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# Role Of Telemedicine In Improving Maternal And Neonatal Health In Sub-Saharan Africa

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***Abstract***
*Several barriers have been shown to contribute to the burden and disparities among infant and pregnant women particularly in sub-Saharan African such as lack of access to quality health care services, isolated communities, deficiency of well-equipped facilities and a lack of well-trained health care professionals. These challenges have resulted into chronic diseases, health burden and health challenges among infant and pregnant women such as maternal mortality, morbidity, infection, eclampsia, hemorrhage, mental health conditions, embolism and gestational hypertension. One of the methods that have been proposed to be effective in overcoming, preventing, monitoring, assessing, educating and evaluating these challenges is Telemedicine. This technology is based on information and communication strategies like mHealth, eHealth, education, and telehealth using smartphones, telephone, computer, videoconferencing, digital image technologies, applications, algorithms, medical devices and other wireless and wearable gadgets. Thus, this review is aimed at giving an overview on the role of telemedicine in improving maternal and neonatal health in Sub-Saharan Africa.*

***Keywords:*** *Pregnancy, infant, telemedicine, healthcare, health education, sub-Saharan Africa*

**Introduction**

According to Escobar et al. (2022), rural communities are characterized with several populational based issues such as low-level education, poverty, lack of prenatal care for pregnant women, and low access to good health services. In line with the third goal of the United Nations sustainable development Goal, by the year 2030 maternal mortality rate should be reduced to less than 70 cases per 100, 000 live births meaning that every country's maternal mortality ratio should not exceed twice the world average. Escobar et al. (2022) revealed that in Low- and Middle-Income Countries (LMICs), many of the cases from maternal mortality are preventable with quality access to reproductive health services.Global report in 2019 from maternal mortality ratio was 211 maternal mortalities per 100, 000 live birthsand about 50 – 100 women experience near miss mortality for every maternal death. Also, 2.7 million neonatal death and 2.6 million stillbirths have been recorded each year. The negative impact of COVID-19 and other infectious diseases on LMICs in relations to perinatal and maternal health, perinatal mortality rate, neonatal morbidity, and near-miss mortality, have been very significant. Thus, a critical and urgent attention is need to innovate and implement affordable ingenuities such as the digital health or telemedicine to improve maternal and perinatal health in sub-Saharan Africa. Many infectious diseases particularly COVID-19 pandemic has led to massive adoption and implementation of telemedicine across the globe (Adetunji et al. 2022a; Adetunji et al., 2022b; Adetunji et al., 2022 c; Adetunji et al. 2022d). This technology has been adopted for the provision of health care to newborn and maternal. Though, several authors have highlighted the importance of telemedicine towards improving maternal and child's health in Low- and Middle-Income Countries (LMICs), there are limitation or constraints such as technological barriers, financial barriers, technological illiteracy, language barriers, lack of non-verbal feedback and distrust on the care provided through telemedicine. Several factors like poor internet and wi-fi connection have been recorded in health care providers trying to establish a connection with women in LMICs, lack of skills to operate and maintain the software and hardware. Even though many of the rural women have access to smartphone, many of them lack the skill and willingness to use it for telemedicine as a result of poor technical skills (Aziz et al., 2020). In many parts of sub-Saharan Africa, there is shortage of medical experts thereby reducing the accessibility of pregnant women to proper medical attention and provision of continuous education. Advancement in the development of technology and communication has provided a platform such as telemedicine to attend to patients virtually in under-served areas. Thus, this review is aimed at giving an overview on the role of telemedicine in improving maternal and neonatal health in Sub-Saharan Africa.

