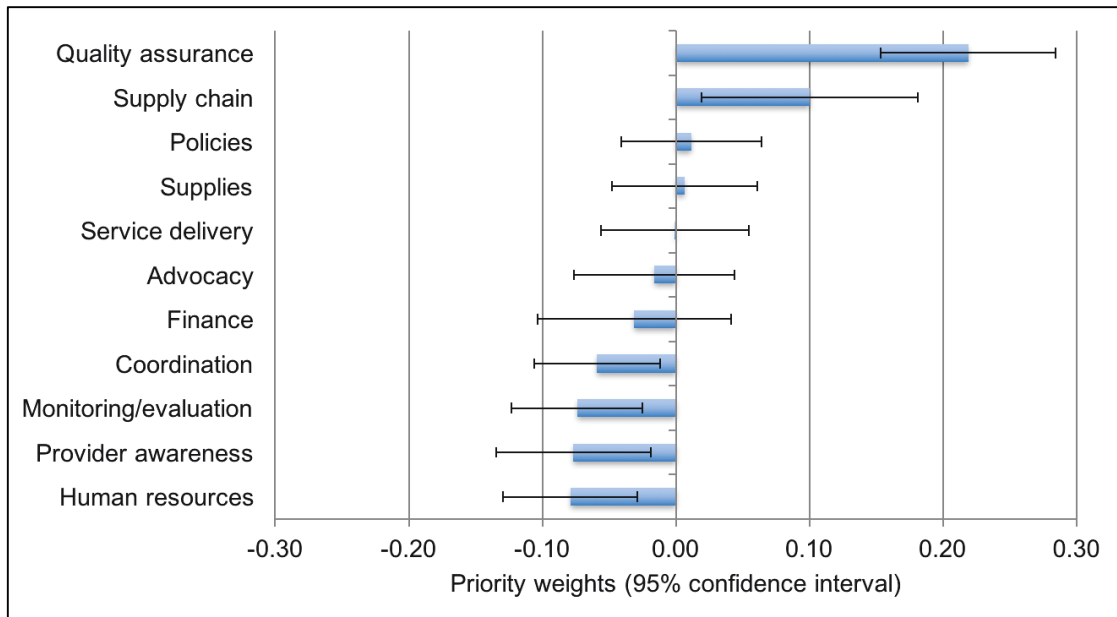
Appendix 4.1 Regression results

Effects-coded linear probability model

	Coefficient		SE	t	P-value
Quality assurance	0.219	*	0.03	6.54	<0.001
Supply chain strengthening	0.100	*	0.04	2.43	0.018
Policies and regulations	0.012		0.03	0.44	0.664
Health supplies	0.007		0.03	0.24	0.811
Service delivery	-0.001		0.03	-0.03	0.974
Advocacy and leadership	-0.016		0.03	-0.52	0.602
Finance	-0.031		0.04	-0.84	0.402
Coordination	-0.059	*	0.02	-2.46	0.017
Monitoring and evaluation	-0.074	*	0.03	-2.95	0.004
Provider awareness	-0.077	*	0.03	-2.59	0.012
Human resources	-0.079	*	0.03	-3.09	0.003

Logit model

	Coefficient		SE	z	P-value
Quality assurance	1.575	*	0.17	9.25	<0.000
Supply chain strengthening	1.124	*	0.17	6.6	<0.000
Service delivery	0.649	*	0.17	3.81	<0.000
Policies and regulations	0.627	*	0.17	3.68	<0.000
Health supplies	0.610	*	0.17	3.58	<0.000
Advocacy and leadership	0.504	*	0.17	2.96	0.003
Coordination	0.378	*	0.17	2.22	0.026
Finance	0.377	*	0.17	2.21	0.027
Monitoring and evaluation	0.220		0.17	1.29	0.197
Human resources	0.195		0.17	1.14	0.253
Provider awareness	0.147		0.17	0.86	0.389

*Statistically significant at $\alpha=0.05$
Pearson's r: 0.99 (p<0.01)
Spearman's r: 0.95 (p<0.002)

Chapter 5: Comparing preferences for community-based health programs in Tanzania: a mixed methods approach[3]

Introduction

Tanzania has just 5.9 skilled health workers (doctors, nurses, midwives) per 10,000 people, which is well below the World Health Organization (WHO) recommended minimum of 44.5 workers per 10,000 to achieve the diverse health targets under the Sustainable Development Goals (222-224). Skilled health workers are also unevenly distributed in Tanzania – geographic areas with fewer workers also have fewer highly-qualified workers per capita – making the problem of providing access to quality health services in rural areas even worse (225).

Community-based health programs (CBHPs) are recognized for their potential to improve health outcomes in low and middle-income countries (LMICs) through task-shifting (23-25). CBHPs can unburden facility-based skilled health workers from delivering certain primary health care and other essential services by systematically shifting those duties to community health workers (CHWs) (226-228). CHWs are typically local volunteers whose activities are intended to complement the skilled health workforce by linking community members to health facilities through health service provision and promotion activities, such as nutrition counseling and family planning (26). The settings and package of interventions delivered by CBHPs vary considerably, but

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[3] Scientific contributors include Sachiko Ozawa, Dereck Chitama, Japhet Killewo, Abdullah Baqui, and John FP Bridges.

they share similar functions that provide technical and social support to CHW activities through selection, training, supervision, and incentives (229-231).

Planning a national CBHP presents health sector actors with a series of programmatic decisions such as how, for example, CHWs will be selected, how thoroughly CHWs will be trained, and how closely they will be monitored (30). Integrating existing programs also presents challenges: CHW skills, duties, and social position matched to address a particular health problem may serve a particular existing CBHP, but the same combination may not perform well when the population served changes, the service package expands, or when the health system shifts around them (29, 232, 233). In Tanzania, CHWs are recognized for their work, both monetarily and non-monetarily; address different population and disease foci; operate seasonally, on campaigns, or throughout the year; and involve donor, civil society, and other non-governmental groups as sponsors who struggle to coordinate activities with government and peer programs leading to both programmatic gaps and overlaps (234). Policymakers and planners want to know whether and how a single CBHP can be harmonized, standardized, and scaled-up across the entire country.

This study's main objective is to inform the development of national policy and strategic planning for the implementation of a national CBHP under the CHW Learning Agenda Project (CHW LAP). CHW LAP was commissioned by the Ministry of Health and Social Welfare (MOHSW) in 2013 to support multiple formative research investigations of more coordinated, integrated, and comprehensive approaches to CBHP implementation and evaluation. CHW LAP research activities are guided by a national CHW Taskforce and supported by Johns Hopkins Bloomberg School of Public Health

(JHSPH) and Muhimbili University of Health and Allied Sciences (MUHAS) study teams through a multi-year, collaborative research partnership. The aim of this study was to identify, assess, and compare factors affecting stakeholders' preferences for the design and implementation of a single, national CBHP throughout Tanzania using a mixed methods approach.

Methods

Study setting

The Morogoro Region located in east central Tanzania was selected on the recommendation of the government-appointed CHW Taskforce for two reasons. Morogoro was an appropriate context for exploring the diversity of existing CBHPs in a combination of rural and urban settings. Morogoro presented an opportunity to build productively on relationships with local governing authorities (LGAs) established under the United States Agency for International Development (USAID)-funded Morogoro Evaluation Project, the predecessor to CHW LAP. Some ongoing and recently transitioned CBHPs operating in Morogoro Region at the time of the study included the USAID-funded Tunajali program (HIV care and treatment); the USAID-funded Maisha program (maternal, newborn, and child health); the Doris Duke Foundation-funded Ifakara Health Institute Connect program (comprehensive primary health care); and the USAID-funded Mwanzo Bora Program (nutrition for children under 5 years) (235-242).

Morogoro Region's population of 2.2 million residents live primarily in rural areas (71.3%) spread among seven districts: Morogoro Municipal, Morogoro Rural, Mvomero, Ulgana, Kilombero, Gairo, and Kilosa (243). Only 50.2% of live births in Tanzania and 58% in Morogoro Region take place in health facilities (244). The region has one of the lowest uninsured rates for women in Tanzania, and the majority still lacks

any coverage (89.4%) (244). Fewer women (5.3%) and men (2.1%) are HIV positive, compared to Tanzania overall (women: 6.2%; men: 3.8%) (245).

Study plan

This study evaluated stakeholder preferences for national CBHP characteristics. Potential characteristics, or attributes, were developed from interviews and focus group discussions with key informants, from consultation with CBHP experts from the MOHSW and CHW Taskforce, and through pre-testing with intended study audiences. Preference estimates for attribute levels were elicited using best-worst scaling (BWS) techniques and compared among three stakeholder groups (104, 246-248). Preliminary results in the form of a "learning brief" were presented to national stakeholders in Dar-es-Salaam, Tanzania in August 2015. A summary of study phases, stages, methods, and outputs appears in **Figure 9.** The study received ethical approval from the JHSPH institutional review board (#00005497) and the Directorate of Research and Publications at MUHAS. Approval was obtained from the regional and district government health councils as ultimate overseers of CBHPs in Morogoro Region at the beginning of each data collection phase.

Phase I: Qualitative methods

We conducted semi-structured interviews with CHWs and governing authorities (GAs) of CBHPs in August 2014 and focus group discussions with recent clients in October 2014 to describe informants' experiences with various CBHPs and to express their preference for their management, operation, and organizational characteristics. To maximize the variety of programs and populations served, we selected informants from a cross-section of four communities in urban, peri-urban, and rural districts in Morogoro Region (249). All participants in both phases of the study were approached by a trained

research assistant in-person or by telephone, informed about the study, and invited to give consent to participate. Participants were compensated 10,000 Tanzania Shillings if they traveled to participate.

CHWs were recruited to be interviewed from ongoing programs focused on nutrition, maternal and child health, HIV prevention and home-based care, and comprehensive primary health care. Governing authorities at the regional, district, ward, and village levels and health facility supervisors were eligible to be interviewed. Clients were divided into adult male and female focus groups by the CBHP service type received. To improve recollection of past experiences, only clients who received services in the prior four weeks were eligible to participate. Research assistants were familiar with CBHPs in Tanzania, and trained in qualitative interviewing techniques. Research assistants used semi-structured guides to lead interviews and focus group discussions in Swahili. Interviews and discussions were digitally recorded and transcribed.

Transcripts were translated from Swahili to English by trained translators at the University of Dar-es-Salaam. Translated transcripts were reviewed to abstract and extract potential CBHP characteristics (i.e. "CHWs deliver tuberculosis services," "CHWs share a motorcycle"). Program characteristics were preliminarily consolidated into topic groups. Members of the MOHSW Health Promotion and Education section, the JHSPH and MUHAS study teams reviewed potential program characteristics together and condensed them into smaller and smaller groupings, to iteratively assess coherence and eliminate attributes likely outside of the MOHSW's consideration. A preliminary set of six program characteristics (attributes) with three options (levels) each were selected for pre-testing.

Phase II: Quantitative methods

Attribute development and pre-testing

A BWS Case 2 experimental design was selected for its ease of administration to study audiences of varying literacy levels and familiarity with CBHPs in Tanzania (247). We used a main effects orthogonal array to generate 18 hypothetical program profiles. Research assistants were trained in BWS survey techniques before the pre-test. Respondents were asked to choose the most desirable and least desirable element from each program profile if a single CBHP were to exist everywhere in Tanzania. Pretest survey respondents were provided with written or verbal definitions of each level and walked through an example task for practice. A professional illustrator prepared contextually appropriate illustrations for each of the 18 attribute levels to better engage survey respondents. In January 2015, we conducted a pre-test of the instrument with CHWs and GAs in an urban district of Morogoro Region. The survey instrument, attributes, and levels were revised through debriefings from pre-test observations and consultation with CHW Taskforce members.

