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# An ICT-enabled community oriented primary care intervention in mining communities during COVID-19 (2019–2022): perceived changes in the role and place of community health workers

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## Abstract

**Background** This is a study of service provider perceptions of the place, role and practices of CHWs in a four-year, large-scale private sector funded, public service ICT-enabled COPC intervention with rural and remote mining communities. Like all South African communities, apart from large mining house employees and some contractors, most people use available public healthcare services and private traditional as well as limited allopathic private sector providers. In addition to the limitations of facility centred primary healthcare and a fragmented health care system, the many negative health effects of mining on the communities, go unattended.

**Methods** This is a rapid, qualitative pragmatic study. Using site and participation convenience sampling, 37 semi-structured individual or group interviews were conducted with 57 stakeholders from 38 of the 135 intervention PHC facilities. Using a data driven, inductive approach, the results were analysed thematically in terms of perceived changes in the role and place of CHWs.

**Results** CHWs registered 42 490 households and captured the demographic and social profiles as well as the health status of over 154 910 individuals using AitaHealth™. These data provided healthcare professionals and managers with knowledge about community demographics, at-risk groups and vulnerable individuals. The intervention changed the locational focus of CHW practice and expanded their scope of work and competencies in household comprehensive health education, advice and care. It led to a growth in community and professional confidence in CHWs as trusted members of mining community PHC teams and to more focused and efficient clinic work.

**Conclusion** This ICT-enabled COPC intervention adopted a comprehensive approach to healthcare delivery that started by including CHWs in PHC teams and locating them in communities. Inclusive and systematic continuous learning, clinically-led CHW service support and ICT-enabled information technology engendered trust in CHWs as competent PHC members, and grew community confidence in them and the PHC system as a whole. Although

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health, care and other professionals and workers valued the changes the intervention brought to their work as well as people's lives in underserved and vulnerable mining communities, its sustainability is contingent on the vagaries of political will and financial commitment.

**Keywords** Community health workers, ICT-enabled COPC, Remote/rural, Underserved, Primary healthcare

## Background

The bifurcations of health care in South Africa play out in mining communities in a complex way. Like all communities in the country, they are recipients of public health services that are a constitutional right and a legal entitlement. These are delivered in a tiered hierarchy where primary health care (PHC) is figuratively and in practice at the bottom of the system [1]. Rendered as a free basic service through 3 477 fixed clinic facilities across the country's 52 health districts, it is ubiquitously used as the sole or main point of first call for allopathic health care by most of the population. This said, PHC is compromised by inadequate infrastructure and equipment, extensive understaffing, variable and insufficient clinical capacity and inadequate management. In 2015/2016 in four of seven provinces where there is mining, nearly half or more of public primary care clinics were without a dedicated manager [2, 3]. In addition, all regulated mines provide PHC and occupational health for mine workers and contractors, with a special focus on human immunodeficiency virus/ acquired immunodeficiency syndrome (HIV/AIDS), tuberculosis (TB) and silicosis as well as medical surveillance for mine employees where mines have their own facilities. The Minerals Council's three yearly study of 74% of mine workers found that nearly all permanent workers (97,4%) and over half of contract workers (54,5%) were covered in 2015 [4].

As elsewhere in the country, people in mining communities also buy private health care through ad hoc out-of-pocket payments and /or health insurance schemes towards which those in salaried employment contribute fully or in part, with their employers. Private sector services are rendered by some 22 975 registered medical practitioners [5] operating in their own private practices and as part of hospital groups. Of these groups, three hold 83% of beds and see 90% of admissions [5]. These services are unevenly distributed across the provincial and remote/rural/urban divides [6].

In addition, the larger mining houses have service level agreements with private hospitals, specialist networks, emergency medical response teams and provincial and district health services [7]. In 2015, in-patient hospital care was available to 90,7% of employees and 38,3% contracted workers and 61% of employees had medical aid [4].

Mining has many negative health effects on the communities that grow around mines. These include (1) water, noise and dust pollution that directly affect human

health; (2) the disruption and/or loss of cultivation, herding and fishing that impacts livelihoods and food security; (3) the physical, social and mental risks from destabilisation of dwellings, animal shelters and other infrastructure; (4) as well as death and injury from road accidents, increased risk of various forms of pneumoconiosis, HIV/TB and other communicable diseases [6]. Although large companies try to address some of their needs through supportive health and social development projects, they do not make mine health facilities and services open to neighbouring communities. Additionally, although theoretically miners and their dependents are eligible for compensation for disease and injury, there is no screening or track-and-trace system in place to conduct regular medical benefit examinations of ex-mine workers who have returned to their homes and families [8].

