Abstract

Communities of Practice to Improve the Delivery of Contact Tracing for Tuberculosis by Community Health Workers: Antecedents and Mechanisms of Action

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2024

Background: Community health workers (CHWs) play a key role in expanding access to health services. Providing CHWs with high-quality and relevant training is critical to facilitate their performance. Communities of Practice (CoPs) are a low-cost implementation strategy to promote continuous learning. CoPs are groups of professionals with a common goal who meet regularly, support each other, share knowledge, and innovate solutions. CoPs have been used within the health field to promote the delivery of evidence-based care by healthcare workers; however, there are a few gaps in our understanding of their utility. For example, few studies have assessed the effectiveness of CoPs in improving clinical outcomes among the target patient population. Furthermore, the majority of CoPs in the healthcare setting have included physicians and nurses in high-income countries; additional work on how CoPs can be used for CHWs working in low-resource settings is warranted. There is also a need to determine how CoPs function to improve CHW performance, including antecedents that are required for CoPs to be established and mechanisms of action, in order to optimize their implementation. This dissertation aims to address these gaps by examining how CHW CoPs focused on improving delivery of contact tracing for tuberculosis (TB) function in Uganda.

Methods: The aim of Chapter 1 was to develop a conceptual model for how CoPs function in preparation for an upcoming stepped-wedge, cluster-randomized trial. Our research group

implemented a CoP including CHWs focused on providing home-based contact tracing services for TB in Kampala, Uganda. We conducted semi-structured interviews with all participants of the CoP to understand their experiences. I analyzed these interviews using abductive analysis, a qualitative technique for merging social science theory with empirical data. In order to test this conceptual model of how CHW CoPs function, I culturally adapted and validated relevant scales to measure these constructs during the stepped-wedge, cluster randomized trial of CHW CoPs in Chapter 2. Specifically, we adapted the 10-item General Self-Efficacy Scale through cross-cultural discussions within our multidisciplinary research team, translation from English into Luganda and back-translation into English, and six cognitive interviews with CHWs. We administered the adapted scale in a staged, two-part cross-sectional study, including a total of 147 CHWs. We evaluated the psychometric properties of the scale by conducting exploratory factor analysis, assessing convergent and discriminant validity, and calculating Cronbach's alpha. In Chapter 3, I conducted a convergent mixed methods study of a stepped-wedge, cluster-randomized trial of CHW CoPs to test self-efficacy and social support as mechanisms of action of CHW CoPs, as well as explore antecedents and additional mechanisms qualitatively. We used the validated scales from Chapter 2 to collect quantitative data on self-efficacy and social support before and after the CoPs were implemented. We used the product of coefficients approach to evaluate if self-efficacy and/or social support mediated the effects of the CoPs on the count of contacts completing TB evaluation. We also conducted focus groups four months after the CoP began and analyzed them using thematic analysis to explore antecedents and additional mechanisms of action.

Results: In Chapter 1, all eight CHWs in the CoP agreed to participate in the interviews. We found that the CoP functioned to enhance self-efficacy and social support among CHWs. For example, CHWs described that their weekly CoP meetings provided an opportunity to learn from their peers' successes and failures and receive support from each other, which enhanced