Survey methods

In March 2015, we engaged three stakeholder audiences from all seven districts in a BWS experiment: CHWs, GAs, and adult community members (CMs). All available governing authorities and CHWs were surveyed from one of three randomly selected wards within each district. CMs were surveyed from a randomly selected village from the selected ward. Men and women were selected at random using a spin-the-pen method employed by vaccine coverage enumerators (250). Men were recruited choosing every third house and women from every fourth moving in counter-clockwise pattern from a central point across the community. If no one was home that met the eligibility criteria,

the study proceeded to the next household. Wherever possible, we conducted all CM surveys in one day to avoid contaminating subsequent responses.

Preference estimates were generated to assess the relative importance that stakeholders place on potential program characteristics for implementation in a national CBHP in Tanzania. To account for potential preference heterogeneity, mixed logit regression was used which allows preference estimates to vary across individual respondents (248). Statistical analyses were performed using Stata® version 13.0 (StataCorp®, College Station, TX) and Microsoft® Excel® 2013 (Microsoft®, Redmond, WA).

Results

Qualitative findings

Interviews (CHWs, n=18; governing authorities, n=34) and discussions (male client groups, n=4, participants = 30; female client groups, n=4; participants = 31) **(Table 8).** Qualitative analysis yielded 19 potential program characteristics, under five major themes: governance, health services, workforce, interpersonal linkages, and enablers (**Table 9).**

Governance

The theme of governance included three potential attributes compensation, supervision, and management and administration.

Compensation

All respondents described a pressing need for CHWs to receive an increased and regular allowance (small payments intended to cover work-related expenses). Many respondents expressed a hope that CHWs would be brought into formal government service and so be paid by government. Clients noted the lack of a salary as a major

deterrent to attracting and retaining CHWs in their programs, considering the expected workload for regular household visits.

Supervision

CHWs frequently described supervision of their activities as centering on regular report submissions to centrally-located program coordinators. GAs more familiar with typical CBHP operations described public gatherings as an appropriate forum for discussing individual CHW performance. However, the GAs stated that community members more frequently gave verbal praise or general concerns, instead of constructive feedback. Clients, in contrast, described feeling very free to confront CHWs with questions about performance and to correct their conduct.

Management and administration

CHWs described having good interpersonal interactions with village GAs, but wished for stronger support to carry out their work, particularly the enforcement of sanitation standards (pit latrine digging, waste disposal, etc.). GAs described village government as open and supportive of CBHPs, and public meetings as a good forum for CHWs to draw attention to their work challenges. Clients were less explicit when recommending how CBHP management should or could change in the future; they focused instead on expanding CHWs training to provide more sophisticated health products and services, for example, injection services.

Health services

The theme of health services included five potential attributes: service features, service packages, populations served, health and health service outcomes, and indirect benefits.

Service features

CHWs mentioned seeing clients anticipate their services as one of the intangible benefits of volunteering, particularly when those services were offered in a public place such as a nutrition counseling during an antenatal clinic. GAs placed greater emphasis on the closeness between CHWs and their clients that allowed for more convenient service. Clients described a wish for a permanent CHW office that would allow them to locate CHWs quickly and consistently. Male clients were particularly hopeful that a fixed workstation would facilitate giving first aid or other assistance in case of emergency.

Service packages

Despite the heavy workload, CHWs were reluctant to consider a future scenario where fewer services were offered. GAs were primarily concerned with the persisting gap of unmet demand for health services in their constituencies. Female clients of reproductive age, who were already targeted for CBHP services, did not want to give up the attention and support the CHWs currently provide.

Populations served

CHWs described providing services primarily to mothers and young children, but involving fathers and male partners with varying degrees of success, particularly in the promotion of antenatal care. Health facility workers lamented the geographic gaps in access to health services, but hoped that future programs would also offer health services to adults and older people in the communities where they already operate. Male clients mentioned confusion and frustration with CHWs when asking for antimalarial or anti-diarrheal drugs and being turned away because they are not the intended targets.

Health and health service outcomes

CHWs reported seeing clients increasingly use services they provide and promote, and associated this behavior with positive or improving health outcomes, especially family planning and reduced maternal and newborn deaths. GAs credited CHWs' promotion activities with increased health service seeking at dispensaries and health centers, particularly labor and delivery services for pregnant women and childhood vaccination. Male clients connected CHW's efforts with improved sanitation in their communities, but also noted their own discomfort with being held accountable through CHW home visits.

Indirect benefits

CHWs noted that their elevated status in the community, including the receipt of allowances from their respective programs, lead community members to withhold non-monetary gratuities. Many GAs viewed CHWs as receiving no outside support for their activities and that while this situation was regrettable, it was also evidence that the CBHP's activities were likely to continue absent additional resources. Clients mentioned small gifts of food they received as part of participating in CHW-led activities as a source of motivation to attend.

Workforce

The theme of workforce included four potential attributes: qualifications, selection, training, and opportunities.

Qualifications

CHWs frequently could not describe how they were appointed by village government, except being notified of their obligation to train and serve. Those CHWs who could describe the criteria cited a willingness to work as a volunteer, having good

relationships with community members, integrity, and seriousness as ideal qualities in a candidate. GAs described prioritizing CHWs for training and service who were more permanent and committed to staying in the community, especially when marriage or economic opportunities might draw suitable candidates away. Clients described wanting to raise the education requirements for CHW service, such as from achieving Standard 7 (primary school) to Form 4 (grade 10 of high school), although few discussants characterized this requirement as excluding current CHWs from service.

Selection

CHWs frequently recalled the process of their appointment as being need-based (i.e. a new vacancy) rather than being based on a planned evaluation of criteria and suitability. GAs viewed the CHW selection process as openly competitive and accountable to the community because it involved posted notices for applications and public meetings involving discussion and voting. Clients also cited high attendance and participation in selection events and voting as evidence of broad approval of CHWs' new roles.

Training

CHWs viewed their work as a step on the way to greater career opportunities, but requiring significant sponsorship from government to cover tuition or other education expenses that might raise the standard of service. GAs described their concerns of a revolving door for training new CHWs, coupled with infrequent training opportunities, leading CHWs to operate without technical guidance. Clients also desired CHWs to be "upgraded," but not to be given responsibilities beyond the scope of their training.

Opportunities

CHWs, particularly younger CHWs, desired pursuing career options beyond CBHP positions and hoped for opportunities that would blend service and formal education. GAs described volunteer CHWs as juggling multiple competing responsibilities and opportunities, particularly farming or other employment that keeps them from completing their volunteer work and may actively encourage them to quit their post. Clients recognized the lack of a salary as a major reason for CHWs to discontinue service.

Interpersonal linkages

The theme of interpersonal linkages included three potential attributes: relationships, behavior and conduct, and modes of communication.

Relationships

CHWs described their relationships with the community as generally warm and friendly, but that some clients took offense at CHW's perceived unwillingness to deliver services. GAs desired harmonious relationships between clients and CHWs, particularly ones where CHWs demonstrated humbleness and respect for privacy when attending clients. Clients drew a direct connection between sustained good working relationships with the community and the community's power to call CHWs to account or be removed from service if relationships soured.

Behavior and conduct

CHWs described their conduct and appearance as important to clients, particularly older clients who desired more traditional behavior and dress. CHWs also recognized that even despite good behavior or performance, they would not be welcomed to serve certain groups of clients (i.e. an HIV-negative caretaker providing home-based care to people living with HIV, a young man without children providing antenatal counseling to middle-

aged mothers). GAs described village government as empowered to remove CHWs from their posts in the case of unsatisfactory behavior. Clients described behavioral background assessments as a part of the criteria they used when selecting or voting for CHWs to be trained. Clients' familiarity with CHWs' behavioral history built confidence in their assessment of CHWs' abilities to serve and created a sense of ownership over the CHWs' work.

Modes of communication

CHWs cited difficulties communicating with health facilities, their program leadership, and clients especially in the case of a referral, which a mobile phone might address. GAs operating in program leadership addressed this barrier by issuing phones to CHWs to increase discussion about challenges faced and to facilitate reporting. Male clients didn't see phones as useful to CHWs when their main clients, women and children, also lacked phones. Instead, they desired that CHWs sit at a central post where everyone could reach them.

Modes of health promotion and information sharing

CHWs described challenges with sharing important messages with clients, particularly counseling pregnant couples on HIV testing and involving male partners in childcare. They felt ill-equipped to address issues involving male partners by themselves. GAs offered that what CHWs provide - low or no cost health messages and interventions – was itself a barrier to reaching certain client groups, because free things were viewed with suspicion or assumed to be of low quality. They saw dispelling these notions as the responsibility of government leadership. Clients appreciated the regular and recurring visits and reminders from CHWs to attend health days or receiving casual advice,

concerning, for example, household sanitation. The routine of engaging face-to-face was seen as reassuring.

Enablers

The theme of enablers included three potential attributes: transport, materials and supplies, and commodities.

Transport

CHWs who received bicycles to support their home visit activities also cited the need for ongoing maintenance, or to replace stolen bicycles. Depending on where in Morogoro Region they lived, CHWs did not immediately view a bicycle as useful. GAs recognized that geography, and not simply distance, as important to CHWs reaching clients in the mountainous parts of Morogoro Region. Clients regularly mentioned transportation as a major barrier to regular visits.

Materials and supplies

CHWs desired supportive supplies for their work particularly uniforms or badges that would identify them as legitimate service providers. GAs saw health promotion materials like posters as effective for sharing information when CHWs could not individually notify clients about meetings and health events. Clients also valued having health information brochures or booklets that allowed reading and reviewing health information on their own.

Commodities

All three groups expressed a strong desire that CHWs be provided with larger quantities of medicines to reduce time spent traveling or in clinics seeking the same drugs. GAs saw a need for CHWs to be equipped with first aid medicines, while acknowledging that other medicines require more training to distribute. Clients often

discussed the supply of medicines as a pressing need to be addressed, separate from the way CHWs are trained, or how quickly new government dispensaries are built.

Quantitative results

Attribute development and pre-test results

The study team settled on a preliminary choice set of six attributes (Incentives, Supervision, Eligibility, Transport, Services, Service features) with three levels each for pre-testing **(Table 10).** In January 2015, we pre-tested the instrument with CHWs (n=13) and GAs (n=13) (data not shown). Open discussions with research assistants and MOHSW representatives helped to further refine attributes and levels after the pre-test. Attributes and levels shifted away from reflecting CHW job attributes and toward CBHP characteristics affecting all stakeholders. The "Incentives" levels were revised to better indicate the expected source of compensation, rather than an exact level. The "Transport" attribute was replaced with "Selection for training" to better reflect intentions to sustain a CHW workforce and CBHP activities by assigning responsibility and ownership of the program. The "Services" attribute was revised to better indicate an expanding service package, instead of the particular services to be offered. The "Service features" attribute was reframed as "Service venue" to better reflect concerns for larger-scale implementation. CHW Taskforce members confirmed these changes by ensuring that the levels reflected the spread of current states, realistic future states, and aspirational states of CBHPs in Tanzania. **Figure 10** shows an example task choice task used in data collection and **Figure 11** shows the corresponding example choice task with illustrations.