Community health workers (CHWs) are deemed to be an essential component of contemporary human resource strategies to achieve universal healthcare [9, 10].

In South Africa, PHC reengineering (rPHC) reform to introduce ward-based outreach teams (WBOTs) was the first national attempt to formally integrate community health and care workers into the public primary health system. Intended to address a passive, low quality service overwhelmed by emerging epidemics and rising demand, rPHC implementation in National Health Insurance (NHI) pilot sites in seven provinces was widely welcomed and enthusiastically embraced even in the face of uncertainty about its actual operationalisation. As elsewhere, the reform floundered on conceptual and implementation flaws, including absence of dedicated funding, poor planning, poor system preparation and integration, unclear functional authority and jurisdiction, inadequate training, poor pay and working conditions, a lack of clinical guidance, policy inconsistency and political ambivalence [11–14].

Nevertheless, rPHC also created opportunities to develop planning scenarios and develop and apply information and communication technology enabled community oriented primary care (ICT-enabled COPC) in defined places as a way of rendering 21st Century quality comprehensive PHC that extends from people in their homes to and from fixed clinics and hospitals [1, 13, 15].

COPC is an internationally recognised approach to PHC. Developed in the 20th century to meet the health care needs of poor, underserved and excluded populations, it remains an appropriate 21st century system response to the health challenges that continue to afflict

millions of individuals, families, communities and societies [16]. The principles that guide COPC draw from the best available understanding and practice of inclusive PHC, namely geographically based, comprehensive generalist care that combines practice with science delivered through services that are equitable and integrated around users [17, 18].

Using the enabling and integrative potential of 21st century information and communication technology, teams and individual health workers are supported by a mobile device and web linked ICT platform called AitaHealth™. AitaHealth™ is a bespoke community care management solution, proprietary to the University of Pretoria developed in partnership with Mezzanine and Vodacom™. The use of AitaHealth™ as part of the COPC initiative is designed to assist quality care, support CHW learning and decision making, optimise human resource management and support management decision-making by ensuring real-time data reporting. The mobile/web intervention also monitors CHW and patient/patient family interactions during household visits. It has successfully been used by South African rPHC community based teams and CHWs in all districts in Gauteng (2014–2022), as well as in the City of Tshwane (2014–2018), in three districts in the Free State (2017–2018), in one and then three districts in Mpumalanga (2017–2018, 2019–2020 respectively), and in three districts in North West Province (2020–2022) [19]. As elsewhere, the use of AitaHealth™ as part of the COPC initiative in mining and other communities was designed to support CHW learning and decision making, optimise human resource management and support management decision-making by ensuring real-time data reporting and performance monitoring of CHW and patient/patient family interactions during household visits.

The effective delivery of health care services, irrespective of the approach, requires the continuous development of capacity. In the ICT-enabled COPC model developed by the University of Pretoria, this is achieved through “a capability approach to learning that is structured into the service pathway through information technology as well as organised curriculum in order

to continuously develop the individual and collective capacity of healthcare providers.” [18] Programmatic work integrated learning (WiL), was introduced with the objectives of providing, deepening and broadening medical and technical information, skills and competencies (e.g. treatment of common minor injuries, techniques of growth measurement, etc.) as well as to develop, deepen and broaden social, communication and ethical skills (e.g. building relationships, what is confidentiality, what is professional behaviour, how to listen, how to take notes, get informed consent, establish respect and mutual expectations, etc.). In this intervention, systematic learning covering 10 topics was delivered in a cascade model at all participant PHC centres. Facilitated by Clinical Associates (ClinAs) and the COPC Research Unit (University of Pretoria), outreach team leaders (OTLs), operational managers and some CHWs underwent master training in COPC and AitaHealth™. They then facilitated the same training to the CHW teams at their respective PHCs over four weeks as part of continuous weekly WiL sessions. This process was repeated until all COPC topics were covered. Additionally, there was on going ad hoc training within communities and with various stakeholders.

The intervention was undertaken over four years (2019–2022) during the Coronavirus disease (COVID-19) pandemic. CHWs worked in teams in defined geographic areas. Within these, each CHW was assigned 150–200 households. After being trained and assessed in COPC and the use of AitaHealth™ they visited, registered and did social and health status assessments with each household.