their confidence dealing with difficult situations in the field. In Chapter 2, we aimed to validate the General Self-Efficacy Scale to test self-efficacy as a mediator in the stepped-wedge, cluster-randomized trial. Exploratory factor analysis yielded a three-factor solution, which had good model fit (standardized root mean square residual=0.07) and explained 53.4% of the variance. We found evidence of convergent validity, as scores for the total scale were positively correlated with years of experience (r=0.48; p<.001) and perceived social support (r=0.39, p<.001). Scores were also higher among those with higher educational attainment in one-way analysis of variance and Bonferroni-corrected post-hoc tests (F[2,72]=9.16, p<.001). We also found evidence of discriminant validity, as scores for the total scale were not correlated with age (r=-0.07, p=.55), in agreement with literature showing that general self-efficacy is an age-independent construct. The internal consistency of the adapted scale was within the acceptable range for a pilot study (Cronbach's α=0.61). In Chapter 3, all 27 CHWs from the stepped-wedge, cluster-randomized trial agreed to participate in the surveys and focus groups. In the focus group discussions, we found that scheduling availability, external motivators (e.g., refreshments at the meetings), a champion, and a shared tool for defining their practice (i.e., feedback reports) were important antecedents of CHW CoPs. In the mediation analysis, neither CHW-reported self-efficacy nor social support were mediators of the relationship between the CoP and TB contact tracing completion (estimate=0.01, 95%CI: -0.06, 0.09, p=.81; estimate=0.04, 95%CI: -0.03, 0.14, p=.32; respectively). However, in the focus groups, CHWs did report perceiving improved collective efficacy, social support, and social accountability from the CoP, which enhanced their abilities and motivation to deliver home-based TB contact tracing. Thus, our findings suggested that CoPs may function by improving collective efficacy, rather than self-efficacy, and the quality, instead of the quantity, of social support.

Conclusions: This dissertation produces knowledge about how to design, implement, and

maintain effective CHW CoPs in low-resource settings. Other programs may use the results from this dissertation to inform the implementation of CHW CoPs in other similar settings. For example, these programs may wish to integrate a shared tool for defining the CoP's practice (e.g., feedback reports) and innovate ways for CHWs to easily convene in the field, such as through virtual meetings. CHW CoPs may also benefit from organizing opportunities to support each other in the clinic as well as the field, e.g., by creating a mobile group chat on a messaging platform, and establishing accountability structures for performance, e.g., through group audit-and-feedback.

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A Dissertation
Presented to the Faculty of the Graduate School
Of
Yale University
In Candidacy for the Degree of
Doctor of Philosophy

By
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May 2024

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Acknowledgments

During the past five years I have thought a lot about *community*, perhaps because my dissertation focused on *communities* of practice and *community* health workers, or because much of this work occurred during the pandemic, which completely transformed how we conceptualized, interacted with, and fought for *community*. When I think about how my communities have supported me throughout this process, I feel blessed beyond measure. To those in my scientific community based in the US and Uganda, to my family and friends, to my church community, thank you for helping me, challenging me, and making me belly-laugh throughout these years.

To my advisor, Dr. Luke Davis, thank you for welcoming me into your research group with warmth and kindness. In addition to training me in rigorous research methods, you have also served as a role model for how to be a thoughtful, effective, and patient leader, teacher, and mentor. It has been clear throughout this process that you not only care deeply about my research, but also my professional and personal growth, and for that I am incredibly grateful. You continually demonstrate how no act of kindness, no matter how small, ever gets wasted.

To Dr. Mari Armstrong-Hough, who was my first mentor at Yale, thank you for your contagious curiosity and fervor for truly understanding the meaning behind things seen and unseen. You have taught me the art of asking questions, which I will carry throughout my career as both a scientist and psychiatrist.

To my colleagues at the Ugandan Tuberculosis Implementation Research Consortium, thank you for welcoming me with ear-to-ear smiles. To Dr. Achilles Katamba, thank you sharing your expertise with me, in addition to your humor. Your leadership to promote the health of marginalized communities in Uganda is profoundly inspirational to me. To Dr. Patricia Turimumahoro, thank you for welcoming me to UTIRC with open arms. You have been an incredible example of how to lead a cross-cultural research team. To Leah Hans, thank you for teaching me, supporting me, collecting loads of data for me, and above all else, your friendship. It has been such an honor to watch your family grow over the past five years, and I cannot wait to welcome you all for a visit to the US. To Joseph Ggita, you have been an incredible teacher and mentor to me ever since I first visited Uganda in 2019. It has been a joy to work and laugh alongside you. To Emmanuel Ochom, thank you for your thoughtfulness, curiosity, and humor. To Johnson Musinguzi, thank you for your dedication and support to collect data critical to my dissertation questions.

