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ORIGINAL PAPER

Exploring the effectiveness of telehealth interventions for diagnosis, contact tracing and care of Corona Virus Disease of 2019 (COVID19) patients in sub Saharan Africa: a rapid review

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Abstract
The efficacy of leveraging telehealth services on clinical outcomes remains scarcely documented. We conducted a rapid review to explore the effectiveness of telehealth interventions for the diagnosis, contact tracing and care of the corona virus disease of 2019 in sub Saharan Africa. Using MEDLINE, Science Direct and Cochrane Library databases, a review was conducted during the month of July 2020 of peer reviewed articles reporting on the use of telehealth interventions in sub-Saharan Africa. All the studies were assessed against the inclusion criteria by two independent reviewers. The 7 studies included in the synthesis were conducted in 2 countries [Nigeria (×1), Zimbabwe (×1)], and commentaries covering the entire sub Saharan Africa in general (×4) and to Uganda (×1). All the included articles and commentaries were published in 2020. We established that mobile applications are effective in providing information for referrals of potential patients infected by COVID 19 and provides convenient access to routine care without the risk of exposure through close contact. In countries such as Nigeria, mobile positioning data significantly improved decision making, capacity and scope of contact tracing and surveillance of known contacts of confirmed cases. We noted that collaborations between the government, mobile network operators and technology companies were utilised for successful mobile positioning data tracing interventions for COVID patients. Mobile applications such as the Vula platform in South Africa were also noted as effective in providing psychological support to health care workers attending to patients.

Keywords Telehealth · COVID19 · Contact tracing · Care · Sub Saharan Africa

1 Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes coronavirus disease 2019 (COVID-19), has caused a global public health crisis in recent times [1–4]. Due to the increasing numbers of morbidity and mortality rates infections among the general populations globally, COVID-19 was declared a Public Health Emergency of International Concern (PHEIC) by the World Health Organization on March 11, 2020 [1]. Although the fatality rate of COVID-19 is about 2 to 5%, the rate exceeds 10% among the geriatric population aged over 60 years [5].This disease has extended to over 206 countries with 1,051,635 confirmed cases, and 56,985 deaths recorded as of 4th April 2020 [6].

The gradual surging of COVID-19 cases has outpaced the capacity of an already-fragile health and disease surveillance systems in Africa to trace, and contain people with suspected infection [7–11]. In particular, major shortages of protective clothing and health care workers (there are 2.7 physicians per 10,000 population in Africa and parts of South America compared with 21.5 in North Americas and 32.1 in Europe), laboratory capacity and intensive care facilities (some European countries have 29 beds per 100,000 population, 35 in the USA and 5 or less in many low and middle income countries), hospital beds (> 12 per 1000 population in much

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of Europe vs. 1–2 in many low and middle income countries) and this situation has placed health institutions under tremendous pressure to contain the spread of COVID 19 [12–16]. Mortality rates among infected healthcare workers likely to be higher in many parts of Africa given the limited number of critical care beds [2].

With restrictions on face to face clinical consultations and the increased risk of occupational exposure for medical practitioners delivering patient care, the COVID19 pandemic has catalysed the use of telehealth in providing timely clinical care, education, and healthcare, at a low cost and extensive coverage [17–25]. Telehealth, a term sometimes used interchangeably with telemedicine, means "healing at a distance" and signifies the use of information and communication technologies to improve patient outcomes by increasing access to care and medical information [26]. It utilises technological solutions such as e-mail, messaging systems, smartphones, tablets, wireless monitors, teleconferencing, video conferencing and other forms of telecommunication technologies [27]. A growing body of evidence suggests that care delivered through telehealth allows patients to be efficiently screened, is both patient-centred and conducive to self-quarantine, and it protects patients, clinicians, and the general community from exposure to COVID-19 [22, 23, 27–29]. This is particularly important for Africa where health care systems are weak and there are shortages of PPE for healthcare workers.

Whilst the potential benefits of telehealth are clear, the uptake of telehealth in emergency situations has been limited [30]. The efficacy and impact of leveraging of telehealth services on clinical outcomes remains scarcely documented [31, 32]. Although quality randomised controlled trials are the standard to demonstrating the effectiveness of telehealth intervention in health care delivery, they may be limited in their generalisability and accounting for intervention adaptations or contextual factors that may influence outcomes in different settings and for different populations [33, 34]. New implementation science methods such as rapid evidence reviews have been noted as providing faster and better research on telehealth implementation and protocols for care coordination [35]. Recent studies also recommend further research into the methods that are best suited for evaluating the different types of telehealth applications, according to their target users and the particular health conditions being addressed [32]. COVID-19 appears to be a rather long term problem and it is urgent to conduct research which feeds into Evidence Based Practice for sustainable long term solutions.

