Chapter

Utilisation of Digital Health in Early Detection and Treatment of Pre-Eclampsia in Primary Health Care Facilities South Africa: Literature Review

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Abstract

Gestational hypertension and pre-eclampsia are the most prevalent in Sub-Saharan Africa leading to undesirable perinatal and maternal outcomes. In South Africa, a high rate of maternal death was noted due to pre-eclampsia. However, the use of digital maternal health in South Africa has become of significance for reinforcement of health care. Digital health initiatives such as mobile health technologies were developed to improve better access to communities in low and middle-income countries. The implementation and practices of digital health seem to be growing expandable to achieve the UHC goals in the provision of care to all globally and nationally. This review aims to review existing literature on the use of digital maternal health to minimise admission of pre-eclampsia and early identification of gravid women who are at risk of developing pre-eclampsia.

Keywords: digital health, early detection maternal health, pre-eclampsia

1. Introduction

Maternal mortality remains a burden across the globe with 295,000 reported by the World Health Organisation. This burden continues to increase despite Primary Health Care (PHC) being are regarded as the cornerstone to curve the rise of maternal deaths due to pregnancy-related complications [1]. One of the leading causes of maternal death is reported to be pre-eclampsia [1]. Pre-eclampsia is the elevation of blood pressure (> 140 systolic mmHg and > 90 mmHg diastolic) after 20 weeks of gestation with a significant amount of protein in the urine in gravid women [2]. It accounts for approximately 5–11% of pregnancies and remains the leading cause of maternal and perinatal morbidity and mortality worldwide [3]. Also, it is reported to account for approximately 63,000 yearly maternal mortality worldwide [4].

Approximately 6% of pregnancies develop mild pre-eclampsia and 1 to 2% develop severe pre-eclampsia in the United Kingdom (UK) [5]. Furthermore, one

in six women with a history of pre-eclampsia is predicted to be most likely to have pre-eclampsia in the next pregnancy. As a result, the development of digital health solutions such as mobile health initiative applications, telemonitoring and SAFE@ HOME to diagnose and manage pre-eclampsia has been implemented and designed for use in health facilities and homes by health care providers and patients respectively. The digital health applications assist by providing recommendations on treatment, reassessment and referral [6, 7].

Digital Health is the utilisation of digital, mobile, and wireless technologies for health [8]. Digital Health innovation has become of significance in Sub-Saharan Africa for the reinforcement of health care [9]. Digital Health initiative such as telemonitoring was applied in Parkinstan to support women at risk of developing pre-eclampsia by close monitoring of blood pressure at home for earliest signs. The use of telemonitoring could lead to early detection of pre-eclampsia and the required need for treatment and admission of women with pre-eclampsia [10]. South Africa implemented mobile health initiatives such as Mom-Connect to improve foetal-maternal well-being at home by targeted communications to pregnant women with various disorders including pre-eclampsia [8].

2. Literature review methodology

The literature review is a survey of scholarly sources and a good literature review summarises, evaluates, synthesises and analyses to give a clear understanding knowledge of the proposed subject of the study [11]. The context of the study adopted a narrative literature review methodology. Narrative literature reviews identify and summarize the previously published studies, and avoid duplications; further seek new study areas [12]. The adopting of the narrative literature review methodology allowed the researcher to identify, evaluate, synthesise and critically analyse the published studies relevant to the topic of study. Moreover, the narrative literature review assisted with drafting an evidence-based global and national perspective picture underpinning the digital health utilisation by patients and health care providers.

2.1 Purpose of the literature review

The literature review aimed at retrieving current empirical evidence underpinning the utilisation of digital health in early detection and treatment of pre-eclampsia at primary health care facilities. Consequently, acquired informed knowledge on the providers' and patient's views of digital health challenges and barriers. Furthermore, the literature review was subjected to identify the extensive existence of research gaps of what is currently known to develop strategies to enhance the utilisation of digital health in early detection and treatment of pre-eclampsia at primary health care facilities. Making use of the practical evidence determined and identified through the literature review to expedite an ingenious background, comprehensive clinical judgement and standardised quality care for gravid women with pre-eclampsia. This was achieved by answering the following questions;

- What are the knowledge midwifery practitioners on utilisation of digital health at primary health care facilities?
- What is the knowledge of gravid women on utilisation of digital health?
- What are barriers to utilisation of the digital health by midwifery practitioners and gravid women?

2.2 Literature review sources identification

A thorough literature sources review was initiated as early from August 2021 using electronic databases with peer-reviewed journals such as PubMed, google scholar, science direct, paperpile and mendeley. Moreover, other sources were also reviewed through cross-referencing of other published articles. Lastly, websites and textbooks were reviewed to identify and synthesis the literature of relevance.