To Dr. Laura Forastiere, thank you for teaching me not only about biostatistics, but also the importance of connecting with people. You inspire me to build out time for pursuits outside of academia that make life meaningful.

To Dr. Gregg Gonsalves, thank you for your unwavering advocacy. You have taught me that activism can take many forms, from advocating for national policy reform to promoting the career development of the students whom you work with. You have inspired me to integrate activism into my careers as both a scientist and psychiatrist.

To Dr. Michael Cappello, thank you for always centering my own career goals when considering my training plans. Your dedication to promoting the best interests of students does not go unnoticed.

To Dr. Barbara Kazmierczak, Alex Mauzerall, Kayla McKay, and everyone else in the Yale MD/PhD office, thank you for your patience, flexibility, guidance, and support throughout this process of integrating my MD and PhD training.

To Dr. Chris Tschudi and Melanie Elliot, thank you for responding to my many questions with clarity, patience, and reassurance (and in record time!); your dedication to training and supporting the next generation of public health researchers has been apparent throughout my time at Yale School of Public Health.

To Amanda Gupta, thank you for your dedication to conducting rigorous research. Your thoughtfulness in designing research studies, from data collection to analysis, is incredibly admirable.

To Drs. Marney White and Robb Pietrzak, thank you for your willingness to teach me about scale validation and providing your expertise in support of Chapter 2. Your openness to mentor me amidst the chaos of a pandemic is a testament to your dedication to students.

To my family, thank you for your unwavering support. To my mother, Julie, my guardian angel, thank you for your unconditional love and prayers. To my younger sister, Niveen, thank you for making me laugh so hard it hurts, and for helping me put out fires. To my older brother, Phillip, thank you for treating me, reminding me of my value, and always protecting me. To my older sister, Lauren, thank you for being a sounding board for all things medical and non-medical. To my sweet nephews, Ronan and Tyler, you give me so much joy and so many giggles; thank you for playing with me.

To my friends, thank you for being a home away from home. To Paula Arcaro, Sarah Moor, Marissa Justen, Sisi Zheng, and Sakura Oyama, thank you for laughing with me, crying with me, and listening to me; you each demonstrate the transformative power of women friendships. To my loving boyfriend, Tyler Brown, thank you for continuously searching for ways to support me, jokes to tell me, reasons to celebrate me, and food to feed me. To my community at Elm City Vineyard Church, thank you for your endless prayers and commitment to loving, serving, and connecting with people in New Haven. To Sang and Charmain Yun, thank you for your hospitality and wisdom.

To the many others who are left unnamed that have supported me, made me smile, and inspired me along the way, thank you for the light that you bring into our world.

Dedication

Our research team decided to call the intervention that is presented in Chapter 3 “Tuli Wamu Nawe,” which translates to “we are together with you” in Luganda. The logo for the intervention is showcased here, with two birds flying together towards the sun. When I was analyzing focus group discussions with community health workers, I was struck by one participant’s creativity to use this image to engage a patient in care. He shared:

“When you interact with that person [with tuberculosis] and tell him that these two birds are moving towards the sun, and you tell him that I can be one of those birds and you are the other bird, each is supporting the other. Let us become these birds, you help me and I do help you as well to be able to reach the sun, which is better health…I am together with you.”

This is just one of many stories that underscores community health workers’ commitment to partnering with patients to provide compassionate and evidence-based care to them.

I would like to dedicate my dissertation to all the community health workers who bring health services to people who need them most. Hearing the stories of how community health workers transform the lives of people they treat has inspired me to center compassion in my research and clinical pursuits.

