Supplementary File 3. Framework analysis key finding: Multilevel perceived barriers to and facilitators of CHWs' effectiveness

Levels of determinate of CHWs engagement		**Key theme**	**Sub-themes**
Individual	Perceived Barriers to CHWs effectivenes s	**Lack of competence**	**Knowledge and skill gap:** CHWs have low satisfaction on the limited trainings content and quality. Due to the lack of appropriate knowledge and skills, CHWs are not adequately providing delivery services, using and analyzing the data from RapidSMS and supporting children with disability.[48,49,50,51,54,55] *"What needs to be improved is the use of the data we are collecting. Health facility staff and everyone who has access to RapidSMS should be trained on data analysis so that they can benefit from the system and know what type of information is provided by the system." (Musabyimana et al., 2018, p7)*[48] *"I am feeling bad because I don't know how to help the child." (Naidoo et al., 2019, p6)*50 **Lack of motivation:** CHWs are demotivated because of their inadequate training and perceived incompetence. The lack of motivation may increase turnover rate among CHWs and their performance. Some of the reasons for low motivations include lack of training for upgrading and refresher, lack of regular supportive supervision, and insufficiency and delay of incentive.[48,49,50,54] *"Even if we get education opportunity and make improvements in our level, there is no difference to me. Because the HEW who upgrades her*

			status will again be assigned in the [same] kebele, no transfer is given to her, just as if she had not joined the school." (Kok et al.,2015, p7)[54]
	Perceived Facilitators of CHWs effectivenes s	**CHWs empowerme nt**	**Continuous training and professional development strategy:** *Continuous training and* professional development empowers CHWs by raising their competency, job satisfaction and work outcomes. It also helps to communicate updated MCH information, map, link and monitor pregnant women and child health.[50,51,53] **Mobile technology access and use:** CHWs are very pleased to use technology to communicate with pregnant women and mothers, peers, supervisors and health systems to monitor and communicate with pregnant women, share new data and information timely and efficiently from distance.[48,55] *"…Through the collaboration between the health facility and CHWs and the information shared with RapidSMS, once the mother is reminded and attends the needed service on time, providers are motivated to do their best to keep the newborn and the mother alive" (Mwendwa,2016, p8)*[55] **Positive attitude:** CHWs like their jobs and responsibilities and are willing to provide the MCH services for their community. Positive attitude among CHWs towards their work is important for the service provider and receivers of care.[48,48,50,54]
Interpersona l	Perceived Barriers to CHWs effectivenes s	**Lack of collaboratio n**	**Weak teambuilding:** There is a weak supportive team approach, poor interprofessional collaboration skills between CHWs, health service providers and other health system actors toward common goals.[49,50,51,56] *"What makes us not work hard is, when the woreda health office comes for supervision, they leave our strong parts and take very minor things and discourage us due to those things." (Kok et al.,2015, p7)*[54] **Weak communication strategies:** Absence of effective interpersonal communication strategies in both personal and professional settings.

			Absence of effective interpersonal communication may increase stress, decreases wellness, and therefore, impacts overall quality of life and work outcome.[50,51,56] The technology is not well suited to local language and culture yet. *"The response sometimes comes in English; I have to look for a translator" (Mwendwa, 2016)* [55]
	Perceived Facilitators of CHWs effectivenes s	**Interpersona l effectiveness**	**Interpersonal Trust:** There is a mutual trust between CHWs and the community, therefor they serve as a bridge to link the community and health system. CHWs are enthusiastic about providing related services, pregnant women and their families are willing to listen to the CHWs and to respond to referral. [49,51,54],[52] **Supportive supervision:** CHWs have positive attitudes towards supportive supervision, as it is an opportunity for constructive feedback, mentoring and motivation.[54,56] "Our supervisor has been there since we started this program. Like sometime back when we had challenges, she would be the one calling CHWs directly... For everything we are to do, she is always leading us and steering everything. To me she has supported us and done almost everything for us" (Ludwick et al.,2018, p6)[56]
Community	Perceived Barriers to CHWs effectivenes s	**The Socio-cultural influence**	**Cultural beliefs and practices:** Pregnancy and newborn are surrounded by many cultural beliefs and traditional practices. The influence of culture affects the perceptions of human reproductive health, and how pregnancy, delivery and childbearing are experienced; and where they seek help for service. *"She was fearful and thought the doctors would do an operation forcefully. She started labour at home and had antepartum haemorrhage. Luckily, she was taken to Adwa Hospital where she had a normal delivery " Jackson et al.,2016, p 475)* [52]