2.3 Selection of search terms

The selection of literature was achieved through using several key words and various combinations of words to select the appropriately relevant literature and exclude the irrelevant literature. Truncation, phrase searching, keywords searching and Boolean operators were adopted using the nesting logic to gather extensive literature relevant to the topic. Truncation and wild card searching permit the researcher to search the roots and portion of words with the variant endings; whilst Boolean operators are based on the Boolean algebra mostly used in databases and further provide the abilities to combine variant concepts to access the relevant items. AND, OR and NOT are the basic Boolean connectors [13]. Meanwhile, nesting is used to reveal search logic and the in order in which Boolean commands will be executed using parentheses.

2.3.1 Key words

The literature search was broadened by the use of; NOT, OR, AND, Vs, asterisk, exclamation mark and question mark. The literature search included keyword search, Boolean operators and truncation such as; (digital health AND utilisation), Digital health*, digital health vs. pre-eclampsia, digital health in primary health care facilities?, ((pre-eclampsia NOT eclampsia), (Pre-eclampsia AND primary health care facilities)), knowledge OR utilisation of digital health. Pre-eclampsia trends*, "digital health utilization in primary health care facilities", "Digital health". Each mechanism used with the key words search revealed an extensive literature and irrelevant literature was excluded (**Table 1**).

2.3.2 Inclusion criteria

The literature review included studies published from the year January 2010 to July 2021. Moreover, the quantitative, qualitative, mixed methods, narrative and systematic analysis were included in the literature. Lastly, the written English sources concentrating on and relevant to digital health utilisation in early detection and treatment of pre-eclampsia were included.

digital health-related terms	digital health methods, digital health in primary facilities, digital health in pregnancy, digital health vs. pre-eclampsia
utilisation of digital health-related terms	knowledge of digital health, implications of digital health
pre-eclampsia related terms	pathophysiology, perinatal and maternal outcomes

Table 1.
Key words search.

2.3.3 Exclusion criteria

Literature that was published before 2010 was excluded and not English-based was excluded. Moreover, literature irrelevant to digital health utilisation in early detection and treatment of pre-eclampsia were excluded (**Figure 1**).

2.4 Literature search findings

The findings of the literature search were as follows:
The literature has a total of 47 studies of which were qualitative, quantitative, mixed research methods, systematic review, meta-analysis review and narrative review. Other 11 kinds of literature were from websites, 3 were magister curations dissertations and 1 book was also reviewed. In addition, this literature review only included literature of relevance.

2.5 Identified themes

The thorough literature review identified the following themes of the current evidence underpinning digital health utilisation;

- Primary health care implications on maternal care
- Pre-eclampsia pathophysiology and implication
- Perinatal and maternal outcomes
- Early detection and treatment of pre-eclampsia
- Digital health in health and maternal care
- Purpose, implications and impact of digital health
- Challenges, barriers and knowledge of digital health

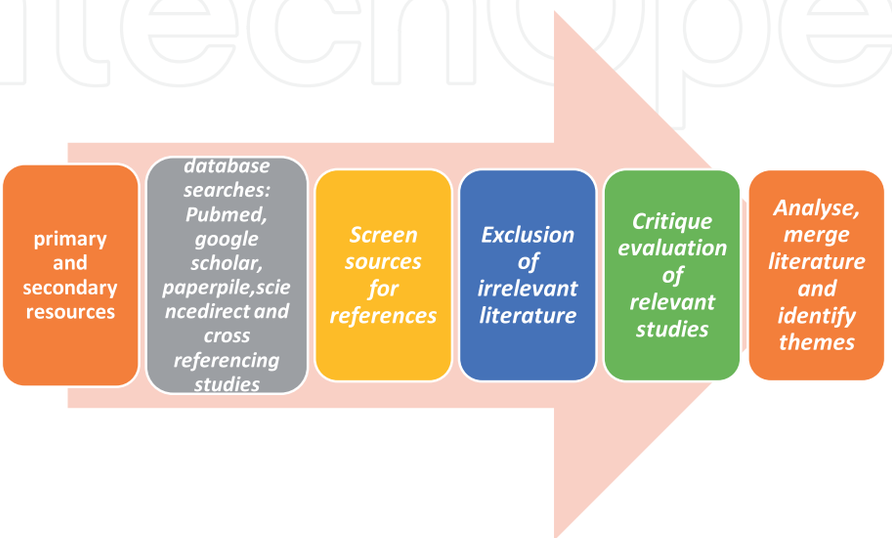

Figure 1.
Literature review process.