Introduction

Tuberculosis (TB) is among the top 10 causes of death worldwide, and, before the COVID-19 pandemic, TB was the leading cause of death from a single infectious agent (1). In 2021, 10.6 million people became newly infected with TB and 1.6 million people died from TB, which increased from 10.1 million people and 1.5 million people, respectively, in 2020 (1). Contact tracing is an important evidence-based strategy to decrease the global burden of TB. During contact tracing, health workers screen and evaluate close contacts of new TB patients to find and prevent TB cases and prevent TB transmission. A meta-analysis of contact tracing for TB, including 244 studies, found that the prevalence of active TB and latent TB among close contacts were 3.6% and 42.4%, respectively, confirming that the contacts of people with TB are at high-risk for acquiring TB (2). In randomized controlled trials, contact tracing decreased mortality and the prevalence of TB in the community (2). Given this evidence, one of the three pillars that the World Health Organization (WHO) outlines in their End TB Strategy includes "systematic screening of contacts and high-risk groups" (1). Specifically, they recommend increasing contact tracing coverage to ≥90% as part of its End TB Strategy (3).

Uganda is among the 30 high TB burden countries (1). In 2021, the incidence of TB in Uganda was 199 per 100,000 people, and the TB case fatality ratio was estimated to be 14% (4). The Uganda National TB and Leprosy Programme (NTLP) provides TB evaluation and treatment services in public health centers free of charge. In 2013, the NTLP began offering home-based TB contact tracing as a routine service in the country's capital of Kampala to address barriers related to the centralization of contact tracing services to health centers (5). Yet, the TB treatment success rate in Uganda was 85% in 2021 (4), below the WHO target minimum success rate of 90% (6, 7). Thus, investment in programs and human resources to

promote the uptake of TB evaluation and treatment in the community is critical to decrease the burden of TB in Uganda.

Community health workers (CHWs) increasingly play an important role for national TB programs in expanding access to TB services in the community. CHWs do not have formal health professional education; rather, they are members of the community who receive training related to specific health services (8). The Millennium Development Goals recommend mobilizing CHWs as a feasible strategy for improving community health in areas with limited access to health professionals (9). In Kampala, Uganda, CHWs provide TB treatment adherence support and deliver contact tracing in the community (10).

CHWs face barriers to accessing relevant in-service training, inhibiting their delivery of high-quality contact tracing services. Our research group previously found that only 20% of high-risk contacts were evaluated for TB in full by CHWs in Uganda (11), far below the WHO target of ≥90% (3). Similarly, only 35% of contacts were successfully evaluated for TB by CHWs in South Africa (12). Although these programs provided CHWs with training on how to deliver these services, systematic reviews have identified that CHWs face barriers to accessing relevant and continuous in-service training, which negatively impacts their delivery of high-quality services (8, 13).

One approach to facilitate CHW training and improve the quality of health care delivery is to implement Communities of Practice (CoPs). CoPs are groups of professionals with a common goal who meet regularly, support each other, share knowledge, and innovate solutions (14, 15). In their original studies among West African tailors, Lave and Wenger (1991) developed CoP theory to describe the organic learning that occurs among tradespersons and other professionals-in-training (15-17). They theorized that the learning that happens within CoPs occurs through social interactions within the specific context where the task is meant to be performed (15, 16). CoPs have been used to improve organizational performance within the trades, business sector, and health field (14, 15, 17-20). In the trades, CoPs have been

established with the goal of developing competent tradespersons through interactions between novices and experts (21, 22). Within the business sector, CoPs have been used to improve job performance in a variety of organizations, from insurance businesses to technology firms (23-25). Within the health field, CoPs have been established to train healthcare students, share knowledge among practicing healthcare workers, and facilitate uptake of evidence-based practices (20, 26-41). Empirical studies of CoPs in these sectors identified that they help participants develop their professional identities; improve their work-related knowledge, confidence, and performance; increase social capital; and enhance their social status (21, 22, 27, 30, 31, 35, 36, 38, 40-42). Although CoPs have been increasingly described in the health care setting (14, 19, 43) and have been applied to improve the implementation of evidence-based practices by healthcare workers (19, 44), the majority of CoPs in the health sector have been conducted in high-income countries among physicians and nurses (14, 19, 20, 43, 45). Additional studies are needed to understand opportunities for CoPs to facilitate health care delivery by CHWs in low-income countries (46), such as Uganda.