**Scale and scope**

In terms of scale, the results reported here come from an intervention undertaken over four years (2019–2022) during the COVID-19 pandemic. It involved 135 public primary healthcare clinics, 100 ClinAs and 1769 CHWs in 13 districts across five South African provinces (Table 1). Of the ClinAs, 35 worked solely on CHW training and clinical support at household level. All ClinAs were employed by the project and all CHWs transitioned from non-governmental to public health employment [20].

In terms of scope, in general, the intervention involved engagement with mining and public health officials and stakeholders, training of all participants in COPC as an approach, and CHW and team leader implementation training on how to do COPC, reporting, using AitaHealth™ for data collection, service support and intervention monitoring. The last included training CHWs on informed consent, households’ registration, household status and individual health status assessments, triage, screening, and health promotion and disease prevention.

**Table 1** Clinics and CHWs per province: intervention and Study sites

Province	Intervention Numbers		Study Numbers
	Clinics	CHWs	Sites
Free State	20	204	5
Limpopo	37	667	20
Mpumalanga	8	175	
North West	49	518	5
Northern Cape	21	205	8
<b>Total</b>	<b>135</b>	<b>1769</b>	<b>38</b>

Support was given through on-going WiL to develop CHWs, team leaders, ClinAs and facility managers competencies in comprehensive care, COVID-19, TB, HIV, chronic disease prevention, treatment and management. Continuous data review was used to respond to local specificities and ensure intervention quality. During implementation, adjustments in scope were made to respond to political and health contexts, including the rise and spread of COVID-19. In total 46 000 households were registered and the demographic and social profiles as well as health status of over 180 000 individuals were captured on AitaHealth™. This information was available to facility and CHW managers.

This paper reports the findings of a rapid pragmatic qualitative study of perceived significant changes in CHW practices over the project intervention period 2019–2022. No explicit questions were asked about community health workers (Appendix 1: KI Interview Guide).

The study was undertaken without funding when the intervention was curtailed by the sponsor, mid-contract and at short notice. As COVID-19 pandemic pressure subsided, the company decided to redirect its support away from health systems strengthening through COPC across DoH clinics to a narrower focus on TB/HIV at selected clinics, without utilising CHWs. The COPC Research Unit, as the healthcare delivery support partner, conducted the study with the DoH staff and other stakeholders as a way of determining some level of impact the service might have had from interviews with key informants about ICT-enabled COPC in mining communities.

**Methods**

This study was a qualitative study grounded in the pragmatic framework, using additional quantitative data. The study setting was the 135 PHC facilities in the five provinces of South Africa in which the intervention took place (Table 1). Convenience sampling was used to select study participants.

**Quantitative data**

Quantitative data are drawn from project annual reports, as well as AitaHealth™ and other routine project monitoring documents to demonstrate the scale and reach of

the project. They are presented as information in itself and because they inform participant perceptions of the project.

**Qualitative data**

Participants were identified and interview sessions were arranged by ClinAs. The place and number of sites and characteristics of study participants were determined by the availability and willingness of key informants to partake in the enquiry at short notice, as well as funding and time constraints. Semi-structured individual and group interviews were conducted with selected stakeholders using a purposively designed interview guide. Interviewers were not part of project implementation in any of the study sites. Interviews were conducted in-person at participants’ places of work. All participants gave informed verbal consent and actively participated in the interviews (Appendix 1: Interview Guide).

**Data collection**

Thirty-seven individual or group interviews were conducted with a total of 57 individuals at purposively selected sites in four of the five intervention provinces between 10 October and 10 December 2022. Participants included 27 managers (facility, operational, project, sub district and local area as well as private and third sector), four professional nurses, 11 OTLs, eight CHWs, three social workers, two auxiliary social workers, one dietician and one clinic committee member (Table 2). With participant informed consent the interviews were facilitated in either English or Afrikaans by three trained facilitators familiar with the project. Responses were recorded on paper in English as summary reports (Appendix 1: Interview Guide).