We conducted a rapid review in order to evaluate the available evidence with regards to for telehealth consultation and the deployment of telehealth interventions for the diagnosis, contact tracing and optimal care of COVID19 patients in sub Saharan Africa. A review was undertaken to answer the following questions: (1) How effective are telehealth interventions in the diagnosis, patient tracing and care of COVID19 patients ? (2) what lessons/ best practices can clinical decision makers and policy makers' use in the implementation of telehealth interventions in sub Saharan Africa ? This synthesis provides insight into the experience of using telehealth interventions and is useful for researchers and healthcare practitioners in improving patient safety and care and reducing the per capita cost of health care.

2 Methods

2.1 Design

The protocol for this review was submitted to the University of South Africa Ethics Committee. The findings of this review were reported in accordance with the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) statement guidelines [36]. The advantage of using this approach is that multiple qualitative studies can pulled together data across different contexts for the generation of new conceptual models, identification of research gaps, and to provide evidence for the development, implementation and evaluation of health interventions. Against the backdrop of a high telephone penetration and need for social distancing, it is quintessential to investigate means for efficacious implementation of telemedicine.

2.2 Inclusion criteria

Research studies that met the following criteria were included: (i) studies that presented qualitative data, commentaries or reviews on the use of telehealth interventions during the COVID-19 pandemic; (ii) studies that reported findings for sub Saharan Africa (iii) studies that reported outcomes or observations relating to diagnosis, tracking and optimal care for COVID-19 patients; and (iv) studies that focused on clinical decision makers such as doctors, patients or nurses who use telehealth interventions within COVID19 situations. The exclusion criteria set out for this study excluded non-English-language studies, quantitative studies such as RCTs and quasi-experimental studies conducted in developed countries, unpublished reports (such as grey literature, dissertations or conference abstracts), study protocols and non-intervention studies that report on the use of telehealth for other conditions such as cardiology, dermatology, gastroenterology, oncology and so on.

2.3 Search strategy

We identified relevant studies published within the period 1 January 2020 through 30 July 2020. The start date of 1 January 2020 was selected because this is the approximate

time when articles about the COVID19 started appearing on the research scene on a sustainable basis. The electronic search was conducted in three electronic bibliographic databases of peer-reviewed literature in medical and social science research: MEDLINE, Science Direct and Cochrane Library. In addition, we also used Google Scholar in order to search for missed articles that met the inclusion criteria. The search terms included key word sets of synonyms and variations in combinations of key words relating to telehealth and the related interventions, COVID19 and sub Saharan Africa as shown in Table 1 below.

Previous reviews were consulted for the selection of appropriate search terms or key words [37]. A manual search also included a review of articles published in high ranking journals relating to telehealth or among which telehealth-related articles had recently been published. These included: Telematics and Informatics; Journal of Telehealth and Telecare; New England Journal of Medicine, Technology and Health Care; Medical Internet Research; Telemedicine and e health and International Journal of Medical Informatics, Pan African Medical Journal among others.

2.4 Title, abstract, and article screening

An initial selection of potential articles was based on the screening of the title and abstract by the primary reviewer (TKM). Given that the title and abstract did not provide sufficient information to determine eligibility, the full-text publications of all potentially relevant citations were downloaded and perused by two reviewers who independently excluded articles that did not meet the inclusion criteria (TKM and MM). The reference lists of all full-text publications were also retrieved and skimmed for eligibility of relevant articles.

The articles that met the eligibility criterion were downloaded, read, and analysed and the relevant themes illustrating the effectiveness of telehealth in the diagnosis, contact tracing and optimal care for COVID19 patients and the best practices that clinical decision makers and policy makers' use in the implementation of telehealth interventions in sub Saharan Africa were compiled [Table 2]. To avoid selection bias, the two authors carried out the full-text article review and any disagreements were resolved through consensus

Table 1 Search strategy and terms for electronic data

Search Category	Telehealth		Corona Virus		Sub Saharan Africa		User
Search terms	Telemedicine	AND	COVID 19	AND	SSA	AND	Doctors
	Virtual medicine		Coronaviruses		Africa		Nurses
	Digital health		SARS-COV		Low income countries		
	Telehealth devices		2019-Ncov		SADC		
	ehealth						