3. Primary health care implications on maternal care

Primary health care (PHC) is a whole of society approach to the well-being of persons that targets optimal health standards while warranting standardised quality and unbiased caretaking into consideration the individuals needs in the context of the prevention of illness such as pre-eclampsia and promotion of health, furthermore, interventions of the PHC across the developing countries expected to save approximately 60 millions of lives and possible upsurge the life expectancy by 3.7 years by the year 2030 [14].

The global health community endorsed an obligation to appoint PHC as a keystone to endeavour the sustainable development goals (SDGs) by the year 2030 [15]. However, with the achieved decrease in maternal mortality between 1990 and 2015 by 44 and 49% correspondingly. Hypertensive disorders in pregnancy (HDPs) pre-eclampsia included remain the cause of death accounting for 11 and 16% of maternal deaths and stillbirth amongst gravid women globally, respectively [15]. The aspects of classification, diagnosis and management of HDPs remains a disparity globally, therefore, leading to lack of consensus that hinders the aptitude not only to study the immediate rates of adverse effects of perinatal outcomes for the classified HDPs but also the long-term effects on the maternal and newborn's health that survived the condition [16].

A study to assess the quality of antenatal care (ANC) to detect and treat HDPs pre-eclampsia included in two-tier Nigerian establishments shown that PHC accomplished significantly worse than tertiary institutions in all elements of quality of care in assessment, diagnosis and treatment of HDPs, further substantiated that to provide optimal standard care PHC must seek to regenerate ANC programs through training to reduce disparity in quality of care [17]. A meta-analysis and systematic review of 34 studies in Etopia shown that the prevalence of HDPs and pre-eclampsia in Etopia were 6.82 and 4.74%. Showing that the prevalence of such conditions is relatively higher compared previously therefore further encouraging stakeholders and government to reinforce ANC practice to include identification of risk factors of HDPs at early ANC visits [17].

Approximately 78% of maternal deaths in South Africa at the secondary and tertiary level of care HDP emergencies such as pre-eclampsia emerged from PHC facilities and district hospitals. Moreover, such deaths were due to preventable factors at community health centres accounting for 60% of cases of maternal deaths as a result of the poor assessment, faults in diagnosing, delayed or no referrals to a higher level of care as well as non-adherence to treatment protocols and inadequate monitoring [18]. As a result of such maternal mortalities resulting from preventable factors, South Africa implemented a mobile health initiative such as mom connect to improve foetal-maternal well-being at home by targeted communications to pregnant with all kinds of disorders pre-eclampsia included and breastfeeding women via messages with the provision of information reflecting on their gestational age or postpartum period twice weekly [8].

4. Pre-eclampsia pathophysiology and implications

Pregnancy results in physiological adaptation in all the body system, however the failure of such adaptation could lead to a number of illnesses within the gravidas, such as pregnancy-induced by hypertension resulting from the failure of the trophoblast to invade the spiral arteries causing vasoconstriction and damage to the endothelial layer such as the impact on gravidas causes impact and compromise placental foetal unit likely to lead to negative perinatal outcomes [4]. Pre-eclampsia

has multifaceted pathophysiology, abnormal placentation being the most primary cause [19]. The pathogenesis of pre-eclampsia progresses in 2 stages; being abnormal placentation in the first trimester and maternal syndrome in the second and third trimester characterised by the antiangiogenic factors. A non-conclusive number of theories has been proposed for placental dysfunction; being oxidative stress, abnormal natural killer cells, genetic and environmental factors [20]. The progressive stages are as follows;

Stage 1: Abnormal placentation

In normal placentation implantation, cytothrophoblasts invade the maternal spiral arteries, to form a maternal-foetal crossing point for nutrition and other functions. However, during pre-eclampsia development, there's a failure of the cytothrophoblast to migrate into the spiral arteries. This leads to incomplete spiral artery remodelling causing spiral artery narrowing causing oxidative stress and placenta ischemia [19, 20]. The placental ischemia will result in foetal complications such as intrauterine growth restrictions (IUGR) and intrauterine death (IUD). The oxidative stress due to decreased oxygen tension results in maternal peripheral endothelial cells dysfunction causing systemic inflammatory response leading to second stage namely; maternal syndrome [19–21].