**Analysis**

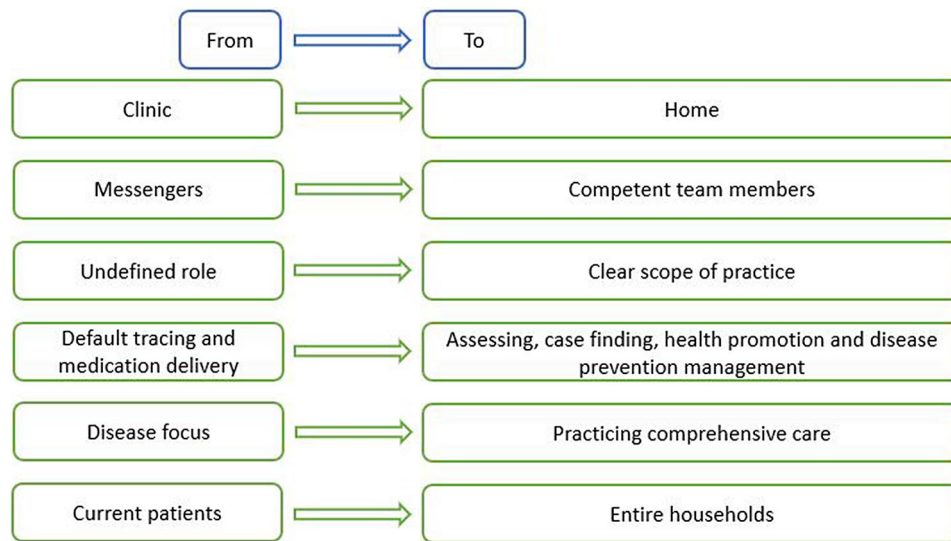
Reports were anonymised and assigned an identifier key. The reports were read and reread by all the authors, using a data driven, inductive approach [21]. Codes were created and all the data were coded using Taguette [22], a proprietary computer-assisted qualitative data analysis software tool. The three authors then identified themes. Following an iterative process of thematic and code review, the results were then analysed in terms of the perceived changes that participants observed in the role and place of CHWs (Fig. 1) [22].

**Results**

Quantitatively, through ICT-enabled COPC 42 490 households were registered and the demographic and social profiles as well as the health status of over 154 910 individuals were captured on AitaHealth™ by CHWs. Amongst other things, as Table 3 shows, CHWs identified a number of households and individuals that were

**Table 2** Interviews and respondents: type-number-position

Type of interview	Number	Participant Position	Number
Individual interview	19	Managers	27
Group interview	18	Professional nurse	4
<b>Total interviews</b>	<b>37</b>	Outreach team leaders	11
<b>Total participants</b>	<b>57</b>	Community health worker	8
		Social worker	3
		Auxiliary social worker	3
		Dietician	1
		Clinic committee member	1



**Fig. 1** Thematic analysis of changes

**Table 3** Selected risks and vulnerabilities of households and individuals registered on AitaHealth™

Variable	Number
Total household registrations	42 490
Total individual registrations	154 910
Vulnerable households:	
Child-headed households	164
Household Head: Diagnosed TB not on treatment	63
Household Head: Under 18 years of age and pregnant	4
Vulnerable individuals:	
Pregnant individuals not in antenatal care	126
Individuals screened at home positive for TB	2 690

particularly vulnerable and in need of priority services because of their socio-demographic and health status. These and other data were available to facility managers and OTLs through AitaHealth™ and other reports to plan, prepare and respond to individual and household health-care service needs as well as monitor CHW performance.

**From clinic to home**

Qualitatively, participants observed that ICT-enabled COPC changed the locational focus of practice. From historical, almost exclusive clinic-based practice, CHWs were now physically in the community visiting all households, doing household assessments, identifying problems, promoting health, developing health literacy, and assisting with the coordination of care from home.

Participants reported an increase in patients going to clinics. They attributed this to the growing competence of CHWs, their presence in as well as the time they spent with households providing better patient education and health promotion. Also, it was said that with patient

education already started at home,<sup>1</sup> clinic visits were more focused and queues were shorter.<sup>2</sup> This, they said was because CHWs were able to do primary care services at the household level, such as taking vitals or collecting sputum, and detecting potential health issues earlier.<sup>3</sup> Even in the face of the greater patient volume generated through CHW engagement, participants felt that by providing services at household level, CHWs reduced the work-load burden with patients at facilities.