Survey results

We approached 108 CHWs, 109 GAs and 226 CMs to be surveyed; only one CM did not complete the survey **(Table 11).** The majority of CHWs were female (52.8%), Christian (65.4 %), and married (59.3%). Median CHW age was 41.5 years. The majority

of CHWs reported completing at least primary school ("Standard 7" - 70.3%; "Form 4" -
18.5%). CHWs reported a median 9 years of service and the vast majority held outside
employment (90.7%). Many CHWs reported multiple program affiliations, most
commonly to the Mwanzo Bora Nutrition program (USAID/Africare; 32.4%), followed
by Tunajali HIV/AIDS Prevention, Care and Treatment program (USAID/Deloitte;
26.8%), and Maisha Maternal and Child Health program (USAID/Jhpiego; 12%) (data
not shown). The majority of GAs were male (71.6%), Christian (64.2%), and married
(78%). Median GA age was 47 years. GAs reported the highest levels of education of the
three groups ("Standard 7" – 40.4%; "Form 4" 11.9%; Certificate, diploma or tertiary
education - 40.3%) The majority of GAs were village or ward-level government officials
(76.1%) with a median of 6 years of experience in their current positions. CMs were
surveyed in comparable proportions by sex to allow for subsequent subgroup
comparisons. More CMs were Christian (54.7%) and married (68.9%). The median CM
age was 38 years old. CMs reported the lowest levels of formal education ("No formal
education" - 10.2%; "Standard 7" – 64%; "Form 4" - 10.7%).

Figure 12 shows preference estimates using effects-coded mixed logit regression.
"Salary" as an incentive for participating CHWs was consistently and significantly
preferred across all groups (CHWs, ß = 1.32, p < 0.000; GAs, ß = 1.69, p < 0.000; CMs, ß
= 1.20, p < 0.000) over an allowance or in-kind contributions. CHWs favored health
facility supervision (ß = 0.08, p = 0.263) over either local government or community
supervision. GAs (ß = 0.08, p = 0.442) and CMs (ß = 0.13, p = 0.011) both preferred
supervision of CBHP activities by local government over health facility or community
supervision, although only CMs' preferences were statistically significant. All three

stakeholder groups strongly disfavored a CBHP that would require CHWs to complete a Form 4 education (CHWs, ß = -1.26, p < 0.000; GAs, ß = -1.04, p < 0.000; CMs, ß = -0.48, p < 0.000); instead, all groups favored requiring that CHWs be either "local" or "acceptable" to the communities they serve.

Among selection and training program characteristics, GAs and CMs both preferred CBHPs where local governments select CHWs to receive bonded scholarships (GAs, ß = 1.54, p < 0.000; CMs, ß = 0.88, p < 0.000) and strongly disfavored self-sponsorship for training (GAs, ß = -1.980, p < 0.000; CMs, ß = -1.13, p < 0.000). CHWs favored donor sponsorship over a bonded scholarship or self-sponsorship for training, but not to a statistically significant degree. All three groups preferred CBHPs that would provide services for the entire family over a single or group of health issues (CHWs, ß = 0.39, p < 0.000; GAs, ß = 0.94, p < 0.000; CMs, ß = 0.79, p < 0.000). They also preferred that services were provided either in clients' homes or in a public area, over seeking services at a CHW's home (CHWs, ß = -0.83, p < 0.000; GAs, ß = -1.21, p < 0.000; CMs, ß = -0.87, p < 0.000). Full results appear in Appendix

Discussion

The scientific evidence to support the effectiveness of CBHPs to address unmet need for primary health care and other critical health services in LMICs is growing, particularly with respect to improvements in maternal, neonatal, and child health outcomes (23-25, 251, 252). The increased focus on the role of CHWs and CBHP activities is concomitant with the global drive to achieve the Millennium Development Goals in a variety of health areas (31). The proliferation of CBHPs has sparked new questions about which program elements, particularly but not exclusively related to

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human resource management, undergird the most successful and sustainable programs (229, 230). Our study begins to fill the knowledge gap on stakeholder preferences, particularly of community members, for the specific human resource management and service delivery aspects of CBHP planning to inform community-based health workforce policy and decisionmaking (253).

In Tanzania, an array of donor-funded CBHPs form a poorly integrated and technically weak link from the community to the national health system. CBHP training curricula in Tanzania are not standardized and CHW's activities aren't regulated by government, allowing for large variation in the standard of care provided (32). In 2014, the MOHSW issued broad guidelines under the Primary Health Service Development Program (PHSDP)/Mpango wa Maendeleo wa Afya ya Msingi (MMAM) 2007-2017 to form a single, integrated CBHP to be over-seen by LGAs throughout Tanzania (32). This study was commissioned, in part, to identify the characteristics of a national CBHP that would recruit, retain, and motivate CHWs, while assessing trade-offs to other stakeholders, especially LGAs and community members (234). Findings from this study guided the CHW Task Force in the creation of a strategy to engage health and non-health related partners in the implementation of a national CBHP, especially the Prime Minister's Office of Regional Administration and Local Government bodies and subordinates.

We elicited preference estimates with a BWS experiment and compared results between three stakeholder groups. Our data indicate that all three group's preferences generally concord with one another. The most and least desirable CBHP elements are consistent across groups, except for "selection for training" and "supervision." Our

findings concur with recommendations for building a national cadre, especially offering

incentives instead of relying on a spirit of community service, and centering eligibility

decisions on community selection processes and local residence over educational status

(31).

Incentives

All groups reacted most strongly to the issue of "Incentives" and compensation

generally. All three groups prioritized CHWs receiving a salary set by the government,

and strongly disfavored in-kind payments from the community as a source of

compensation. All three groups weakly favored or disfavored allowances, which are a

very typical form of compensation for CHWs in Tanzania. A separate analysis of

motivation and job satisfaction factors showed CHWs in Morogoro Region, Tanzania to

be similarly discouraged by low compensation, and dissatisfied with the availability of

job aides to carry out their work (235). Consistent and predictable incentives that are

commensurate with workload and training have been found important in other countries

as well (233). Adding CHWs to the Tanzanian public scheme of service may address

issues of workload for facility-based workers and compensation for CHWs, but create a

new financing challenges in the new cadre (254, 255).

Supervision

No clear pattern for supervision preferences appeared across the three stakeholder

groups, suggesting that stakeholders may not know, care, or feel able to evaluate how

systems of performance measurement and accountability of CBHPs should be structured.

The MOHSW should proceed to establish a clear plan for accountability that considers a

role for local government, the health facility, and the community. Additional education

for all stakeholder groups about the implications of a particular supervisory model could build greater confidence in CBHPs.

Financial and administrative responsibilities for health programming was devolved to district councils (sub-regional government) in the 1990s under health sector reforms on the notion that LGAs were better situated to assess, plan, and budget for health services in their constituencies (256, 257). The degree to which decentralization has forged working partnerships between district councils, health facilities, village governments, and community members for health care priority setting has been questioned (256-259). Council health management teams coordinate village health committees (VHCs) through corresponding ward and village government structures. Health facility management teams interact with the community through VHCs, although these committees vary in their activity and successful function (259). Governments and citizens may prefer instead to defer judgment to higher-level government bodies as was seen in two districts in Tanga Region, Tanzania (260). Responsibility for supervision is frequently shared between health facility management teams, program leadership, and the community and is, therefore, neglected for lack of a clear roles and resource commitments, as was observed in a comparison CBHPs in Democratic Republic of Congo, Ghana, Senegal, Uganda, and Zimbabwe (261). Investigating whether and how stakeholders value the role of CBHP governance, particularly community governance, deserves more study.

Eligibility

CHWs preferred "living in the community" and "community acceptability" much more than "having a Form 4 education," which was strongly disfavored. GAs and CMs ranked these factors similarly. We expected that CHWs might not favor a high barrier to serving in a CBHP, but found that both GAs and CMs also de-prioritized an education requirement. This result may discourage MOHSW from raising the education requirement for CBHPs too quickly, at the expense of other desirable characteristics (262). In a comparative assessment of CHW program harmonization to deliver HIV-related services Lesotho, Mozambique, South Africa, and Swaziland, stakeholders expressed similar concerns that professionalization would exclude important but older CHWs (263). In a global evaluation of CHW performance across multiple programs, more years of formal education are associated with better outcomes, but more educated CHWs were also less likely to be retained by their respective programs (230).

Selection for training

In the area of selection for training, governing authorities and community members' preferences diverged noticeably from CHWs. Governing authorities and community members strongly preferred that CHWs be selected to receive a bonded scholarship provided by the government, and strongly disfavored self-sponsorship, while CHWs preferences were ambivalent across characteristics. CHWs weakly favored donor-sponsored scholarships and weakly disfavored a bonded scholarship, but confidence intervals crossed zero suggesting no strong preference relative to the alternatives. Additional exploration of CHWs' expectation from various training programs and their obligations may be helpful before selecting a training model.

Services

All three groups agreed that services for the whole family were more preferred; and single-disease or "vertical" health programs were strongly disfavored. This result supports a move by the MOHSW to expand the expertise of CHWs to include more comprehensive services and especially the wider range of ages represented in a family. Concerns for whether CHWs themselves will be overloaded by an expanded service package to serve the whole family will also need to be addressed as they were in HIV program harmonization in four Southern African country programs (263). In South Africa, for example, CHWs have transitioned from a primarily HIV and tuberculosis case management approach to a more comprehensive service, but remain programmatically marginalized compared to the priorities for the national primary health care system (264).

Service venue

All three groups favored receiving services either in the client's home or in a public venue, while providing services in the CHWs' homes was not favored. This result supports continuing to promote community-level service provision and care models.

Our study also expands preference research on health workforce policy into volunteer health workforce concerns using stated-preference methods techniques. In 2012, USAID, WHO, and World Bank prepared guidance for conducting DCEs on health workforce recruitment and retention strategies for rural areas (62). The charge appears to have been enthusiastically taken up; however, to the best of our knowledge there have been no other applications of any stated-preference methods to elicit the preferences or priorities of beneficiaries or ancillary stakeholders on either CBHPs or general health workforce concerns in sub-Saharan Africa. Our study is one of the first applications of

best-worst scaling methods for health and health systems policy and planning in sub-Saharan Africa, particularly one that engages higher and lower literacy populations (53, 63, 185).

Applications of stated-preference methods to assess human resources for health (HRH) problems have increased over the last decade, particularly in sub-Saharan African settings. In 2009, Lagarde and Blaauw found five of ten DCEs concerning human resource policy questions were conducted in a sub-Saharan African country, although none were peer-reviewed at the time (84). In 2014, Mandeville and colleagues found 12 HRH-related DCEs conducted in African countries, most of them peer-reviewed (47). Fifteen DCEs and two ranking exercises concerning health workforce incentives in sub-Saharan Africa were published between 2008 and 2016, all peer-reviewed (51, 54, 59, 110, 115, 124, 138, 139, 142, 145, 146, 148, 154-157, 163). Most applications concerned eliciting preferences directly from facility-based skilled health workers or trainees about the job attributes that would attract and retain them in rural postings. Only three explore the workforce concerns of CHWs, and none of these studies engaged other stakeholder perspectives, nor have any studies explored broader workforce-related concerns of CBHPs (51, 124, 163).