Table 2 Characteristics of Included Studies

Author/s	Year of Publication	Country	Methods	Intervention/s	Study Participants	Ratings
Ekong et al	2020	Nigeria	Internet Search	Mobile Phones	COVID 19 contacts	Moderate
Kamulegeya et al	2020	Uganda	Commentary	Mobile applications Online platforms Call center providers Smart phone app	COVID 19 patients	Moderate
Chersich et al	2020	Africa	Rapid Review	Social Media Voice Calls Whats app groups	Health Care Workers	Moderate
Gupta et al	2020	Africa	Commentary	Mobile phones Internet devices	Health care providers COVID 19 patients	Minor
Malinga et al	2020	Zimbabwe	Commentary	Smartphones	Health care workers COVID 19 patients	Moderate
Bakibinga-Gaswaga et al	2020	Africa	Commentary	Electronic tools Smartphones		Moderate
Smith et al	2020	Africa	Commentary	Portable telemedicine kits	Health Care workers COVID 19 patients	Moderate

(TKM and MM). In order to document the information presented in each selected paper, a table was drawn up on an Excel file and the following details were documented: author/s, year of publication, search strategy, country, methods, type of telehealth intervention and study participants (TKM).

2.5 Quality assessment

The methodological rigor of each selected study was assessed using a set of seven items adapted from the Critical Appraisal Skills Program tool [38]. The following aspects were taken into account in the evaluation of studies of the selected studies; (i) clarity of aims and objectives; (ii) the appropriateness of the qualitative methodology; (iii) the appropriateness of the research design to the aims and objectives (iv) the appropriateness of the participant recruitment strategy to the research aims and objectives; (v) the relevance of the data collected in answering the research aims and objectives; (vi) the researcher reflexivity (vii) consideration of ethical issues in the study (viii) the rigor of the data analysis (ix) the availability of a clear statement of findings (x) the value of the research. The articles were rated as having minor, moderate, or major concerns based on evaluation of two reviewers (TM and MM).

3 Results

3.1 Characteristics of included studies

The 7 studies included in the synthesis were conducted in 2 countries [Nigeria (×1), Zimbabwe (×1)], and commentaries covering the entire sub Saharan Africa in general (×4) and to Uganda (×1). All the included articles and commentaries were published in 2020. The recent timeline is important because the various articles represent the latest thinking regarding telehealth in the research community regarding COVID-19. A study done in Nigeria explored how mobile positioning data technology can be used to reduce the spread of COVID-19 [39]. Another study explored how video calls can be used to address the secondary effects of COVID19 such as social isolation and loneliness [40]. This opens a very interesting linkage to psycho-social support, social work and counselling for COVID-19 patients going through quarantine related social isolation. Three commentary papers included in this synthesis explored how telehealth can be used in the prevention and management of COVID-19 [30, 41, 42]. Another commentary specific to Uganda explored the rising roe of digital technologies in medical service delivery especially within the intra COVID period [43]. One rapid review explored the challenges facing the health sector during the COVID19 period and how telehealth can close in that gap [13]. Five out of seven studies (71.4%) were perceived to have moderate methodological issues and two (28.6%) were considered as having minor issues. Overall, studies rated as moderate did not explore the contextual factors in specific sub Saharan countries that may hinder or enable the successful use of telehealth. Two of the three papers rated as having minor issues reported country specific findings but did not include primary data and participants' verbatim quotes to substantiate findings. Table 2 below provides a summary of the included studies.

Five main issues emerged from the studies that reported on the use of telehealth interventions in the diagnosis, contact tracing and care of COVID 19 patients: (1) mobile positioning data significantly improves decision making, capacity and scope of timely response to COVID19 (2) application of teleconsultation is effective for emergency medical dispatching when suspicious symptoms are detected by an individual and thus reduce the risks of infection through personal contact; (3) telehealth interventions are effective as mental health tools for relieving stress among health care workers; (4) lessons for clinicians and policy makers which include standardized guidelines for telemonitoring of patients are necessary and should be based on evidence and best practices to support appropriate safeguards and regulatory oversight and reducing the costs of accessing the telehealth interventions in developing countries; (5) Future research needs to design and implement models for mobile position contact tracing. Researchers ought to envisage the post COVID era as an opportunity to rebuild and to formulate alternative research designs and new research methods such as the using of digital technologies as outbreak investigation platforms and not just as a tool for field data collection.