Through CHWs’ relationships with patients and their households, clinicians and even hospital administrative staff were able to access households when needed.<sup>4</sup> This, in turn, led to a reduction in loss to follow-up, including of patients discharged from hospital.<sup>5</sup>

Previously, the clinics had the CHWs work within their facilities. The shift out of facilities to homes, left some of them with reduced capacity, as they had been used to help them with understaffing.<sup>6</sup>

<sup>1</sup> PN, OTL/ F/ LP/ WR, JMM/ 02-12-2022.

<sup>2</sup> PN, OTL/ F/ LP/ WR, JMM/ 02-12-2022.

<sup>3</sup> OPM, OTL/ F/ NWP/ JM/ 18-11-2022; OTLS, CHWS/ F/ FS/ WR, SM/ 11-10-2022.

<sup>4</sup> EX-LAM, LAM/ F/ FS/ WR, SM/ 12-10-2022; OTLS, CHWS/ F/ FS/ WR, SM/ 11-10-2022; OPM, OTL/ F/ NWP/ JM/ 18-11-2022; OTL, PN/ F/ LP/ WR, JMM/ 08-12-2022.

<sup>5</sup> EX-LAM, LAM/ F/ FS/ WR, SM/ 12-10-2022; OTLS, CHWS/ F/ FS/ WR, SM/ 11-10-2022; OPM, OTL/ F/ NWP/ JM/ 18-11-2022; OTL, PN/ F/ LP/ WR, JMM/ 08-12-2022.

<sup>6</sup> CHW, OTL/ F/ LP/ WR, JMM/ 24-11-2022.

**From messengers to competent team members working with a clear scope of practice**

Previously, CHWs were underutilised and their reporting pathways were unclear.<sup>7,8</sup> CHWs felt they were sent out for “nothing”, and experienced themselves as mere messengers for nurses to find patients.<sup>9</sup> With COPC they felt they were team members, who not only participated in the management of patients and families, but also delivered services and initiated care through case finding during household health status assessments. They felt that their competencies had grown and that they were able to work more independently, with greater confidence because of their training, the clinical guidance and support they got from ClinAs and OTLs and by having their own equipment and supplies.<sup>10,11</sup>

A perception change of CHWs was iterated, albeit differently, by clinic staff, who came to view CHWs working in COPC as part of the team, as “one of us”.<sup>12,14</sup> They observed a noticeable increase in CHW knowledge and competencies, a growth in their interest in their work as well as an increase in community trust towards them.<sup>13</sup> CHWs became better at their work, not only in terms of screening the whole household, taking patient vitals at home and providing reports to the clinic,<sup>14</sup> but also in providing health education and promotion and being more proactive in their communities.<sup>15</sup> CHWs were able to participate in case discussions with clinic staff.<sup>16</sup> In this they were observed to be different from CHWs in the non-COPC clinics.<sup>17</sup>

OTL and operational manager confidence in CHWs as team members was boosted by AitaHealth™. Through it, they said they were able to access the data collected by CHWs, make data driven decisions, and more effectively monitor CHW performance. AitaHealth™ made it easier for them to know which CHW was responsible for which patient [13]. Together, these factors generated increased

trust, which in turn contributed to a positive change in their relationships.<sup>18</sup>

**From default tracing to assessing, case finding, health promotion and disease prevention**

Previously, CHW work in the community was confined to delivering medicines and tracing patients who were not adhering to treatment. Now they went house to house, advised and cared for people about health and disease, did case finding and participated in care coordination, including bringing clinical associates to do home visits.

Because CHWs were now considered an extended arm of PHC services and clearly linked to clinics, participants observed an increase in disease prevention uptake. Through AitaHealth™, managers said they had increased knowledge about the demographics of the communities, which helped them respond to at-risk groups. By example, mention was made of increased deworming and Vitamin A supplementation in households and creches, because it was possible to know where all the under-5s were.<sup>19</sup> By being in the community, CHWs were able to find more patients and detect people in need of services at the household level. This, in turn, resulted in perceived increases in referrals, pregnancy testing and the return to treatment of patients lost to follow-up. It also led to down-referral, from hospital and other doctors who looked to CHWs to provide support at the household level for their patients.<sup>20</sup>

**From Disease Focus to comprehensive care**

Previously, because CHWs mainly did directly observed treatment with TB patients and tracking and tracing of TB and HIV patients lost to follow up in the community, the households they visited were stigmatised. With COPC, participants said CHWs now worked comprehensively, engaging with any health-related issues they found in households. Because they worked with a biopsychosocial understanding of health, they were able to go beyond HIV or TB and to respond to social problems, chronic lifestyle diseases, child health, antenatal care etc.<sup>21,16</sup>

**From patients to people**

Using the COPC approach, the focus of CHW work in communities shifted from patients that already had been diagnosed, or households with known disease issues to everyone and all households within the

<sup>7</sup> ACTING OPM, OPM/ F/ LP/ WR, JMM/ 11-22-2022.