These three separate studies in nearby Uganda have used stated-preference methods to elicit volunteer CHW preferences for job attributes. Ludwick and colleagues employed pair-wise ranking to assess seven motivating factors for service among 46 CHWs (163). Non-monetary motivators like "improved child health" (rank: 1st; score: 5.72) and "education and training" (rank: 2nd; score: 4.50) outranked monetary motivators like "income-generating projects" (rank: 5th; score: 2.02) and "transport stipends" (rank:

7th; score: 0.43) out of seven attributes. Brunie and colleagues' DCE on preferred job attributes among 182 CHWs showed a bicycle, (ß =3.90, SE=1.41) added to other work enablers like t-shirts and badges (ß =1.97, SE= 1.02), was the most attractive job feature (51). Mobile phones, transport refunds, and opportunities to participate in refresher trainings were also favored at a statistically significant level, but to a lesser degree. Kasteng and colleagues conducted a DCE of work characteristics among 43 CHWs, including community appreciation, flexible work time, regular training, mobile phones, and remuneration levels (124). Monetary remuneration was the most valued work characteristic (ß = 1.38; SE = 0.243), although community appreciation (ß = 0.992, SE = 0.139) ranked higher than did monthly payments of 20.20 U.S. dollars (ß = 0.868, SE = 0.199). No stated-preference methods applications, so far as we are aware, have concerned the features of a CBHP from the perspective of both beneficiaries, government leaders, and CHWs themselves.

The study has limitations. Despite thorough investigations into the salience of program characteristics to three stakeholder groups through pre-testing and extensive discussions with MOHSW and community-based health program experts in Tanzania, it is possible we omitted an important attribute or level from consideration. Attributes were gleaned from interviews transcribed by third-party professional translators; however, deeper analysis of the Swahili language transcripts may have yielded deeper and even more contextual understandings of priority attributes to be included in the final experiment. Results are based on what respondents say they would choose in a hypothetical situation rather than what they would actually support or utilize, which is a weakness of all stated preference experiments. The study lacks data concerning whether

study participants would either participate in or support a future CBHP that reflects the presented characteristics. Including an "opt in/out" question might have grounded our results better (248). Analyses of preference heterogeneity are increasingly featured in heath preference elicitation research, although there have been only two applications in sub-Saharan African settings and each with samples of fewer than 150 participants (109, 115, 265). Future analyses will examine additional stratified as well as segmented results.

Conclusions

The study demonstrates that a mixed methods approach can be used to identify, prioritize and compare preferences among multiple stakeholder groups for their jointly preferred characteristics of a community-based health program in a Tanzanian setting. The qualitative findings and quantitative results provide clear guidance to the MOHSW and CHW Taskforce for developing policies and strategic approaches for creating a national CBHP that reflects key stakeholder preferences. Study participants preferred a national CBHP that offers a set salary to CHWs and expands the scope of CBHPs to provide more comprehensive services. Participants qualitative and quantitatively endorsed service delivery in clients' homes or public areas. The MOHSW should explore the feasibility of a scholarship program, or other means to train CHWs, at no direct cost to trainees, although the desirable and undesirable aspects of various selection-for-training approaches should be explored in greater depth with CHWs who were undecided among the three options. The MOHSW and CHW Taskforce should move to establish a clear accountability system for CBHPs with health facilities and local government, but with an eye toward deeper study of supervision structures. The generalizability of these results to other SSA and low and middle-income country settings is limited, but could

inform priority setting for national health systems where CBHPs are active. As country

governments consider whether and how to build national CBHPs, they should engage

multiple stakeholder perspectives, especially but not exclusively the potential

community-based workforce, to assure that planning and policymaking priorities are

aligned.

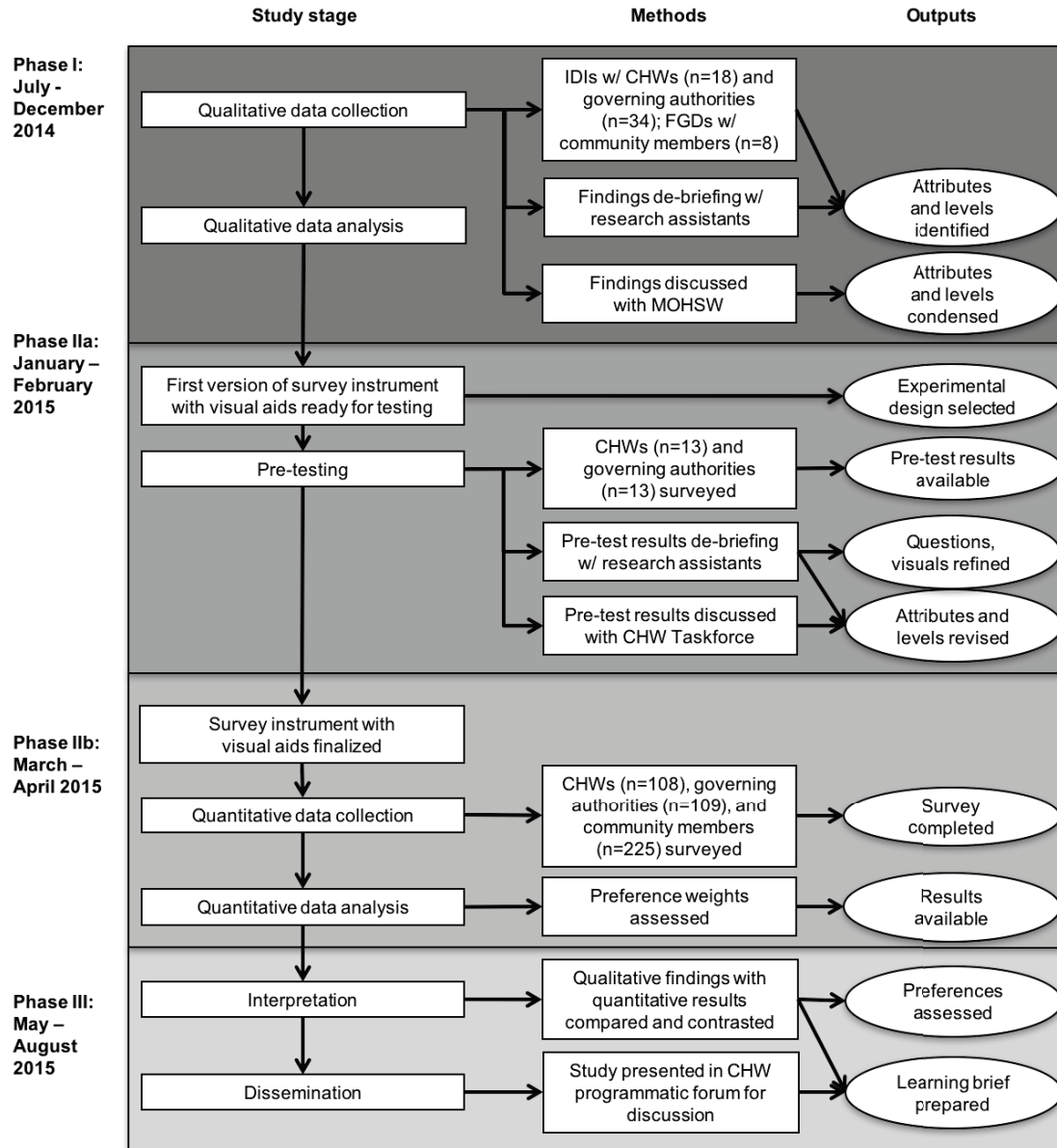# Figure 9 Summary of study phases, stages, methods, and outputs

| Study stage | Methods | Outputs |

Phase I: July - December 2014

Qualitative data collection → IDIs w/ CHWs (n=18) and governing authorities (n=34); FGDs w/ community members (n=8)

Qualitative data analysis → Findings de-briefing w/ research assistants → Attributes and levels identified

Findings discussed with MOHSW → Attributes and levels condensed

Phase IIa: January – February 2015

First version of survey instrument with visual aids ready for testing → Experimental design selected

Pre-testing → CHWs (n=13) and governing authorities (n=13) surveyed → Pre-test results available

Pre-test results de-briefing w/ research assistants → Questions, visuals refined

Pre-test results discussed with CHW Taskforce → Attributes and levels revised

Phase IIb: March – April 2015

Survey instrument with visual aids finalized

Quantitative data collection → CHWs (n=108), governing authorities (n=109), and community members (n=225) surveyed → Survey completed

Quantitative data analysis → Preference weights assessed → Results available

Phase III: May – August 2015

Interpretation → Qualitative findings with quantitative results compared and contrasted → Preferences assessed

Dissemination → Study presented in CHW programmatic forum for discussion → Learning brief prepared

Table 8 Summary of qualitative methods, sampling, and collection approaches

Group	Method	Sampling	Collection	*n*
Community health workers	Semi-structured interview	Maximum variation (at least one unique CBHP operating), stratified (urban, peri-urban, rural)	All available CHWs in a sampled community in four districts	18 interviews
Governing authorities	Semi-structured interview	Maximum variation (at least one unique CBHP operating), stratified (urban, peri-urban, rural)	All available village and ward-level health officials, health facility representatives in a sampled community in four districts; regional and council health program representatives	34 interviews
Community members, male and female	Focus group discussion	Maximum variation (at least one unique CBHP operating), stratified (urban, peri-urban, rural), criterion (sought services for themselves or a family member in previous 4 weeks)	One discussion per gender group in two sampled communities across four districts	8 groups; female = 31, male = 30

CBHP = community-based health program

Table 9 Community-based health program characteristics, identified by theme

Themes	Quote		
Group	Community health workers	Governing authorities	Community members
Governance			
Compensation	*We get very meager allowances indeed. Because I love this job, it is my humble suggestion to the government that they increase the allowances they give us and doing so will boost our morale. I know that I do this job voluntarily. However, I should at least be able to earn a living out of this job. It is embarrassing if I go to visit clients unclean.* Informant #13, Kilombero, HIV prevention for women and children under 5	*As I said previously, these community health workers need to be paid, and therefore if the government can pay them or if there are non-governmental organizations which can support them then I think it will motivate them it will also increase their efficiency. You know these people work also in some very remote [areas] where it is not easy to reach so if they will be supported I think they will help a lot our communities.* Ward official, #20, Morogoro Rural	*I think there is a need to increase the [number of] community health workers because they are very few, but the government should employ them and therefore they will be paid as employees because currently they are doing very tough tasks but without payment. For instance, I cannot blame my community health worker is not visiting me because I know how difficult her life is and she has no salary….* Discussant #5, male, Morogoro Rural
Supervision	*Honestly, I haven't received any feedback about the work that I have been doing, apart from the reports that I submit to them. But some guests once came here to evaluate the work we are going and the challenges that we face. They educated us about a few things and encouraged us to keep doing this work. They said they depend on us to reduce infant and maternal mortality rate.* Informant #1, Morogoro Municipal, maternal and newborn services and helminth control	*Ok, I think I should not lie you on that… there is no feedback my friend even in the meetings… [silence]… it is… people simply give general comments that they appreciate their work. But for us if there are no complaints we assume that the work is done well.* Ward official, #26, Kilombero	Those young guys are very serious with their work and they are really working. I am speaking also as a member of village government to which they are responsible; even the reports of their meetings are brought to us. Those who supervise them from the district also come to us. We also obtain more information about them from the dispensary Discussant #7, male, Kilombero