Rigorously evaluating how CoPs improve, or fail to improve, clinical outcomes can inform how to use CoPs to facilitate the work of CHWs. For health systems to optimize the implementation of effective CoPs, systematic reviews describe a need to determine how CoPs function to improve performance (19, 44). Social scientists have postulated that CoPs increase their participants' self-efficacy, defined as their confidence in performing a target behavior, thereby improving their performance of that behavior (15, 47). For example, a program that implemented a CoP focused on pediatric care in Canada found significantly increased self-efficacy among healthcare workers post intervention (48). However, the researchers did not evaluate if improvements in healthcare worker self-efficacy led to improvements in the delivery of evidence-based care. Systematic reviews of CoPs have highlighted the need for studies to evaluate how CoPs impact both healthcare workers and the delivery of evidence-based care to optimize their effectiveness (14, 19, 20).

This dissertation aims to address these gaps in knowledge of how CHW CoPs function in low-resource settings. In Chapter 1, I developed a conceptual model for how CoPs function based a pilot study of a CoP including CHWs providing home-based contact tracing services for TB in preparation for an upcoming stepped-wedge, cluster-randomized trial. I analyzed semi-structured interviews with CHW participants to explore their experiences in the group. I analyzed the interviews using abductive analysis, a qualitative technique for merging social science theory with empirical data (49, 50). I found that the CoP functioned to enhance self- efficacy and social support among CHWs. For example, CHWs described that their weekly CoP meetings provided an opportunity to learn from their peers' successes and failures and receive support from each other, which enhanced their confidence dealing with difficult situations in the field.

In order to test this conceptual model of how CHW CoPs function, I culturally adapted and validated the General Self-Efficacy Scale for use among Ugandan CHWs in Chapter 2. We adapted the 10-item General Self-Efficacy Scale through cross-cultural discussions within our multidisciplinary research team, translation from English into Luganda and back-translation into English, and six cognitive interviews with CHWs. We administered the adapted scale in a staged, two-part cross-sectional study, including a total of 147 CHWs. We evaluated the psychometric properties of the scale by conducting exploratory factor analysis, assessing convergent and discriminant validity, and calculating Cronbach's alpha. Our evaluation of the Uganda-adapted General Self-Efficacy Scale demonstrated promising psychometric properties and was suitable to collect longitudinal self-efficacy data among CHWs throughout the stepped-wedge, cluster-randomized trial.

In Chapter 3, I conducted a convergent mixed methods study of a stepped-wedge, cluster-randomized trial of CHW CoPs to test self-efficacy and social support as mechanisms of action of CHW CoPs, as well as explore antecedents and additional mechanisms qualitatively. We used surveys to collect quantitative data on self-efficacy and social support before and after

the CoPs were implemented. We used the product of coefficients approach to evaluate if self-efficacy and/or social support mediated the effects of the CoPs on the count of contacts completing TB evaluation. We also conducted focus groups four months after the CoP began and analyzed them using thematic analysis. We found that scheduling availability, external motivators (e.g., refreshments at the meetings), a champion, and a shared tool for defining their practice were important antecedents of CHW CoPs. In our mediation analysis, neither CHW-reported self-efficacy nor social support were mediators of the relationship between the CoP and TB contact tracing outcomes. However, in the focus groups, CHWs did report perceiving improved collective efficacy, social support, and social accountability from the CoP, which enhanced their abilities and motivation to deliver home-based TB contact tracing. Thus, our findings suggested that CoPs may function by improving collective efficacy, rather than self-efficacy, and the quality, instead of the quantity, of social support.