<sup>8</sup> ACTING OPM, OPM/ F/ LP/ WR, JMM/ 11-22-2022.

<sup>9</sup> CHW, OTL/ F/ LP/ WR, JMM/ 24-11-2022.

<sup>10</sup> OTLS, CHWS/ F/ FS/ WR, SM/ 11-10-2022.

<sup>11</sup> LAM/ F/ LP/ WR, JMM/ 23-11-2022.

<sup>12</sup> ACTING OPM, OPM/ F/ LP/ WR, JMM/ 11-22-2022; LAM/ F/ LP/ WR, JMM/ 23-11-2022; ACTING OPM/ F/ LP/ WR, JMM/ 22-11-2022; PN, OTL/ F/ LP/ WR, JMM/ 02-12-2022; OPM/ GENDER UNDISCLOSED/ NCP/ JM/ 29-11-2022.

<sup>13</sup> ACTING OPM/ F/ LP/ WR, JMM/ 22-11-2022.

<sup>14</sup> OPM/ F/ LP/ WR, JMM/ 22-11-2022.

<sup>15</sup> PN, OTL/ F/ LP/ WR, JMM/ 02-12-2022; CHW, OTL/ F/ LP/ WR, JMM/ 24-11-2022.

<sup>16</sup> ACTING OPM/ F/ LP/ WR, JMM/ 22-11-2022; DIETICIAN/ F/ LP/ WR, JMM/ 22-11-2022; OPM/ F/ LP/ WR, JMM/ 22-11-2022.

<sup>17</sup> CHW, OTL/ F/ LP/ WR, JMM/ 24-11-2022.

<sup>18</sup> OPM/ F/ LP/ WR, JMM/ 22-11-2022; LAM/ F/ FS/ WR, SM/ 11-10-2022; ACTING OPM, OPM/ F/ LP/ WR, JMM/ 11-22-2022; PN, OTL/ F/ LP/ WR, JMM/ 02-12-2022.

<sup>19</sup> ACTING OPM, OPM/ F/ LP/ WR, JMM/ 21-11-2022.

<sup>20</sup> LAM/ F/ LP/ WR, JMM/ 21-11-2022.

<sup>21</sup> ACTING OPM, OPM/ F/ LP/ WR, JMM/ 11-22-2022.

community.<sup>22, 17</sup> Also, as CHWs spent more time with people in their homes,<sup>23</sup> they had a chance to build relationships at the same time as they detected potential health issues.<sup>24</sup> Participants observed that community attitudes to CHWs had become more positive,<sup>25</sup> because they monitored health at home, provided advice and some care and helped patients to the clinic.<sup>26</sup> Participants said the COPC approach to rPHC made healthcare more accessible to all people.<sup>27</sup>

### Changed outcomes

Participants in the study attributed several important outcomes in health in their communities to the changes brought about by ICT-enabled COPC with capacitated and clinically guided CHWs. These included the following:

- An increase in ANC visits.<sup>28</sup>
- Improved immunisation rates.<sup>29</sup>
- Improved post-natal care support. One hospital that created CHWs in their post-natal care programme to ensure follow-up care of mothers and babies saw an increase in the return utilisation rate and became the top performer in immunisation in the health district. The hospital planned to include CHWs in other wards to improve follow up.<sup>30</sup>
- Improved treatment adherence with an increase in people consistently collecting their medications, and increased enrolments in the Central Chronic Medicines Dispensing and Distribution (CCMDD) programme.<sup>31</sup>
- A decline in loss to follow-up.

- Increased uptake of family planning and a reduction in the incidence of illegal termination of pregnancy.<sup>32</sup>
- Increased referrals but more focused clinic visits made possible by better informed and more knowledgeable patients.

### Discussion

To address the overall and rising shortage of human resources for health, great store has been placed in the potential of CHWs to ensure that the reach of primary health care within existing healthcare systems extends to underserved and marginal populations [23–25].