4 Discussion

The overarching questions guiding this review were; how effective are telehealth interventions in the diagnosis, patient tracing and care of COVID19 patients and what lessons/ best practices can clinical decision makers and policy makers' use in the implementation of telehealth interventions in sub Saharan Africa. We used thematic analysis to combine the studies reporting on the use of telehealth interventions within the context of COVD19 and we identified key themes from the included studies [44, 45].

Regarding the first question, the findings from the included studies indicate that mobile positioning data can significantly improve decision making, capacity and scope of timely response to COVID19. African countries such as Nigeria are currently using mobile data to monitor and tracking of mobile phones of confirmed cases, suspected patients and known contacts of confirmed cases [39]. Analysis of ready

satellite data have also been made available across African countries through the Digital Earth Africa online platform to support decision making by clinicians, It has also been integrated with other information platforms supporting the COVID 19 response in Africa.

From these cases, it was apparent that collaborations between the government, mobile network operators and technology companies were utilised for successful mobile positioning data tracing interventions and other African countries can emulate the same. However, policy makers need to ensure that the current guidelines and regulations for data handlers incorporate measures to curb misuse and unauthorized access. Standardized guidelines for telemonitoring of patients are necessary and should be based on evidence and best practices to support appropriate safeguards and regulatory oversight [34]. Continuous efforts also need to be done in order to reduce the costs of accessing the telehealth interventions in developing countries [8].

In addition, the work reviewed suggest that telehealth interventions are effective as mental health tools for relieving stress among health care workers. Recent studies demonstrate that the incidence of anxiety and stress disorder is high among medical staff caring for COVID-19 patients, especially nurses and these conditions undermine their decision making ability and quality of interaction with patients [46, 47]. Under such conditions, social media interventions such the Vula platform in South Africa have been effective in offering mental health support for healthcare workers [48]. Video calls were also noted as effective in addressing social isolation and loneliness especially among the elderly patients who are considered as vulnerable to the pandemic [40]. WhatsApp groups among healthcare workers were also noted as having the potential of providing clinical decision making advice to health care workers and messaging on mental health support [13].

However, the reliability and validity of data sourced through social media remains a challenge [49]. Social media posts consists mostly of voluntary submissions from non-experts and the applications lack gatekeeping features that identifies inaccurate information. Practioners across sub Saharan Africa and mobile application developers should consider developing mobile applications with security features that detect inaccurate information especially within the context of fake news. Recent studies also note more needs to be done to leverage digital platforms for telepsychiatry and online support for psychological support during times of crisis [49]. Telehealth applications to help patients to deal with the psychological impact of being diagnosed with COVID19 and the subsequent isolation and quarantine were missing from the review [50]. Clinicians and policy makers need to consider such applications for improved care.

Thirdly, we established that telemedicine reduces patient contact and thus reduce the risks of infection through social contact. For people not infected with the COVID-19 virus, telehealth provides a convenient access to routine care without the risk of exposure in congested hospitals or in medical practice waiting rooms [30]. A recent study notes that application of teleconsultation for emergency medical dispatching would occur when suspicious symptoms are detected by an individual [51] The use of telehealth allows for national or international experts to give advice from a distance and support to local doctors and thus improving the quality of care. Although African governments face much budgetary constraints, the rate of telecommunications and ICT penetration in Africa is very high with countries like Tanzania. reaching up to 97% of the population having telephone access. This puts the continent at an immediate and sustainable advantage in terms of telemedicine. However, the implementation and overall uptake of telehealth interventions may, however, be challenged by considerable costs in setting up such systems, clinician's unwillingness to adopt telehealth, infrastructural constraints such as an unstable power supply or limited internet connectivity, and a lack of interoperability between digital systems [52]. The exercise will also require high level, strategic buy in from government leaders in order to be successful.

Regarding the second question, the key lessons learnt for practitioners are that telehealth has to routinely be used and mainstreamed into the health system in a proactive manner for effective emergency responses and long term outcomes. Some of the strategies that sub Saharan countries can adopt to ensure that telehealth is used regularly, alongside conventional service delivery methods include flexible funding arrangements which adequately covers the cost of providing telehealth, training and accrediting of healthcare workers [50], modifying protocols for telehealth and redesigning the existing models of care, supporting all stakeholders with an effective communication and change management strategy and establishing systems to manage telehealth services on a routine basis [34].