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**Telemedicine**

eHealth or Digital health is information and communication technology for the provision of health surveillances and services for public health safety. The adoption and implementation of this technology carries technological, cultural and financial burden in many parts of the LMICs. The low number of qualified health workers, unequal distribution of workers, access to a geographic inaccessibility have limited the contributions of telemedicine to health coverage. In 2018, the WHO member states recognized the importance and accepted the contributions and impact of digital technologies or telemedicine to the sustainable development goals. Telemedicine or telehealth is the utilization of electronic information and communication technologies for clinical health care, health administration and patient's education. Examples of telehealth are live video, mobile health, electronic consults, and remote patient's monitoring. Joy and Pooja, (2021) reported that in the year 2015, about 7 % of all health application account for pregnancy and women health using monitoring tools and maternal health applications. This provides remote patient monitoring and management of high-risk pregnancy like disabilities, chronic illness, pre-eclampsia, gestational diabetes, and neonatal infections. Telemedicine facilitates isolated, remote and rural clinical support for patients from distant medical system. With the recent advancement in communications, electronics, technologies, hardware and software, it has become possible to transmit important health information and physiological parameters to high tech centers. Telemedicine provides avenue for the utilization of medical equipment, computer software and hardware, medical experts, technologies and communication through patients can be investigated, monitored, diagnosed, evaluated, examined and treated by an expert from a distant. Telemedicine interaction can be stored and forward method and real time method. Telemedicine also involve trans telephonic screening, transmission and monitoring of physiological variables (blood pressure, heart rate, and weight) through telephone conversation and computer display of biological signals (oximetry, ECG trace, spirometry, patient monitoring devices, wireless devices). eHealth is a novel field of telemedicine that is expanding exponentially for the management of diseases, prenatal diagnosis, fetal monitoring, screening, antenatal care and neonatal care services. The practice of medicine can be transformed with the adoption of telemedicine through the provision of affordable and accessible medical care and interventions. Zeinab et al. (2022) reported that smartphone application was utilized for the management and treatment of celiac patients. In their study, a Persian-language algorithms, an educational intervention was developed to assist patients with celiac disease. From their results, it was suggested that utilizing a smartphone algorithm for providing data and information to patients with celiac disease had a significant improvement and positive impact on indigestion symptoms when compared with routine clinic education. Ramesh, (2015) reported that over the years, there has been effort to make people work from work through the use of telecommuting. Telecommuting using computer, videoconferencing equipment, robotic technology and mobile devices are also utilized for diagnosis emergency health challenges. The advantages of telemedicine in healthcare are numerous ranging from hospital services, research, healthcare delivery, technician, collaboration, health worker training, and education. Tang and Reddy (2022) revealed that telemedicine could be utilized for the providing palliative care in the treatment of advanced cancer cases in patients. In their study, the authors reported that smart health care delivery using telemedicine models changed the landscape of corona virus diseases, chronic diseases and cancer treatment. Mathur et al. (2017) and Shankar et al. (2016) indicated that India is the largest world democratic country as second most populated country globally. The social challenges faced by this country ranges from poverty, sanitation, illiteracy, lack of healthcare and gender inequality hence, there is need for reducing health care disparities as a result of shortage in trained health care workers. The authors reported that m-health is cost effective and increase the impact assessment for the promotion of newborn, maternal, and child-health in rural settings. The authors suggested that telemedicine is a tool and technology for advancing healthcare delivery, reducing disparities in healthcare in underserved areas in India which can be replicated in several countries in developing economic particularly in Low- and Middle-Income Countries.

**Maternal and neonatal health**

Studies have shown different maternal and neonatal health issues such as eclampsia, postpartum hemorrhage, and perinatal mortality can be reduced and health care strengthened through the adoption and use of non-technical and technical competencies like the structured telemedicine services for health system intervention (Kim and Zuckerman, 2019). Studies have revealed that there has been consistent fall in maternal mortality to about 37 % in recent years and about 17, 000 fewer children die per day since 1990 globally (Harahap et al., 2019). Though, the ratio of maternal mortality in developing countries particularly in sub-Saharan Africa is about 14 times higher the developed countries with about 5.4 million of children dying in their first five years of age and half of this figure are newborns. The authors revealed that lack of access to quality health care is a major factor for this high figure. Others are delay caused by cultural and socioeconomic factors, quality of care, and accessibility of facilities. Different technologies can be adopted to reduce the incident of maternal and child mortality in developing nations such as communication and transport technologies. In the developing countries, the high rate of child and maternity rate is attributed to so many factors such as hospital closure, shortage of workforce and low access to care resulting into serious detrimental maternal and child health issues such as premature birth, maternal mortality, low-birth weight, severe maternal morbidity, and high risk of postpartum depression. The high rate of child and maternal mortality rate has resulted into different strategies being implemented to reduce the incident in several developing nations such as improve access to well trained and skilled maternal health workforce in technologies and communications, incentivizing and boosting maternal healthcare providers to practice in developing countries through the provision of grant, scholarship, loan, Leveraging on

Telehealth, innovations and related technology and leveraging on the existing well trained health care workforce. Serious disparities exist in maternal and infant health outcomes due to race, socioeconomic status and age. Maternal mortality outcomes include infection, hemorrhage, embolism, stroke, acute renal failure, hypertension, gestational diabetes and acute myocardial infarction. Every year globally, about 290, 000 women lose their lives as a result of delivery and pregnancy related causes together with 6.9 million children die before age of five accounting for 99% childhood and maternal mortality in developing countries. Infection and disease burden from HIV/AIDS, malaria and tuberculosis kill 3.35 million individual yearly in sub-Saharan Africa due to social and economic development. The sustainable development goals of Goal 4, 5 and 6 which deals with reducing child mortality, improving maternal health and combating malaria, HIV/AIDS, and other diseases. To achieve these goals developing countries must increase expenditure on health system to improve maternal and child health. Recent advancement in technologies has provided assistance in the utilization of information and communication technologies like telemedicine (mobile health, eHealth, distance learning, electronic health records, decision support system and medical devices) in the enhancement of health services in low-income countries. The primary purpose of child and maternal health is to offer and sustain child and mother's health in any community. The major problem with maternal health can be attributed to pregnancy complications, uterine ruptures, obstetric hemorrhages, eclampsia, infections and obstructed labor.