Management and administration	*One of the things that I don't like is the lack of cooperation between us and the village leadership. Most of the village leaders are not serious about health issues. I am saying this because sometimes I may advise them something very important for the good of our village but to my disappointment, I may have no one to support me.* Informant #10, Morogoro Rural, women and children under 5	*We had a village meeting and they got chance to present their issues when given the opportunity by the chairperson. CHWs can present any challenge related to their job in their village. They can talk about health issues for example, if the patients and diseases have increased in the health centers and maybe the cause is that people drink contaminated water without boiling.* Council health official, #24, Kilombero	*Saying on their behalf what is to be changed is difficult because we just know the training they got and their activities. Everyone knows it so we may see like it can remain as it is because if we say something has to be changed we don't even know what has to be changed.* Discussant #7, male, Ulanga
Health services			
Service features	*I like the way the community members respond to the appointments we make with them. For instance, we inform them that our meeting starts at 8:00 am, but at around 7:30 am they are always around at health centers. We comfortably do our duties as our clients (pregnant women) are really cooperative. Our meetings take four to five hours.* Informant #16, Ulanga, comprehensive services	*I think what I like from them is they brought the service on their doorsteps in the community.* Village official, #27, Kilombero	*I wish there was a place…where the community health workers can be found, because I don't think that all of us have their number and another thing is that when there is a problem it difficult to start looking for someone but if there is a specific place I can then go for bicycle and rush to such a place to obtain one of them and help me out. That's my opinion.* Discussant #3, male, Kilombero
Service packages	*So, if you remove any component that means there will be a gap and the whole project issue will stop as will not be self-sufficient. Moreover, if there are seven components, three should be added to make them ten and those seven should be improved and that is why I said those should be left but improved.* Informant #6, Morogoro Municipal, nutrition services	*As I have said, the current healthcare services are not aligned with the community needs and expectations. There are a great number of health challenges in this area which include imbalance between the number of people who should receive health care services and services provided. This is a huge challenge indeed.* Ward official, #34, Ulanga	*We would like to congratulate and encourage them because we know they face a lot of challenges when they visit their clients, so they should not be discouraged and should carry on providing the services because we are still bearing children and we still need their services.* Discussant #2, female, Kilombero

Population served	*Another thing which I don't like has to do with the husbands; when you are providing education to their wives they are supposed to be there but instead they say that these matters concern women. I provide education to men and women on the importance of going to clinic together in order to be educated; therefore, I would like for this challenge to be taken care of because very few men understand this matter.* Informant #11, Kilombero, HIV prevention and nutrition services	*First of all, I would like the community health workers to be in the whole country and not only in some places, and the community health workers should be employed and identified as workers and not as service providers. This is because they are dealing with health issues which are basic issues, however they are specifically dealing with mother and child health, but their services can be extended to the older people.* Health facility worker, #11, Morogoro Municipal	*[CHWs] direct people very well and if for instance according to my age I am not supposed to be served by them and I go to them may be asking for Panadol they do provide them if they are available instead of forcing us to go to the dispensary. However, if you have another problem such as malaria or dysentery they advise you to go to the dispensary for examination because according to their work they are supposed to deal with pregnant women and the under-fives.* Discussant #7, male Kilombero
Health and health service outcomes	*At first many women wanted to use family planning service, but men didn't want and it reached a time [when] men tell you that "I just want give birth," despite providing explanations and the effects of giving birth after short time. She was afraid to die, but when she talked to her husband he seemed not to understand, but later they understand and accept. But frankly in the first days they were doing it secretly, but after seeing the outcomes men also see there is importance of giving birth that way because even children can get to school.* Informant #7, Morogoro Rural, family planning services	*Frankly speaking their performance is good and now we are getting more clients. Some women used to think that delivering at home is a normal thing, they encountered a lot of complications, others lost their babies but still they took it easy but through these community health workers they have been educated on door to door basis. Like right now as you have seen for yourself women are attending RCH clinic which is good; we already have two pregnant women who have come to deliver today. Therefore, the number of women delivering at the center has increased, children coming for treatment and vaccination as also increased because the simply because of motivation given be the community health workers* Health facility worker, #17, Morogoro Rural	*The community members like what they do but the only thing is that people hate being disturbed every time [laughing]. And when they urge you to clean the environment and you don't do it, they report it to the office of the village local government [Group agreeing: mmh]. Now when these charges are presented there and people are called to the village office to explain why they didn't clean the environment, they really get [upset]. So, the community members like the activities they do but they have some problems with them during rain seasons.* Discussant #5, male, Ulanga

Indirect benefits	*When we invite community members to attend meetings for health seminars, they think we have money. Therefore, they don't even prepare us some food.*	*As I have said the community health workers are volunteering. They are elected by the people, they do not have allowances, and they do not have any benefits. They are volunteering on their own ability as they were elected by their willingness that's why they are working well.*	*Those who come there sometimes give us some food as compensation for the good services you provided to them.*
	Informant #15, Ulanga, HIV prevention services for women and children	Ward health official, #11, Morogoro Municipal	Discussant #7, female, Morogoro Municipal
Workforce			
Qualifications	*Regarding this, the same procedure was used, namely the qualifications of applicants were identified such as willingness to volunteer and several others. In order to guarantee the quality of work, the project team stressed the importance of getting CHWs basing on the qualifications desired. This is because this particular job requires a great deal of integrity and seriousness. So, when the project team came here, they emphasized that CHWs be selected on the basis of their qualifications and that those who had become primary health providers be top priority.*	*One of the criteria is that he should have good behavior and should have interest in the job, and second is that one should have the capability of doing the job. This is because some may be selected but may not have interest in the job. Some may just accept but will not do it or for example ladies may be selected but later she gets married to another village and she leaves the gap. You must make sure whether somebody selected will be a permanent resident of the village and if it is the young man you have to be sure that he does not move from one area to another seeking for a job.*	*For those who have form four level of education, they should go up to form six, so if it is possible the level should be increased*
	Informant #10, Morogoro Rural, maternal health care, home-based care and nutrition services	Village health official, #27, Kilombero	Discussant #1, male, Ulanga

Selection	*I can't tell you the procedures because they had an official meeting there and after the meeting they observed that Ward A didn't have a health worker. So, they decided that, because they had [fellow CHW] and she was their member, she should then work as a community health worker there… You see now, when they got the positions for community health workers, they decide to directly choose me. I just realized it when they called me and told me to start the training but I still don't know what criteria they used to select me.*	*It is the locals who have mandate to select the CHWs, basing on the qualifications outlined by the organizations which advertise these vacancies. However, the local leaders should also take part…The village government leaders advertise the vacancies to be filled and establish the criteria for selection of applicants. The community members then select them.*	*… regarding how do the community members regard their participation in selecting the CHWs, I can say in the [this] district, [this] village was number one in participating in electing the CHWs. A lot of people showed up than in any other area, if you don't believe that, try to make follow up. You will know that a lot of people showed up*
	Informant #4, Morogoro Municipal, home-based care	Ward official, #34, Ulanga	Discussant #4, male, Kilombero
Training	*I mean they really need to send us to college for further education. The government should also cover the costs of our studies just like the way the organization did for the training we received. They can even set some conditions. It's ok with us. For instance, they can pay for our studies on the condition that, when we come back, we should work in the village we were working before and we should not move to another village or area. We have no problem with that.*	*And the problem is those who were here previously were well trained compared to the new ones and the government has no tendency of taking them for training frequently, therefore they provide the services only by using their own common sense.*	*Injection is something that requires the right level of expertise, I don't want someone to administer it and cause complications to the child unless they have been trained on how to administer them. Since they have a lot of complications and because of the level that the community health workers have, they shouldn't be allowed to administer them…that's my person observation [laughs] I am saying that because I understand when someone is allowed to administer injection it requires him/her to have studied about that but having them take only some training for a month or two weeks may cause some damage.*
	Informant #17, Ulanga, delivering comprehensive community services	Village official, #7, Morogoro Rural	Discussant #6, female, Morogoro Rural

Opportunities	*I make this suggestion because we need to further our career in term of education. We only have a certificate now. If we get more training, we will broaden our horizons.*	*So, in the end a health worker may decide to say for instance 'I have agricultural activities to take care of this year, therefore I won't be able to serve as the health worker anymore', and because these workers are chosen on their own will, they are not paid so they cannot be controlled when they want to quit.*	*And they spend most of their time there at the hospital. So, they cannot engage in other economic activities to get some income.*
	Informant #17, Ulanga, comprehensive community services	Village health official, #18, Morogoro Rural	Discussant #2, female, Morogoro Municipal
Interpersonal linkages			
Relationships	*The community members are not very happy with some of the CHWs. They have been blaming them for not delivering. The members feel that they don't get enough from some of us. However, I have had no such complaints from them.*	*My opinion is I am with the villagers. They say that [CHWs] are doing well, they serve them well, their children are checked well when they come here, when they visit them, they talk to them calmly. The society says that they treat them well, they don't say that these children are boastful. No, they are living well with them.*	*They are normally asked to have good relations with the community members [Group agreeing: mmmh]! If they don't work properly, we normally inform the village leaders through village meetings that this person cannot provide the services that we need… Because, as community members, we were given an opportunity to select them, we selected people whom we thought could provide the services properly.*
	Informant #10, Morogoro Rural, maternal health, home-based care and nutrition services	Village official, #32, Ulanga	Discussant #5, female, Ulanga

Behavior and conduct	*What I mean is that some community members appreciate what we do but some complain on the way some community members are dressed. For example, elders would like to see community health workers dressed in a way that the community is used to. Another challenge focusses on some community members suffering from certain diseases who prefer certain community workers.*	*However, I don't know to what extent but I think the community is contented with them, and that is also because they were involved in electing them. The people are also advised to report if the community health workers misbehave, hence if they do not report anything then that means they are performing well.*	*When we gathered, there were two [potential CHWs] who had sent their application letters. So, we all sat as village to look at the applicants. We have lived with them, we know their education, we know their behavior. We know how s/he will be when we elect her. So [CHW name] was elected because of her behavior because she is our child. She has been here and was born here, we know her behavior that is all.*
	Informant #17, Ulanga, comprehensive services	District health official, #23, Kilombero	Discussant #8, female, Ulanga
Modes of communication	*Also, the means of communicating with the health centers should be improved…I mean in the community health workers system the ones who introduced it have special phones which are purposely for communicating with health centers when a patient is referred.*	*We supervise them in the sense that we meet them every month in order to give them allowances. That is a good time to supervise them; we even give them phones in order to know their progress, and to know where they are stuck.*	*It is true that if there was a specific place for them they could even arrange so that today two of them are available and the day after one of them is which would be better because most of women here do not have phones and we the husbands may be far from home, therefore I am forced to go see her/him because you can be given medicine for your child before s/he is examined. So, if they are in a specific place it would be easier instead of thinking of going to her/his home where you do not know if you can find her/him.*
	Informant #18, Ulanga, comprehensive services	Program coordinator, #16, Morogoro Rural	Discussant #2, male, Kilombero