Whilst clinical practice in developed countries has rapidly incorporated telehealth into conventional health care practice, this cannot be said of sub-Saharan Africa health service delivery systems. Most telehealth applications in sub Saharan Africa are restricted to telephone support and monitoring, with very little evidence of the use of interventions such as, teleconferencing, video conferencing and other forms of telecommunication technologies. Several evidence gaps were identified which require further research to guide. Future research also needs to design and implement models for mobile position contact tracing. Researchers ought to formulate alternative research designs in the post COVID19 era such as using digital technologies as outbreak investigation platforms and not just as a tool for field data collection.

The merits of our study are that the use of rapid review enabled us to synthesize available evidence in a timely

fashion in order to inform research and practice [53]. Our findings are likely to provide health decision makers such as clinicians, patients and policy makers with timely access information to evidence related to the current COVID19 pandemic. This will bolster sector wide organisational learning in the health fraternity and this results in the incremental improvement of health service delivery. In addition, there is growing recognition of the value of synthesising qualitative research in order to facilitate effective and appropriate health care [54]. The rigor of rapid evidence syntheses was maintained through adhering to most of the general steps of a systematic review process [53]. We considered the collection of primary data as potentially harmful to the participants or to the researcher during the intra COVID period. The use of online tools and approaches such as a rapid review was more appropriate.

Our study had a few limitations. First, this study depended on conducting a rapid review in compiling the findings. This approach is a less rigorous approach compared to systematic reviews. The streamlining of some aspects of a systematic review such as the number of search databases and restricting the extent of the synthesis by omitting line by line coding compromised the rigour of the study [53]. Secondly, this study considered qualitative studies and commentaries on the use of telehealth in sub Saharan Africa whose descriptive nature makes the synthesis of the data difficult. Statistical meta- analysis such as randomised controlled trials, quasi-experimental studies that could have dealt with this problem were excluded from the synthesis. However, it should be noted that the limitations stated above do not invalidate the findings of this investigation yet open up areas for future research and areas of improvement by clinical decision makers.

5 Conclusion

In conclusion, it can thus be noted that this study sought to understand the effectiveness of telehealth interventions in the diagnosis, patient tracing and care of COVID19 patients. Lessons and best practices were also drawn from the studies reviewed to guide clinical decision makers, researchers and policy makers' on how best to scale up the implementation of telehealth interventions in sub Saharan Africa. In order to answer the overarching questions guiding this study, a review of studies published in 2020 were done with inclusion of studies based on a laid down criteria. From the review we established that mobile app interventions are effective in providing information for referrals for potential patients infected by the COVID 19 and a convenient access to routine care without the risk of exposure. In countries such as Nigeria, mobile positioning data significantly improved decision making, capacity and scope of contact tracing and surveillance of known contacts of confirmed cases. We noted that collaborations between the government, mobile network operators and technology companies were utilised for successful mobile positioning data tracing interventions for COVID 19 patients. Mobile applications such as the Vula platform in South Africa were also noted as effective in providing psychological support to health care workers attending to patients.

6 Recommendations

Hereunder are a few recommendations for the improvement of the diagnosis, contact tracing and care of COVID 19 patients in sub Saharan Africa:

- Policy makers need to prioritise preparing and adopting standardized guidelines for telemonitoring of patients based on evidence and best practices to support appropriate regulatory oversight of telehealth interventions.
- Clinical decision makers need to ensure that telehealth is mainstreamed into the health system, alongside conventional service delivery for effective emergency responses and long term outcomes.
- Policymakers need to ensure that sustainable funding arrangements are available which adequately covers the cost of providing telehealth, training and accrediting of healthcare workers, modifying protocols for telehealth and redesigning the existing models of care.
- An effective communication and change management strategy is required to inform all stakeholders on the protocols for implementing telehealth services on a routine basis
- Practioners and mobile application developers should consider developing mobile applications with security features that detect inaccurate information especially within the context of fake news
- Future research needs to design and implement context specific models for mobile position contact tracing.
- Researchers ought to establish new research methods of conducting clinical research post COVID19 such as the use of digital technologies as an outbreak investigation platform and not just a tool for field data collection.

Author contributions MM assessed the selected studies against and inclusion criterion and editing of the final version of the paper, and TM co- assessed the studies included in the paper and was a major contributor in writing the manuscript. All authors read and approved the final manuscript.

Declarations

Ethics approval and consent to participate A protocol was submitted to the University of South Africa Ethics Committee. Authors adhered to all the Springer ethical policies.

Consent for publication Authors agreed for the material to be published.

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

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