Realising this potential globally and within South Africa’s rPHC reform [26] however, has been much more faltering for multiple reasons [27]. Amongst these, is the underestimation of the importance of the understanding and experiences of the healthcare professionals and workers charged with realising the reform, as it is they who shape and have discretionary power over how PHC is rendered [28, 29].

Service provider perceptions in this study describe significant changes in the place, role and practices of CHWs in this large-scale ICT-enabled COPC intervention with rural and remote mining communities. These changes did not happen by chance. Rather, they can be attributed to several key features of the intervention.

As the Karks’ had done in Pholela in the 1940s [10], there was preparation and an exchange of clinical, social and epidemiological skills and knowledge through a training programme, ICT-enabled decision support and ongoing work-*i*-learn that involved clinicians, managers, and community health workers.

Now, as then, rather than having CHWs in facilities running intermittent forays to patients in their homes, locating CHWs in communities changed service provider understanding of local health and care needs. For the first time, through AitaHealth™, these PHCs had a socio-demographic and epidemiological understanding of the health of the people in the communities they served. Beyond supporting system reporting requirements, having local public health and household status data meant that PHCs were able to use AitaHealth™ in the delivery of household specific, risk group and general population services because they were linked to CHW. In this, ICT-enabled COPC enhanced the bridging functions of CHWs as connectors of communities to professional health services [30].

As noted, elsewhere [31–32] the level of clinical support and guidance, together with training, are essential to the quality of services provided by CHWs as well

<sup>22</sup> LAM/ F/ LP/ WR, JMM/ 23-11-2022; CHW, OTL/ F/ LP/ WR, JMM/ 24-11-2022.

<sup>23</sup> LAM/ F/ LP/ WR, JMM/ 23-11-2022.

<sup>24</sup> OPM/ F/ LP/ WR, JMM/ 22-11-2022.

<sup>25</sup> LAM/ F/ LP/ WR, JMM/ 23-11-2022; LAM/ F/ FS/ WR, SM/ 11-10-2022.

<sup>26</sup> OPM/ F/ LP/ WR, JMM/ 22-11-2022.

<sup>27</sup> LAM/ F/ FS/ WR, SM/ 11-10-2022.

<sup>28</sup> LAM/ F/ LP/ WR, JMM/ 23-11-2022; PN, OTL/ F/ LP/ WR, JMM/ 02-12-2022; ADMIN, SOC, PROJCO/ M, F/ LP/ WR, JMM/ 28-11-2022; OPM/ F/ NCP/ JM/ 28-11-2022; EX-LAM, LAM/ F/ FS/ WR, SM/ 12-10-2022.

<sup>29</sup> LAM/ F/ LP/ WR, JMM/ 23-11-2022; OTLS, CHWS/ F/ FS/ WR, SM/ 11-10-2022; OPM/ F/ NCP/ JM/ 28-11-2022; OPM, OTL/ F/ NWP/ JM/ 18-11-2022.

<sup>30</sup> LAM/ F/ FS/ WR, SM/ 11-10-2022.

<sup>31</sup> ACTING OPM/ F/ LP/ WR, JMM/ 22-11-2022; PN, OTL/ F/ LP/ WR, JMM/ 02-12-2022; OPM, PN, CLINIC COMM MEMBER/ GENDERS UNDISCLOSED/ NCP/ JM/ 29-11-2022; OPM/ GENDER UNDISCLOSED/ NCP/ JM/ 29-11-2022; FACILITY MANAGER/ GENDER UNDISCLOSED/ NCP/ JM/ 30-11-2022.

<sup>32</sup> PN, OTL/ F/ LP/ WR, JMM/ 02-12-2022; MAN, CHAIR, ADMIN M, F/ FS/ WR, SM/ 11-10-2022.

as service provider and community trust. In this study, participants’ perceptions of CHWs’ performance were positively influenced by their confidence in the development of CHW competencies and their ability, through AitaHealth™, to know what CHWs were doing. Through ClinAs or directly, they also were able to ensure in-field support and training.

This, in turn, impacted on the CHWs scope of work. There are many organisational challenges to providing comprehensive treatment services in a healthcare system characterised by fragmentation, specialism and vertical programmes. By starting with a comprehensive approach to health and disease with people in their homes, however, this study found CHWs were able to spend time engaging with health promotion and primary disease prevention before people came to facilities. Even though previously unattended health issues added to the volume of people seeking services, the study found that prior preparation and better understanding by patients of their reason for coming into facilities meant that professional services at PHCs could be more focused and efficient. Also, there was a system in place to support the many and diverse needs CHWs uncovered in the communities they served, despite the fact that laying the knowledge and practice foundations needed to develop their capability in comprehensive care was a process that developed over time.