Modes of health promotion and information sharing	*Another thing which I don't like has to do with the husbands; when you are providing education to their wives they are supposed to be there but instead they say that these matters concern women. I provide education to men and women on the importance of going to clinic together in order to be educated; therefore, I would like for this challenge to be taken care of because very few men understand this matter.*	*[CHWs] are not always very much accepted in the community. That I think because of lack of education among community members. People believe that because the vaccines are offered free of charge, free things are not always good. Some complain that they are taken as a sample for drugs testing… So, these people always get such comments from people and that is the reason why, we, as the leaders have to intervene and educate people so that they get to know.*	*I think it is a very good plan which they are doing because even if you forget after weeks they must visit you again and educate you about cooking, home compound cleanliness as well as how should the children live and the food they should eat. It reaches a point where you become used to the fact that in a certain date and month there must be people who will visit you.*
	Informant #11, Kilombero, HIV prevention and nutrition services	Village official, #28, Kilombero	Discussant #2, female, Morogoro Rural
Enablers			
Transport	*Another thing is about the mode of transport. We have been repairing the bicycles using our own money. It is now high time we received an allowance to repair them because we may sometimes fail to work if they are broken and we have no money to fix them.*	*I don't know what to say but I think that will help in the improvement in health services, and currently there is expansion of villages and therefore in order to access the community in those areas transport is very important.*	*Another thing is that to help them to get transportation this is also a problem in the environment they live that is not very good because we live in a mountainous environment where it is difficult to reach there. So, she or she has to incur costs to come and see us there. She or he has to use his/her money to come to see us.*
	Informant #12, Kilombero, delivering comprehensive services	Regional program coordinator, #12, Morogoro Municipal	Discussant #1, male, Morogoro Municipal
Materials and supplies	*First, they should give use something like jersey, like T- shirts or what? Like uniforms because that can be seen when you go at work, they will see you are a real service provider, and they should increase these allowances, medicines, and work equipment…* Informant #9, Morogoro Rural, delivering women and children under 5	*Another thing is that the authorities ignore the suggestions they give. They sometimes give prior notice of vaccine day using posters in the streets and show time and date. Even the people in the farms get the information and attend the health center.* Village official, #27, Kilombero	*They should also be given books or magazine for instance concerning good health…they could also distribute them to us for us to read instead of teaching only.* Discussant #3, female, Morogoro Rural

Commodities	*Frankly, in my opinion, they should at least bring us medicines and equipment because if you find a person has some small problems once you give her medicine it will help her sometime she will not even go at hospital. It just ends there at home.*	*The people from health department said that they are not supposed to give medicines, because it needs expertise but when you check in the village, if someone is sick we take Panadol. Teaching someone how to use Panadol is normal, he/she can help people, the villagers say "I had a headache and the community health worker failed to give me even a Panadol." So, there are minor things that they could offer like helping someone with a small wound, it is just a normal thing, so they do that.*	*Those are our views regarding the dispensary. That is the biggest cry for us. We have been suffering for all years regarding this dispensary. Now the dispensary is being built there and we are supposed to get at least one room from the teachers. The medicines should come even before the dispensary. And the gloves we are saying should be close by, we beg.*
	Informant #9, Morogoro Rural, delivering women and children under 5	Ward official, #33, Ulanga	Discussant #8, female, Ulanga

Table 10 Program characteristic attribute and level descriptions, pretest and finalized

Attribute Level		Level description
Incentives		
1	Full-time	Receive a salary of 100K TSH per month working as a full-time CHW
2	Timely	Receive regular timely salary payments
3	Special	Receive a special allowance during farming season to incentivize visits
Supervision		
1	Government	Meet with village or ward government once a month to assess CHW's performance
2	Facility	Meet with health facility supervisor once a month to assess CHW's performance
3	Community	Host a community gathering once a month for health promotion activities
Eligibility		
1	Acceptable	Be acceptable to the community where they serve
2	Local	Live in the community where they serve
3	Education	Have a minimum of Form 4 education
Transport		
1	Motorcycle	Receive an allowance to travel by motorcycle to visit clients
2	Bicycle	Receive a bicycle to visit clients
3	On foot	Travel on foot to visit clients
Services		
1	RH	Provide HE promotion, Vitamin A, RH commodities
2	Vitamin A	Provide HE promotion and Vitamin A
3	Education	Provide HE promotion
Services features		
1	Home	Provide services at clients' homes
2	Confidential	Keep clients' information confidential
3	Reminders	Provide reminders to seek services at facilities

Finalized

Attribute Level		Level description
Incentives		
1	Salary	Receive a salary that will be set and paid by the government for CHWs
2	Allowance	Receive an allowance provided by the private sector (NGOs, insurance, etc.)
3	In kind	Receive non-monetary incentives provided by the community (e.g. food)
Supervision		
1	Government	Meet with village or ward government once a month to assess CHW's performance
2	Facility	Meet with health facility supervisor once a month to assess CHW's performance
3	Community	Attend monthly gathering lead by VHC to assess CHW's performance
Eligibility		
1	Acceptable	Be acceptable to the community where they serve
2	Local	Live in the community where they serve
3	Education	Have a minimum of Form 4 education
Selection for training		
1	Donor	Be selected by VHC to receive scholarship provided by a donor (e.g. NGO)
2	Self-sponsor	Apply to become CHWs; trainees will pay for their own training
3	Bonded	Be selected by VHC to receive bonded scholarship provided by the government for CHWs
Services		
1	Family	Provide services to address health issues of the whole family
2	Group	Provide services to address a group of health issues (e.g. infant diarrheal disease and FP)
3	Single	Provide services to address a single health issue (e.g. infant diarrheal disease)
Service venue		
1	Home	Provide services at clients' homes
2	Public	Provide services at a regular place in the village/streets
3	CHW	Provide services at the CHW's home

CHW = community health worker, FP = family planning; HE = health education, NGO = non-governmental organization; RH = reproductive health, TSH = Tanzanian shilling, VHC = village health committee

Figure 10 Example choice task for data collection

> **Choose a most desirable and least desirable thing about this program.**
>
> Remember you have to choose a most desirable and a least desirable thing before we move to the next question. Remember that a computer chose combinations to make the experiment work, and some of the combinations may seem strange. Even so, please pick the most desirable and the least desirable thing.
>
> CHWs will:
>
> | Most desirable | | Least desirable |
> |:---:|:---|:---:|
> | ○ | Have a minimum of Form 4 education | ○ |
> | ○ | Provide services to address a single health issue, such as infant diarrheal disease | ○ |
> | ○ | Provide services at a regular place in the village/streets | ○ |
> | ○ | Receive non-monetary incentives provided by the community (e.g. food) | ○ |
> | ○ | Attend a monthly gathering lead by the village health committee to assess CHW's performance | ○ |
> | ○ | Be selected by the village health committee to receive a CHW scholarship provided by a donor (e.g. NGO) | ○ |

CHW = community health worker, NGO = non-governmental organization

Figure 11 Example choice task with illustrations

CHW = community health worker, NGO = non-governmental organization

Table 11 Respondent characteristics

Characteristic		CHWs n=108		Governing authorities n=109		Community members n=225	
		n	%	n	%	n	%
Age (years), median (IQR)		41.5	(35,49)	47	(36,54)	38	(28, 52)
Sex	Male	51	(47.2)	78	(71.6)	113	(50.2)
	Female	57	(52.8)	31	(28.4)	112	(49.8)
Religion	Christian	70	(65.4)	70	(64.2)	123	(54.7)
	Muslim	37	(34.6)	39	(35.8)	102	(45.3)
	Other	0	(0.0)	0	(0.0)	0	(0.0)
	Unknown	1	(0.9)		(0.0)	0	(0.0)
Marital status	Single	22	(20.4)	16	(14.7)	36	(16.0)
	Married	64	(59.3)	85	(78.0)	155	(68.9)
	Divorced	6	(5.6)	1	(1.0)	8	(3.6)
	Widowed/widower	13	(12.0)	3	(2.8)	13	(5.8)
	Cohabitating	3	(2.8)	4	(3.7)	13	(5.8)
Highest level of education	No formal education	0	(0.0)	1	(0.9)	23	(10.2)
	Some primary	2	(1.8)	0	(0.0)	19	(8.4)
	Completed standard 7	76	(70.3)	44	(40.4)	144	(64.0)
	Some secondary	5	(4.6)	3	(2.8)	2	(0.9)
	Completed form 4	20	(18.5)	13	(11.9)	24	(10.7)
	Completed form 6	0	(0.0)	1	(0.9)	0	(0.0)
	Completed certificate	4	(3.7)	14	(12.8)	3	(1.3)
	Completed diploma	0	(0.0)	25	(22.9)	4	(1.8)
	Tertiary education	0	(0.0)	5	(4.6)	6	(2.7)
	Other	1	(0.9)	3	(2.8)	0	(0.0)
Are you currently working with a program or organization?	Yes	84	(77.8)				
	No	24	(22.2)				
Currently have other job?	Yes	98	(90.7)				
	No	10	(9.3)				
Other job types[1]	Farmer	74	(75.5)				
	Small business owner	15	(15.3)				
	Technician	5	(5.1)				
	Other	4	(4.1)				
Role	Village or ward official			83	(76.1)		
	Community leader			6	(5.5)		
	Facility health worker			16	(14.7)		
	Teacher/ Educ. officer			3	(2.8)		
	Other			1	(0.9)		
Tenure (months), median (IQR)				72	(10,132)		
Received services from CHW?	Yes					68	(30.2)
	No					157	(69.8)
	Don't know					0	(0.0)
Household member received services from CHW?	Yes					101	(44.9)
	No					117	(52.0)
	Don't know					7	(13.1)
Attended meeting concerning CHWs?	Yes					41	(18.2)
	No					184	(81.8)
Attended meeting lead by CHWs?	Yes					18	(8.0)
	No					207	(92.0)

IQR = interquartile range, [1]Percentages calculated from among respondent who reported any other employment