			In some cases, the women prefer to give birth at home assisted by TBAs, and never called CHWs during labour or birth.[49,50,52] *"People say 'the known devil is better than the unknown God', and the people believe in them [TBAs]. We also communicate with the TBA, because the TBA is more popular than me in the kebeles, so I use her to contact women." (Kok et al.,2015, p7)[54]* **Gender prejudice**: *Gender* refers to the sociocultural constructed characteristics of women and men, such as norms, roles and so on. Gender may sometimes restrict access to MCH services. The community has low interest and trust on health center service due to low interest to be seen by male health workers and fear of Caesarean Section. Community members reported that CHWs being female (gender aspect) was important to them, as they prefer to discuss maternal health issues amongst women.[54,52]
	Perceived Facilitators of CHWs effectivenes s	**Institutionali zation of community engagement**	**Community participation:** Community ownership can be developed through engaging the various social structures that exist in the community, like the existing community institution, associations, and TBAs while planning, implementing and monitoring community health/MCH intervention to enhance ownership and access culturally competent MCH services.[49,52,54] *"We have the pregnant women's forum with tea and coffee to discuss maternal health with them. This is not considered by other health offices, but we have taken the time in the forums to increase their participation and to discuss maternal health so that we help them and support them financially…" (Kok et al.,2015, p4)[54]* *"They(community) help us very well during the vaccination mobilization period." (Kok et al.,2015, p8)[54]* **Culturally relevant health access:** CHWs capitalized on social networks to identify pregnant women who would become new clients, learn about

			births and child health. Local community associations/ health development army can make health services more culturally acceptable and influence women's decisions to trust health centers for delivery and other MCH services. Once trust is established, pregnant women and their families would be willing to listen to the CHWs and to respond to referral[49,52,54]. "*At the health post, they can tell us their secrets like a sister—they can't talk about these things to people they don't know." (Jackson et al.,2016,p 475)* [52] *"As I told you, at first the community members used not to value the CHWs; these days it is the community that explains to those who are hesitant to get the service from us, our importance as CHWs has improved and people who have sick children also come to seek advice from us, which was not the case before."(Okuga et al., 2015,p4)*[49]
Health system and Logistic	Perceived Barriers to CHWs effectivenes s	**Fragile health and logistics system**	**Fragmentation of empowerment of CHWs program:** Fragmentation of empowerment of CHWs program is the insufficient and lack of continuity of coordination, training and professional development strategy, motivation strategies, referral policy/system and supportive supervision that can directly or indirectly affect the MCH service accessibility and health outcome. Some of the descriptions are as follow: **Fragmented coordination of CHWs:** There is lack of coordination on planning and monitoring between different level health actors.[51,54] *"… When we plan to teach mothers or want to have community conversations, the woreda health office may tell us to do other activities like vaccination campaigns." (Kok et al., 2015, p7)*[54] **Fragmented training and professional development strategy:** There is no standard on the content and the quality of the basic and refresher

			training, the service they provide and the community they serve in different countries of CHWs/MCH programs.[48,49,54,55,56] *"What needs to be improved is the use of the data we are collecting. Health facility staff and everyone who has access to RapidSMS should be trained on data analysis so that they can benefit from the system and know what type of information is provided by the system." (Musabyimana et al 2018, p.7)*[48] **Inconsistent motivation strategies**: The motivation approach is not regular and sufficient. Financial and non-financial incentives and intrinsic motivation are key to job performance and satisfaction.[48,49,50,53,54] **Fragmented /poor referral policy/system:** CHWs experience poor referral system between CHWs and local health facility, lack of referral forms, feedback, and documentation/ lack of registers. Despite the poor referral system, there is a disparity in service provision among rural and urban community once they reach the health facility and delay for service.[50,51,52,54] *"I sent there a mother for delivery, but reaching [the health unit] it was around 5 pm; she couldn't receive the services ... She had to go to another health facility and she later came up to [the district hospital]."(Okuga et al., 2015, p6)*[49] *"The basic thing we have to consider is a woman should not die giving birth. Sometimes even death can happen in a health center. I knew a woman died ..., because the health center didn't refer her to the hospital as early as possible." (Kok et al., 2015, p. 7)*[54] **Fragmentation of supportive supervision:** There is no regular supportive supervision, evaluation and feedback mechanism.[48,54,55]

			Logistics and basic supply/resource challenge: CHWs experience challenges of transportation and distribution of essential medical devices to undertake their work, limited access to ambulance service; lack of materials for the job, absence of health facility in the neighborhood and the like. [49,51,52,53,54,55] *"One woman started her labour at home and called me. I called the ambulance and we waited on the road, but the ambulance had gone somewhere else. The woman delivered on the roadside…"(Jackson et al., 2016,p 475)* [52] *"Equipment are not yet available. . . We need the right equipment to take measures from pregnant women and children. For example, we need instruments to measure the height and weight of pregnant women because those measures were not taken at the health facility. . .. We also need thermometers to measure temperature." (Musabyimana et al., 2018, p.6)*[48]
	Perceived Facilitators of CHWs effectivenes s	**Integration and Technology**	**Integration of CHWs into health systems:** This describes interconnecting different levels of health system service, supply chain, data sources for better health access and outcomes. This includes strengthening links among CHWs, health facility and drug dispensing outlet collaboration to improve supply chain, service quality/ continuum of care system.[49,51,52] "Now the community recognizes us because in the past we were only providing service to specific program, but now we are dealing with almost every health system" (Dillip et al., 2017, p6)[51]

			Digital initiatives: It is an initiative of integrating technology into CHWs programs to enhance MCH service outcome and information access. Mobile health/ mHealth like RapidSMS supported CHW programs have been demonstrating increased CHW performance and improved MCH outcomes. RapidSMS is helping in resolving location, information, context and time challenges.[48,55] *"RapidSMS has helped a lot to prevent maternal, child and neonatal death. ... the information shared with RapidSMS, once the mother is reminded and attends the needed service on time,…" (Musabyimana et al., 2018, p.5)*[48]