**Role of telemedicine in improving maternal and neonatal health in sub-Saharan Africa**

Harahap et al. (2019) reported that there are very limited studies that have addressed the role of telemedicine on neonatal and maternal mortality in several regions of the developing nations. The authors revealed that there is high rate neonatal and maternal mortality in developing countries. National welfare is determined based on the individual health of the citizens, thus different approaches that will improve child and maternal health is an important strategy in healthcare goals. Child and maternal health are highly important in the society which is based on the United Nations sustainable development goals. In the year 2030, the sustainable development goals strategies include the overall reduction of global maternal and child mortality rate to about less than 70 per 100, 000 live births, neonatal mortality as low as 12 per 10000 live births and under five mortalities as low as 25 per 1000 live births. Harahap et al. (2019) showed that in developing countries, various communication and transport technologies can be provided to improve neonatal and maternal health. Many of these technologies provide support and functions that healthcare workers can utilized to identify different complicated issues, linkage of health facilities with healthcare workers, coordination of emergencies and responses. Telehealth can provide support for improved effectiveness between patients and clinicians for informed decision making. Examples include mobile health (m Health) or mobile application for referral guidance, coordination and follow-up, toll free mobile call center, telehealth, monitoring system and GIS-based transport system. Mobile health can be utilized by traditional birth attendants for guidance, support, link to health facilities and evaluation when attending to patients. There is provision for on-call medical service team to monitor transportation to health care centers using ambulance. Other technologies for low-cost perinatal monitoring system and screening that can be adopted by traditional birth attendant in developing countries include shelf sensors, a pulse oximeter, smartphone and 1D Doppler fetal heart monitor. Harahap et al. (2019) demonstrated that many participants have difficulties in the utilization of these technologies due to low level of education and lack of experience, thus suggesting training for many of these healthcare workers in the future. M Helath can address social and cultural issues by providing support for decision-making for healthcare workers. There are many challenges being faced in the adoption and implementation of telehealth across the developing countries such as limited access to broadband, scheduling time with providers, cost of equipment or technologies, reimbursement for teleconsultation, and legislative barriers.

Maternal and child health improvement in services can be implemented through telehealth through;

1. Expanding remote monitoring: Care can be given to women in distance through telemedicine, thus reducing the burden of traveling particularly for perinatal care services. Remote monitoring programmes that can provide timely monitoring of physiological parameters like blood pressure, blood sugar, and electrolytes levels during gestation. This will enable prompt monitoring of any risk factors against health of pregnant women remotely and empowering them to make informed decisions.
2. Utilization of virtual platforms: Telemedicine facilitate provision and improvement in child -maternal health. Various health online platforms offer opportunity for pregnant women unlimited access to mental health care, lactational consultation, prenatal and gestational care.
3. Utilization of Phone application for programmes: Perinatal services such as safe sleep, nutrition, doctor visits, and weigh gain can be implemented by using phone applications.
4. Enhancing virtual consultations: Geographical distance can be reduced with provision of access to specialists on telehealth maternal fetal programmes through the provision of video consultation, and real time discussion.
5. Expanding quality training improvement: Virtual training capacity for health workers for improving accessibility of maternal health care services in developing nations.

Joy and Pooja, (2021), reported that telehealth services and mobile applications are currently being utilized to facilitate high level of maternal and child health care. The authors revealed that many pregnant women are at high risk of infectious diseases, but implementation of telehealth services is a potential strategy for the prevention or reduction of child and maternal mortality. Over the past few decades, telemedicine has been seen to provide innovative approaches in

the improvement of health care services across the globe. In LMICs, there has been consistent deficiency in the number of healthcare workers, increased aging population and many living in remote places with numerous health challenges with little or no medical attention. Thus, telemedicine will serve as appropriate solution to deliver medical services via information and communication strategies. This will save cost from traveling, bed space for admission, promote medical education, access to medical services, and unnecessary delay (Ittipong et al., 2019).

Marwah and Mittal, (2018) demonstrated that maternal health challenges can be bridged using M-health (mobile-health) interventions for advancing the improvement in maternal health. They noted that lack of care, support, distance, and ineffective use of data are among the problems confronting pregnant women, and child's health particularly in the developing countries. the authors pointed out that M-health is an innovation of telehealth programs for medical service delivery through information and communication technology such as videoconferencing, emails, web sites, telephone conversation, and smart gadgets or devices. These technologies can be utilized remotely by patients for monitoring, of physiological parameters. They suggested that m-health contributed to reducing the delays associated with the movement of patients, offers real time maternal health information and also increased the number of antenatal care attendants compared to physical meetings. This will provide continuous care, management of cases, save lives in case of emergency, robust referral system, and evaluate the condition of patients remotely.