Figure 12 Preference weights for community-based health program characteristics, by stakeholder group
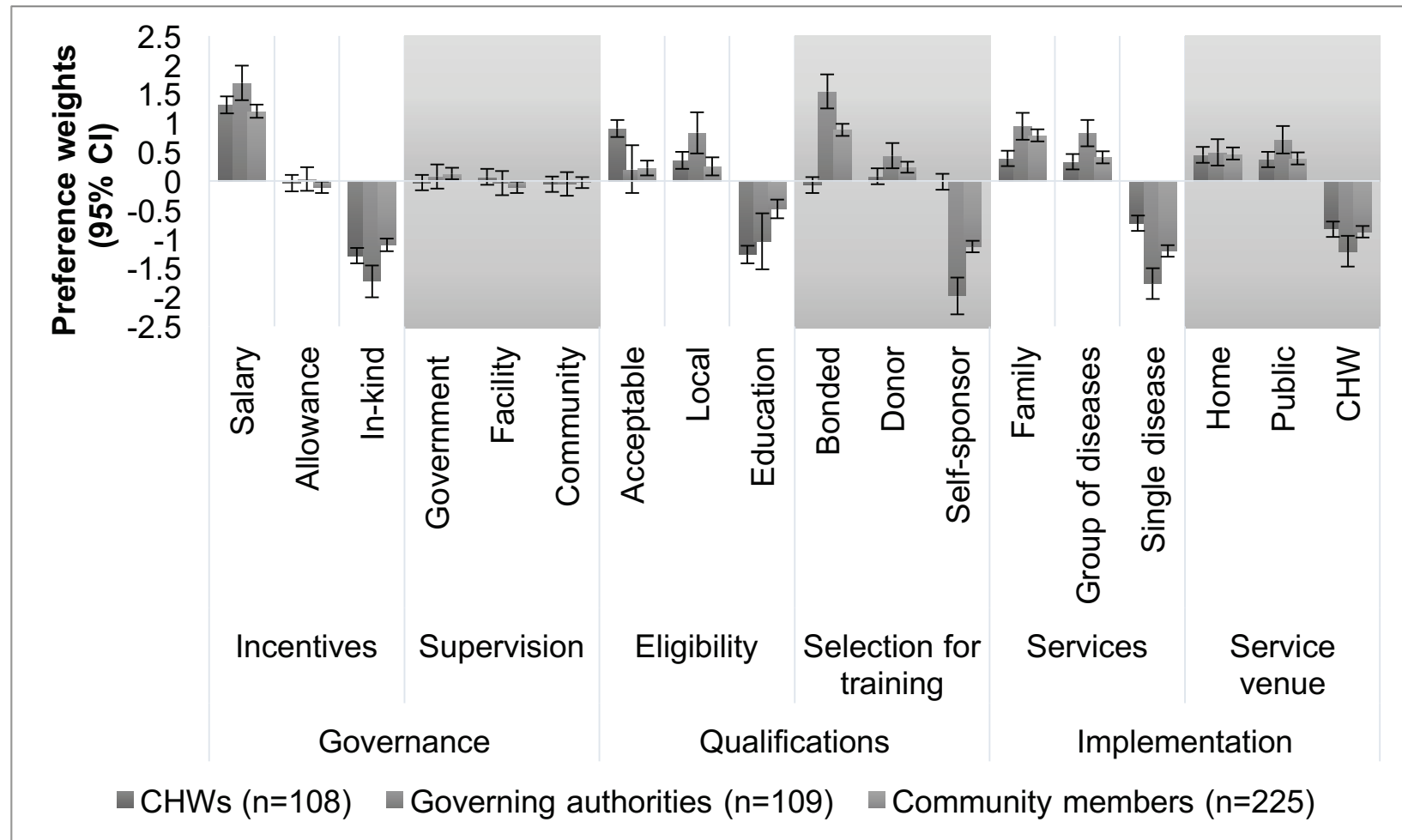
CI = confidence interval, CHW = community health worker

Appendix 5.1 Regression results

Mixed logit model with effects coding, by stakeholder group

	Attribute	Level	Community health workers n=108			Governing authorities n=109			Community members N=225		
			Coef.	SE	P-value	Coef.	SE	P-value	Coef.	SE	P-value
Governance	Incentives										
		Salary	1.32	0.075	*	1.69	0.150	*	1.20	0.057	*
		SD	-1.07	0.292	*	0.89	0.519		1.05	0.270	*
		Allowance	-0.03	0.072		0.03	0.100		-0.10	0.051	^
		SD	1.19	0.153	*	-1.22	0.270	*	-0.73	0.137	*
		In-kind	-1.28	0.068	*	-1.73	0.140	*	-1.10	0.055	*
		SD	-0.11	0.244		0.33	0.499		-0.32	0.227	
	Supervision										
		Government	-0.03	0.069		0.08	0.110		0.13	0.051	^
		SD	0.04	0.289		0.52	0.323		-0.32	0.212	
		Facility	0.08	0.069		-0.03	0.110		-0.11	0.051	^
		SD	-0.06	0.195		-0.45	0.281		0.02	0.147	
		Community	-0.05	0.068		-0.05	0.110		-0.02	0.050	
		SD	0.02	0.309		-0.08	0.437		0.31	0.261	
Qualifications	Eligibility										
		Acceptable	0.91	0.076	*	0.21	0.210		0.23	0.066	*
		SD	-1.74	0.236	*	-7.19	0.795	*	-3.28	0.186	*
		Local	0.36	0.075	*	0.83	0.181	*	0.25	0.079	#
		SD	0.69	0.206	#	2.13	0.355	*	1.38	0.159	*
		Education	-1.26	0.078	*	-1.04	0.250	*	-0.48	0.082	*
		SD	1.04	0.190	*	5.05	0.653	*	1.90	0.158	*
	Selection for training										
		Bonded	-0.07	0.069		1.54	0.150	*	0.88	0.053	*
		SD	0.25	0.220		0.57	0.405		0.57	0.144	*
		Donor	0.08	0.070		0.44	0.110	*	0.24	0.049	*
		SD	-0.41	0.215		-1.26	0.327	*	0.08	0.232	
		Self-sponsor	-0.01	0.069		-1.98	0.160	*	-1.13	0.051	*
		SD	0.15	0.220		0.70	0.405		-0.64	0.144	*
Implementation	Services										
		Family	0.39	0.068	*	0.94	0.120	*	0.79	0.052	*
		SD	0.03	0.284		-1.26	0.451	*	0.36	0.390	
		Group of diseases	0.34	0.068	*	0.83	0.110	*	0.41	0.053	*
		SD	-0.01	0.220		1.32	0.267	*	-0.73	0.149	*
		Single disease	-0.73	0.068	*	-1.77	0.140	*	-1.20	0.053	*
		SD	-0.02	0.180		-0.05	0.358		0.37	0.301	
	Service venue										
		Home	0.45	0.068	*	0.49	0.110	*	0.48	0.053	*
		SD	0.60	0.184	#	1.54	0.262	*	1.21	0.111	*
		Public	0.37	0.068	*	0.71	0.120	*	0.40	0.053	*
		SD	-0.85	0.295	#	-1.97	0.445	*	-1.24	0.523	#
		CHW	-0.83	0.067	*	-1.21	0.130	*	-0.87	0.052	*
		SD	0.26	0.292		0.43	0.368		0.02	0.524	

* P<0.001; # P<0.01; ^ P<0.05
SD = standard deviation

Chapter 6: Conclusions

Policymakers in sub-Saharan Africa (SSA) desire to improve health outcomes and extend efficacious, safe, and quality health services to their constituencies, in part, by strengthening various components of the health system. How to divide limited resources and which aspects of what problems to prioritize for intervention present important human and financial resource allocation questions that are difficult to answer for diverse stakeholder groups in resource-limited settings.

This dissertation sought to synthesize the applications and approaches of stated-preference methods to health systems problems in SSA in a systematic review (Chapter 3), and to apply these methods to two health systems problems in two SSA countries. In the first application, we identified and prioritized strategies to promote uterotonic security as important step toward reducing maternal mortality among national stakeholders in Kenya using conjoint analysis (Chapter 4). In the second application, we identified, assessed, and compared factors affecting stakeholders' preferences including potential beneficiaries for characteristics of a national community-based health program in Tanzania using best-worst scaling (Chapter 5).

Stated-preference methods have been successfully applied to a range of health systems problems and populations throughout SSA for the purposes of stakeholder preference elicitation and priority setting. The issues investigated have included problems of service delivery, governance, interventions, financing, information, as well as workforce development as far back as 1996, although most studies were published from 2010 onward. The most well-represented areas include primary health care for women, and interventions for the prevention and treatment of infectious diseases like HIV/AIDS

and malaria. Applications have focused especially on skilled health workers to understand their preferences for rural practice over the last 10-15 years. More recently, applications of stated-preferences methods have shifted toward assessing more patient, client, and beneficiary preferences for service delivery and health-related interventions, particularly health products.

Uterotonic drugs are important tools for the prevention and treatment of postpartum hemorrhage, which is a major cause of maternal mortality in Kenya and other low and middle-income country settings. National-level maternal health and pharmaceutical commodity stakeholders in Kenya are aware of threats to uterotonic security, but have yet to set a commodity-specific strategy. In combination with contextualizing advice from experts gleaned during interviews, our preference elicitation survey helped to identify the areas of the health system that affect uterotonic security most needing improvement in Kenya.

Health service provision, including procurement of uterotonic commodities, was devolved to county governments as a part of Kenya's constitutional reforms. Prioritization activities take on new meaning when governance functions such as budgeting and procurement are already devolved away from the national experts who are less politically empowered to address the issues. Any future strategy concerning maternal health commodities should consider both county government priorities and lessons learned from the commodity security approaches of other successful national programs, especially the HIV/AIDS, malaria, immunization, and family planning programs that operate outside the framework of Kenya's devolved health system.

Applications of stated-preference methods research topics have coincided with strategic areas already well-established by the public sector, donors, and major initiatives. Applications have focused very little on preferences for the design and delivery of community-based health programs (CBHPs), which are increasingly critical and central to plans for achieving major global health and development targets, like the Sustainable Development Goals. CBHPS, which are staffed by community health workers (CHWs), continue to be a mainstay of Tanzania's health system and other low and middle-income country settings as they build up their skilled health workforces. Tanzanian Ministry of Health and Social Welfare (MOHSW) leaders desire to standardize, harmonize, and integrate many disparate programs and players into a single, national CBHP that minimizes programmatic gaps and overlaps, and maximizes coverage of the most important primary health care services. This mixed-methods study elicited preference estimates and compared results between three important stakeholder groups: CHWs, their governing authorities and community members. Results indicate that all three group's preferences generally concord with one another: CHWs chosen by the community should be paid regularly and fairly, and CBHP services should target a wider range of community members in their own homes or in local venues. Our findings concur with recommendations for building a national cadre particularly on issues of incentives and eligibility.

Stakeholder desires for a CBHP that offers an expanded service package, fair compensation staffed by locally-selected CHWs counter-balances the MOHSW's hope to raise the standard of health services and the profile of CHWs with higher formal education requirements. Indeed, stakeholders themselves didn't agree whether a

community health workforce should be bonded to service. Any future CBHP will have to navigate constituents' desires for more services from familiar faces, with CHWs' desires for career advancement and the freedom to pursue opportunities beyond community-level service provision.

Stated-preference methods research can contribute to meeting emerging expectations for more patient-centered health care across the dual burdens of disease. Although the total number of applications is growing, more resources are needed to build capacity among researchers, implementers, and policymakers in the region to assess stakeholder preferences for a broadening sphere of health interventions especially drugs, technologies, and services for prevention of infectious disease. Preference studies are likely to be needed to inform the delivery of HIV pre-exposure prophylaxis (PrEP), isoniazid preventive therapy (IPT) for tuberculosis, or intermittent preventive therapy in pregnancy (IPTp). Preference researchers, and especially those based in SSA, should combine and adapt lessons learned from past studies with those on non-communicable disease care and treatment in North America and Europe to prepare for increasing pressure to deliver more and better NCD-related health services, which have been neglected by both health programs and research.

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263. De Neve J-W, Garrison-Desany H, Andrews KG, Sharara N, Boudreaux C, Gill R, et al. Harmonization of community health worker programs for HIV: A four-country qualitative study in Southern Africa. PLoS Medicine. 2017;14(8):e1002374.

264. Schneider H, Schaay N, Dudley L, Goliath C, Qukula T. The challenges of reshaping disease specific and care oriented community based services towards comprehensive goals: a situation appraisal in the Western Cape Province, South Africa. BMC Health Serv Res. 2015;15:436.

265. Zhou M, Thayer WM, Bridges JFP. Using Latent Class Analysis to Model Preference Heterogeneity in Health: A Systematic Review. PharmacoEcon. 2017. Epub 2017/10/05.