This dissertation produces knowledge about how to design, implement, and maintain effective CHW CoPs in low-resource settings. Characterizing how CHW CoPs affect, or fail to affect, contact tracing using mixed methods can produce knowledge on antecedents and mechanisms of action of CoPs that can be leveraged to optimize clinical outcomes (51-53).

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Chapter 1: Core components of a community of practice to improve community health worker performance: A qualitative study

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This manuscript has been previously published as:

Hennein, R., Ggita, J. M., Turimumahoro, P., Ochom, E., Gupta, A. J., Katamba, A., Armstrong-Hough, M., & Davis, J. L. (2022). Core components of a Community of Practice to improve community health worker performance: a qualitative study. *Implementation science communications*, *3*(1), 27. https://doi.org/10.1186/s43058-022-00279-1

1.1 Abstract

Background: Communities of Practice (CoPs) offer an accessible strategy for healthcare workers to improve the quality of care through knowledge sharing. However, not enough is known about which components of CoPs are core to facilitating behavior change. Therefore, we carried out a qualitative study to address these important gaps in the literature on CoPs and inform planning for an interventional study of CoPs.

Methods: We organized community health workers (CHWs) from two tuberculosis (TB) clinics in Kampala, Uganda into a CoP from February to June 2018. We conducted interviews with CoP members to understand their perceptions of how the CoP influenced delivery of TB contact tracing. Using an abductive approach, we first applied inductive codes characterizing CHWs' perceptions of how the CoP activities affected their delivery of contact tracing. We then systematically mapped these codes into their functional categories using the Behavior Change Technique (BCT) Taxonomy and the Behavior Change Wheel framework. We triangulated all interview findings with detailed field notes.

Results: All eight members of the CoP agreed to participate in the interviews. CHWs identified five CoP activities as core to improving the quality of their work: (1) individual review of feedback reports, (2) collaborative improvement meetings, (3) real-time communications among members, (4) didactic education sessions, and (5) clinic-wide staff meetings. These activities incorporated nine different BCTs and five distinct intervention functions. CHWs reported that these activities provided a venue for them to share challenges, exchange knowledge, engage in group problem solving, and benefit from social support. CHWs also explained that they felt a shared sense of ownership of the CoP, which motivated them to propose and carry out innovations. CHWs described that the CoP strengthened their social and professional identities within and outside of the group, and improved their self-efficacy.

Conclusions: We identified the core components and several mechanisms through which CoPs may improve CHW performance. Future studies should evaluate the importance of these mechanisms in mediating the effects of CoPs on program effectiveness.

1.2 Introduction

Sub-optimal healthcare worker performance is a major barrier to delivery of high-quality health services in low- and middle-income countries (1-3). This barrier is particularly salient for community health workers (CHWs), who have limited formal health professional education and access to training in low-income countries (4). While many quality improvement initiatives include training to improve healthcare worker performance, a systematic review of such strategies found that training was associated with only moderate improvements in performance. When combined with group problem solving, however, large improvements were observed (3). Furthermore, a Cochrane qualitative evidence synthesis concluded that providing continuous education and enabling CHWs to share their experiences with peers facilitated their work (5).

Communities of Practice (CoPs) offer a promising mode of delivery for continuous group learning and problem solving (6). Communities of Practice (CoPs) are groups of people with a common work objective who meet regularly to support each other, share and create knowledge, and explore innovations (6, 7). In their original studies among West African tailors, Lave and Wenger (1991) developed CoP theory to describe the organic learning that occurs among tradespersons and other professionals-in-training (6-8). They theorized that the learning that happens within CoPs occurs through social interactions within the specific context where the task is meant to be performed (6, 7).