Jack and Mars, (2008) reported that telemedicine is a novel approach in delivery medical services particularly in developing countries. In their study, the authors noted that due to resources constraints, there must ethical guidelines to facilitate the practice of telemedicine in order to overcome many of the challenges of health care system in remote system like sub-Saharan Africa. Fang, (2021) carried out an analysis and revealed that telemedicine interactive system for elderly care using audio and video devices for health care management. The authors noted that telemedicine system in developing countries will play an increasingly important role in the delivery health and medical care. The use of telemedicine in Africa is of utmost importance even though the funding is low due to low political will and support by the government.

Transforming health sector in Africa can be achieved using functional national telemedicine for screening perinatal care, postnatal depression, cognitive behavior and fetal monitoring. Donohue et al. (2019) reported that telemedicine could be use in the improvement of neonatal resuscitation, airway management, emergent procedures, umbilical line placement and needle thoracentesis. In their study, the authors noted that advanced resuscitation skills as educational and training platform using telemedicine could be provided to rural patients and healthcare workers who do not have the privilege for such skills.

Maternal mortality and morbidity are profound in low- and middle-income countries particularly in Africa. An average of 300, 000 women died of several preventable childbirth and pregnancy related issues in 2015. Mobile technology and advancement in technology has enhanced health interventions through digital health technologies intervention towards pregnant women. Over the years, low- and middle-income countries have battled with high rate of child and maternal mortality ranging from pregnancy complications, postpartum infections, obstructed labor and hemorrhage, according to World Health Organization, 2014. Ngabo et al. (2012) reported that utilization of wireless and mobile devices to facilitate public and medical health research and practice. M Health is gaining increased attention providing robust opportunity for reducing delay in health accessibility, decision making, and education in many of the underserved sub-Saharan Africa countries. van den Heuvel et al. (2018) highlighted the role of eHealth in providing support and serving as Next Generation care for perinatal physiology. In their study, the authors demonstrated that electronic health provide value-based health care and empowerment for patient particularly those of reproductive age using social media, internet, smarth phone, and different apps and algorithms to facilitate fetal and maternal health. The authors suggested that eHealth interventions are a multilevel field and application in providing perinatal care and patient satisfaction. Galle et al. (2020) and Amel et al. (2020) showed that telemedicine and telehealth could be utilized in the improvement of maternal health outcomes particularly during COVID-19. The implementation of telehealth in developing countries during COVID-19 pandemic is important for health care delivery, continuous care and safe antenatal services. The authors suggested that more research is needed to increase the efficacy, effectiveness and quality of telemedicine in service delivery for maternal healthcare in minimizing technological inequalities and socioeconomic status. Maddox et al. (2021) showed that video-assisted resuscitation for newborn have save over $1. 2 million through increase hospital capacity, quality delivery and care. Incerti et al. (2020) revealed that maternal and neonatal mortality in Tanzania is very high as a result of poor-quality antenatal care services and postnatal care. The authors suggested that telemedicine such as PANDA system like smartphones, electronic records and other application can improve clinical screening, medical history, birth plan, health education and postnatal care. Theis PANDA system can be use in identifying high risk pregnancies and neonatal and maternal mortality. In a similar study, Tsedmaa et al. (2012) carried a study on telemedicine in providing support for newborn and maternal health in rural areas of Mongolia. The authors discovered that telemedicine is very effective and relevant strategy thus strengthening the capacity and discrepancies in quality of health for service delivery in Mongolia for childbirth complication and pregnant women. Anam et al. (2017) reported that mHelath applications is effective in providing quality medical service delivery such as postnatal care and antenatal care in Low- and Middle-Income Countries. In their study, the authors demonstrated that there is need for further

research like quasi-experimental studies or controlled trials to facilitate interpretation of data regarding m Helath in relations to maternal and child health.

**Conclusion**

Improving access to child and maternal health care system through telemedicine in sub-Saharan African remain a crucial approach to reducing morbidity and mortality rate. These technologies will help to reduce the burden of geographical and economic challenges in this sub region. The United Nations mission is to reduce the global incidence of maternal mortality rate particularly in low -income countries where 7700 maternal deaths occur yearly alone in Kenya accounting for about 32 % death of women of reproductive age, (37% in Chad, 38% in Nigeria) due to proximity disparities, socioeconomic disparities and transportation in accessing maternal care. West Africa countries are the leading countries in terms of unsafe abortions, eclampsia, sepsis and obstetric haemorrhage accounting for about 60% of the total population of women using unskilled specialist. Telemedicine is an appropriate technology for screening, provision of prenatal, antenatal and postnatal care at a distance in Africa.

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