CURRICULUM VITAE

Lauren Elizabeth Brown, MSPH

Email: lbrown28@jhu.edu
Nationality: American

EDUCATION AND TRAINING

Doctoral candidate   The Johns Hopkins University, Bloomberg School of Public
                     Health, Department of International Health, 2013-
                     Program area: Health Systems
MSPH   University of North Carolina at Chapel Hill, Gillings School of
                     Global Public Health, Department of Health Policy and
                     Management, 2010
                     Graduate Certificate, Global Health, 2010
BS   University of Washington, Inter-departmental Program, 2006
                     Major: Public Health
BA   University of Washington, Department of Anthropology, 2006
                     Major: Anthropology

HONORS AND AWARDS

The Johns Hopkins University, Bloomberg School of Public Health, Department of
Epidemiology, Center for Excellence in Regulatory Science and Innovation (CERSI)
        CERSI Scholar (2015)
The Johns Hopkins University, Bloomberg School of Public Health, Department of
                International Health
        Fellowship (2013)
University of North Carolina at Chapel Hill, Gillings School of Global Public Health,
Department of Health
Policy and Management
        Delta Omega Public Health Honors Society (2010)
        Public Health Traineeship Award (NIH) (2010)
        Global Health Travel Grant (2009)
University of North Carolina at Chapel Hill, Gillings School of Global Public Health,
        Student Travel Award (2009)
University of North Carolina at Chapel Hill, Center for Global Initiatives
        Internship Award (2009)
University of Washington, Center for Experiential Learning and the Mary Gates
Endowment
        Leadership Scholar, Mary Gates Research Training Grant (2005)
        Research Scholar, Mary Gates Leadership Grant (2004)
University of Washington, College of Arts & Sciences
        Undergraduate Research Scholar, Research Scholarship (2004)

EXPERIENCE

Current positions

The Johns Hopkins University, Bloomberg School of Public Health, Baltimore, MD
Research Assistant, Department of Health Policy and Management, (2015-)
- Protocol design, instrument design for mixed methods study concerning oxytocin supply chain and quality control in Uganda and Kenya (Supervising Investigator: J.F.P. Bridges)
- Protocol design, instrument design for qualitative needs assessment of m/eHealth applications for drug development in South Africa and India (Supervising Investigator: J.F.P. Bridges)

Past positions

The Johns Hopkins University, Bloomberg School of Public Health, Baltimore, MD
Research Assistant, Department of International Health, Institute for International Programs (2014-2015)
- Instrument design, training and data collection for mixed methods study concerning governance preferences for community-level health provider programs in Morogoro, Tanzania (Supervising Investigator: S. Ozawa; Principal Investigator: A. Baqui)

Research Assistant, Department of International Health, Institute for International Programs (2013-2014)
- Secondary qualitative data analysis, provider perspectives on male involvement in antenatal and family planning counseling (Supervising Investigator: A. George; Principal Investigator: A. Baqui)

FHI 360 (formerly "Family Health International"), Durham, NC
Senior Business Development Officer, Business Planning and Proposals (2012-2013)
- Manage development of research and program proposals for human development funders, especially USG agencies, commercial funders and private foundations
- Facilitate inter-organizational teaming negotiations and collaborative discussions for new business development opportunities
- Facilitate annual country office new business planning cycle

Business Development Officer, Business Planning and Proposals (2010- 2012)
- Manage development of research and program proposals for human development funders, especially USAID and NIH
- Monitor and report business development activities to leadership and collaborating units

World Health Organization, Geneva, Switzerland
Intern, Department of Immunization, Vaccines and Biologicals, Immunization Policy
Unit (2009)
- Conducted a literature search on surveillance and epidemiology of pertussis burden, particularly in developing countries
- Conducted an evaluability assessment and drafted an evaluation plan of vaccine policy dissemination and uptake

University of North Carolina at Chapel Hill, Gillings School of Global Public Health, Chapel Hill, NC
Research Assistant, Department of Health Policy and Management (2008-2009)
- Conducted and documented interviews of key stakeholders in state-level rural health care organizations
- Assisted principal investigator in assembling investment options for rural health care funders in North Carolina

Fred Hutchinson Cancer Research Center, Seattle, WA
Project Coordinator, Molecular Diagnostics Program, Translational and Outcomes Research Group (2008)
- Administered career development and research development programs, leadership activities of an ovarian cancer research program
- Administered leadership activities of research consortium in gynecologic and women's cancers

Program Assistant, Fred Hutchinson Cancer Research Center, Molecular Diagnostics Program, Translational and Outcomes Research Group (2006-2008)
- Assisted principal investigator in administration of ovarian cancer research programs
- Prepared manuscripts and grant proposals for public and private funders, especially NIH and CDC
-
University of Washington, Seattle, WA
Undergraduate Researcher, UW-Sichuan Research Exchange Program (2003-2006)
- Conducted anthropological field work on medical systems available to and medical-decision making among Yi ethnic minority group in rural Sichuan province (Supervising Researcher: S. Harrell)

Children's Hospital and Regional Medical Center, Seattle, WA
Intern, Center for Children with Special Health Care Needs (2004-2006)
- Reviewed materials on congenital birth defects, developmental delays
- Led materials development focus groups
- Developed resource tools for care coordinators in Washington State

Consultations

Catholic Relief Services, Monitoring, Evaluation, Accountability and Learning Unit (2016-2017)
- Reviewed project documentation, developed qualitative instruments for Strengthening Capacity of Women Religious in Early Childhood Development (SCORE-ECD) Summative Evaluation
- Conducted interviews, focus group discussions, site observations and debriefings in Kenya, Malawi, and Zambia
- Analyzed findings and draft report evaluation report and results debriefing for CRS technical advisors and sponsor representatives (Hilton Foundation)

Catholic Relief Services, Monitoring, Evaluation, Accountability and Learning Unit (2015)
- Developed and adapted training sessions and relevant materials to increase knowledge and skills of qualitative methods for implementation science during weeklong internal workshop
- Provided relevant technical support to country research teams for successful development and design of research proposals

FHI 360, Business Planning and Proposals (2014)
- Provided short-term technical assistance and management support on the development of research and program proposals for human development funders, especially USG agencies, commercial funders and private foundations

PROFESSIONAL ACTIVITIES

Journal Articles
   Accepted
1. Brown L., Lee T, De Allegri M, Rao K, Bridges JFP. Applying stated-preferences methods to improve health systems in Africa: A systematic review. **Accepted to**: Expert Review of Pharmacoeconomics and Outcomes Research. 2017/09/01

   Published
1. Thorpe JD, Duan X, Forrest R, Lowe K, Brown L, Segal E, Nelson B, Anderson GL, McIntosh M, Urban N. Effects of Blood Collection Conditions on Ovarian Cancer Serum Markers. PLoS ONE 2007; 2(12): e1281.

Professional Papers
1. E Brooks, J Paul, GH Pink, A Radford, J Simms, L Brown, R Garr, A Howard, N Mathews, R Randolph and L Susswein. Rural Health and Economic Development in North Carolina: Options for the Golden LEAF Foundation, Report submitted to the Golden LEAF Foundation, January 2009.

TEACHING

Teaching Assistant

Qualitative Data Analysis (224.691.02) (5 credits) (Instructor: S. Harvey, P. Surkan):
   Term 4, Spring 2015
Health Systems Program Seminar (220.860.01) (1 credit) (Instructor: M. Merritt, D.
   Rodriguez): Term 4, Spring 2015
Health Financing in Low and Middle Income Countries (221.652.01) (3 credits)
   (Instructor: S. Ozawa, K. Rao): Term 3, Spring 2015
Doctoral Seminar in International Health II (220.606.01) (3 credits) (Instructor: J. Katz):
   Term 1 and 2, Fall 2014, Fall 2015
Doctoral Seminar in International Health I (220.605.01) (3 credits) (Instructor: J. Katz):
   Term 1 and 2, Fall 2014, Fall 2015
Introduction to International Health (220.601.81) (4 credits) (Instructor: H. Perry): Term
   4, Spring 2014

RESEARCH GRANT PARTICIPATION

Past:
FDA Enhancing Regulatory Science through a unique FDA-Academic partnership
("Project CURE") Grant No. 117301) ($100,000)
     10/1/15-9/30/16

Project C.U.R.E. (Collaborative Use Repurposing Engine: Using existing drugs in new
ways) is an innovative partnership between the FDA, Johns Hopkins Center for
Excellence in Regulatory Science and Innovation (CERSI) and emocha Mobile Health, to
develop a web-based application to be developed that will capture novel uses of existing
drugs to treat drug-resistant and neglected tropical diseases in the absence of established
safe and effective options. Johns Hopkins collaborators will conduct the qualitative needs
assessment and evaluation of prototype application in South Africa.

Project role: Research lead

USAID, Technologies for Health (T4H), No. AID-OAA-A-11-00050
  10/1/15-9/30/16

The Jhpiego ACCELOVATE Maternal and Neonatal Health team will assess the needs
and priorities of professional stakeholders via a facilitated decision-making exercise,
designed to support the identification of at least one priority oxytocin quality
intervention. The primary goal of the project is to generate national will, amongst high-
level stakeholders in Kenya and Uganda, to invest in high-quality, efficacious maternal
health commodities, and to facilitate the collaborative prioritization of potential oxytocin
quality solutions.

Project role: Research lead

PRESENTATIONS

Scientific presentations

Brown L, Lee J, Bridges JFP. "Stated-preferences methods applications in health in Africa: The how, the what, and the where." Podium presentation at International Choice Modeling Conference, April 3-5, 2017, Cape Town, South Africa.

Brown L. "Stated Preference Methods in Global Health" Panel presentation on "Integrating Private-Sector Tools Into Modern Global Health Initiatives" at Global Health Mini-University, George Washington University, March 4, 2016, Washington, D.C.

Brown L. "Cost-effectiveness of vaccination for the prevention of Haemophilus influenzae type b disease among young children in the People's Republic of China" Poster presentation of Master's papers from Department of Health Policy and Management, UNC Gillings School of Global Public Health, April 24, 2010, Chapel Hill, NC

Brown, L. "Cost-effectiveness of vaccination for the prevention of Haemophilus influenzae type B disease among infants and very young children in the People's Republic of China" Oral defense of Master's paper proposal as qualifying exam for the Department of Health Policy and Management, UNC Gillings School of Global Public Health, February 11, 2010, Chapel Hill, NC.

Brown L, Bryant K. "Cost-Effectiveness Analysis of Social Distancing and Pandemic Influenza A (H1N1) Vaccination among School-Aged Children in Thailand" Poster presentation at the UNC Gillings School of Global Public Health Office of Research Annual Spotlight on Student Research, March 25, 2010, Chapel Hill, NC.

Thorpe J, Forrest R, Scholler N, Nelson B, O'Briant K, Segal E, Lowe K, Brown L, and Urban N. "The Effect of Conditions of Blood Draw on Serum Markers Prolactin, MIF, and CA125" Poster presentation at the 3rd Annual Realizing the Promise: Canary Foundation National EDI Stakeholders Symposium, May 22-24, 2007, Stanford, CA

Brown L. "A Narrow Spiritualism: Health Care-Seeking on the Margins of Southwest China." Oral presentation at the 9th Annual University of Washington Undergraduate Research Symposium, May 19, 2006, Seattle, WA

Professional presentations

Brown, L. "Strengthening Capacity of Women Religious in Early Childhood Development (SCORE-ECD) Summative Evaluation" Results Debriefing for Conrad N. Hilton Foundation at Catholic Relief Services, January 11, 2017, Baltimore, MD

Hennigan M, Brown L, Schooley J, and Hathaway M. "What Does it Really Take: An Interactive Discussion on Integration from the User, Provider and Project Staff Perspectives" Facilitated discussion session at CORE Group Global Health Practitioner's Conference, October 8, 2015, Washington, DC