ICT-enabled COPC was also found to address some of the complexities of integration [28]. In terms of system integration, the fact that CHWs in the intervention were employed by the public health system contributed to service providers’ sense of them being accountable, part of the PHC team and community confidence. They were also valued by higher tiers of health service providers, because their foothold in communities meant that patients discharged home could continue to receive the health and care support they needed.

In terms of horizontal integration, the adoption of a bio-psycho-social approach meant that, as reported elsewhere [33] CHWs knew about and had tools to support nutrition, social care and other social determinants of health, including being able to make referrals to social services professionals who were part of the COPC teams.

Through four years of intervention (2019–2022), participants observed growing trust between health care professionals and CHWs and of communities in CHWs and the health care system generally. They saw notable improvements in a number of key PHC prevention and treatment outcomes particularly in respect of maternal, child and reproductive health, as well treatment adherence. Whether these and other outcomes of ICT-enabled COPC in mining communities translate into impacts that have been observed elsewhere [34] is less of a factor of the feasibility and effectiveness of the approach. Rather,

from our repeated experience doing COPC over the past 15 years, it is more a consequence of political and financial commitment to sustaining the program beyond the short-term limits of donor involvement, which came to an end in 2023.

**Conclusion**

This ICT-enabled COPC intervention adopted a comprehensive approach to health care delivery that started by including CHWs in primary health care teams and locating them in communities. Inclusive and systematic continuous learning, clinically-led CHW service support and ICT-enabled information technology both engendered trust in CHWs as competent members of the primary health care team, and grew community confidence in them and the primary care system as a whole. While healthcare and other professionals and workers valued the changes brought about by the intervention to their work and the lives of underserved and vulnerable mining communities, its sustainability once again comes down to political will and economic commitment.

**Appendix 1: key Informant/Focus Group Interview Guide**

- What was the situation before the introduction of COPC?
- What is your understanding of COPC (role, principles, objectives)?
- What was the role of the clinical associates in COPC locally? What were your interactions with clinical associates?
- Do you see a future role for clinical associates in primary healthcare?
- Have any key relationships changed since the implementation of COPC?
- Has your role/work/workload changed since the implementation of COPC?
- What do you think will be the consequences of the withdrawal of the University of Pretoria’s COPC Research Unit?

**Abbreviations**

AIDS	Acquired Immunodeficiency Syndrome
CHWs	Community health workers
ClinAs	Clinical Associates
COVID-19	Coronavirus disease
HIV	Human Immunodeficiency Virus
ICT-enabled COPC	Information and Communication Technology Enabled Community Oriented Primary Care
NHI	National Health Insurance
OTLs	Outreach Team Leaders
rPHC	PHC reengineering
PHC	Primary Health Care
TB	Tuberculosis
WBOTs	Ward-Based Outreach Teams
WIL	Work integrated Learning



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**Author contributions**

Qualitative data results were produced by JFM, WR, JM, ZP; quantitative data were produced by JMM; manuscript was authored primarily by TSM with inputs from JFM, WR, JM, SM and JMM; All authors read and approved the final manuscript. Through the Department of Family Medicine (UP) and then the COPC Research Unit, JFM and TSM, have conceptualised, developed, trained and provided implementation support to ICT-enabled COPC with public and private sector partners at national, provincial, district and municipal levels. Using the best available educational theories, TSM and JFM developed a capability approach to learning as a way to progressively developing healthcare provider competencies and general public health literacy. TSM authored COPC-A Practical Guide, as a learning aide to support ways of thinking about and doing COPC. It has been made available in hard copy and on-line to support the education of successive undergraduate and post graduate medical, nursing and allied health students as well as in the training of health care professionals and community health workers across the country.

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**Data availability**

Data is provided within the manuscript or supplementary information files.

**Declarations**

**Ethics approval and consent to participate**

Ethical approval in accordance with the Declaration of Helsinki for the intervention study was obtained from the Faculty of Health Sciences Research Ethics Committee of the University of Pretoria (Ethics reference number: 102/2011) as well as from the research committees of each of the respective provincial department of health. This study used anonymised data. Participants gave verbal consent for their information to be collected and used for research and study purposes.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare no competing interests.

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