CoPs have been used to improve organizational performance within the trades, business sector, and health field (7-11). In the trades, CoPs have been established with the goal of developing competent tradespersons through interactions between novices and experts (12, 13). Within the business sector, CoPs have been used to improve job performance in a variety of organizations, from insurance businesses to technology firms (14-16). Within the health field, CoPs have been established to train healthcare students, share knowledge among practicing healthcare workers, and facilitate uptake of evidence-based practices (17-32). Empirical studies

of CoPs in these sectors identified that they help participants develop their professional identities; improve their work-related knowledge, confidence, and performance; increase social capital; and enhance their social status (12, 13, 18, 21, 22, 26, 27, 29, 31-33).

Wenger (2002) describes three fundamental elements of CoPs: (1) *domain* (i.e., the subject of shared interest), (2) *community* (i.e., the social interactions and relationships among members), and (3) *practice* (i.e., the frameworks, ideas, tools, language, documents, and stories that members share) (34, 35). Previous studies have provided empirical data that support these three characteristics. For example, studies have highlighted that consistent participation of members during CoP activities is vital to foster social interactions and build a *community* (28). These social interactions cultivate group trust, mutual respect, and confidence to share their ideas and experiences without fear of being judged, which is critical for negotiating the group's purpose and goals (i.e., *domain*) (14, 19, 33). Furthermore, providing opportunities to interact with mentors and peers during and outside of work is important to develop shared frameworks, language, and tools to accomplish group goals (i.e., *practice*) (12, 13, 18, 36-38).

Despite this mounting evidence of the potential for CoPs to improve healthcare worker performance, there remain a few critical gaps in the literature pertinent to CHW CoPs in low-income countries. First, the majority of studies on CoPs have taken place in high- and middle-income countries, and additional exploration of CoP functioning in low-income countries is warranted given differences in culture, education systems, and health systems (10, 11). Furthermore, empirical evaluations of CoPs including CHWs are sparse, as the majority focus on nurses and physicians (10, 11). Thus, additional exploration of how CoPs function for lay healthcare workers who do not receive formalized health professional education is needed. While previous studies have focused on identifying the key elements of CoPs in healthcare, few have investigated the intervention components that elicit behavior change (10, 11, 39). Identifying the core intervention components of CoPs (also known as the "active" components) that elicit behavior change could enable researchers and implementers to design them for

continuous quality improvement (40, 41). Because the concept and theoretical understandings of CoPs are still evolving (8, 9, 42), applying behavioral theory to data collected in empirical studies of CoPs could improve our understanding of when, where, how, and under what conditions these groups can be engineered to change behavior (39, 43). For example, the Behavior Change Technique (BCT) Taxonomy and the Behavior Change Wheel framework provide comprehensive approaches to cataloguing the core components of complex health interventions in order to design and implement strategies that optimize outcomes (44, 45).

To address these gaps in the literature, we performed a qualitative study to identify the core components of a CHW CoP formed to improve tuberculosis (TB) contact tracing in Kampala, Uganda. Through semi-structured interviews and field notes, we aimed to explore CHWs' experiences participating in the CoP and determine the extent to which the CoP was acceptable, feasible, and effective in facilitating delivery of contact tracing. We analyzed qualitative data using the BCT Taxonomy (45) and the Behavior Change Wheel's intervention functions (44). In so doing, we aimed to identify behavioral mechanisms to describe how CoP activities function to improve CHW performance in low-resource settings.

1.3 Methods

Setting

Uganda has a high TB burden, with an annual incidence rate of 201 cases per 100,000 and an annual mortality rate of 26 deaths per 100,000 (46). In Kampala, TB services are provided free of charge through the Uganda National TB and Leprosy Program (NTLP) and the Kampala Capital City Authority. CHWs support clinic-based health workers in delivering TB services, with funding and technical assistance from non-governmental or research organizations partnering with the NTLP. TB CHWs in Kampala receive on-the-job training specific to delivering TB services in the community, and are supported through supervision by TB clinic leaders. CHWs are responsible for community-based treatment adherence support