Stage 2: Maternal syndrome

The effects of stage result in decreased blood flow to the maternal organs leading to multi-organs failure in the maternal systems. The biological assessment will then indicate vasospasm, coagulation cascade activation and decreased plasma levels [21]. As a result of the endothelial cell dysfunction, a hepatic system will be affected contributing to haemolysis, elevated liver enzymes and low platelet count (HELLP) syndrome, neurological system impairment (cerebral endothelial damage) causing neurological disorders [19]. Moreover, the endothelial dysfunction results in renal system impairment, i.e. acute kidney failure and proteinuria [22]. Lastly, the endothelial dysfunction promotes microangiopathic haemolytic anaemia and

Box 1 | Risk factors for pre-eclampsia from three systematic reviews[13 18 19]

- Chronic hypertension
- Antiphospholipid antibody syndrome
- Systemic lupus erythematosus
- Pre-gestational diabetes
- Chronic renal disease
- Multifetal pregnancy
- Pre-pregnancy BMI >30
- Previous stillbirth
- Nulliparity
- Maternal age >40
- Increased pre-pregnancy BMI
- Long inter-pregnancy interval (>5 years)
- Reduced school education
- Previous pre-eclampsia
- Assisted reproduction
- Previous intrauterine growth restriction
- Previous placental abruption

Figure 2.
pre-eclampsia risk factors [21].

hyperpermability linked with low albumin levels causing pulmonary and peripheral oedema [19]. Pre-eclampsia is associated with the number of risk factors as outlined in the table below (**Figure 2**) [21].

5. Perinatal and maternal outcomes of pre-eclampsia

Globally, approximately 10% of pregnant women develop hypertension during pregnancy and 2–8% of the pregnancies are complicated by pre-eclampsia [23]. Approximately 10–15% of direct maternal deaths leading to undesirable physiological changes in the kidneys, liver, brain, and clotting systems, further associated with poor foetal outcomes such as poor foetal growth and prematurity [24]. More than a half-million women died during pregnancy and childbirth across the globe in 2000 and 2002. It was also estimated that half of these maternal deaths occurred in Africa (251000) and about 48% in Asia (253000) [25].

In Sub-Saharan Africa (SSA), a meta-analysis of 13 studies in Etopia revealed that out of 5894 women diagnosed with hypertensive disorder 4% died and 13% had HELLP syndrome. Moreover, adverse perinatal outcomes were reported with perinatal death at 25% and prevalence of low birth weight at 37% [26]. Hence it is of recommendations to develop strategies and policies to enhance quality maternal health services [26]. As cited by [27] WHO estimates that the prevalence of pre-eclampsia in developing nations is seven times that of developed nations, furthermore, the rates of pre-eclampsia in African countries vary from 1.8 to 7.1%, with Nigeria prevalence varying from 2–16%.

Gestational hypertension and pre-eclampsia are the major causes of maternal and perinatal morbidity and mortality in low and middle-income countries [28]. Severe pre-eclampsia remains a major burden health problem is Sub-Saharan Africa leading to undesirable perinatal and maternal outcomes [29]. Gestational hypertension and pre-eclampsia are the most prevalent in Sub-Saharan Africa with 4.1 and 4.1%, respectively; these may be due to poor-seeking behaviour, present late and with advanced disease [30].

A prospective cohort study conducted at three South African tertiary hospitals to describe the maternal and perinatal outcomes on women with pre-eclampsia reported that hypertensive disorders remain a burden amongst pregnant women [31]. It was also reported that the incidence of pre-eclampsia is relatively in obese women and pregnant teenagers. Further reported that obese women and pregnant teenagers were more prone to pre-eclampsia complications such as perinatal deaths and preterm deliveries [31]. Furthermore, Nathan et al. further reported that out of 1547 women having pre-eclampsia 1% died, 0.3% had a stroke whilst approximately 9.5% progressively developed eclampsia and kidney injury at 17.6% [31]. Moreover, it was reported out of 1589 of the births were associated with perinatal deaths at 21 and 84.5% of stillbirths; 1308 of live births were preterm deliveries. A dissertation on factors contributing to stillbirth at Witbank hospital corroborated that hypertensive disorders pose a significant risk to the well-being of the mother and the foetus. It was reported that approximately 12% of the women admitted at Witbank hospital had stillbirths were due to hypertensive disorders in pregnancy [32].

6. Early detection and treatment of pre-eclampsia

Detection of early-onset pre-eclampsia can be achieved through effective screening as early as the first trimester. Moreover, screening can be achieved via

certain methods such as maternal history screening by combination of maternal risk factors, placental growth factor, mean arterial blood pressure and uterine artery Doppler [33]. Digital health has been introduced in maternal health to help curve maternal mortalities rise due to preventable conditions such as pre-eclampsia. A retrospective study for early prediction of pre-eclampsia using machine learning through analysis of clinical and laboratory data in previous ANC visits; revealed that a significant set of features for prediction of pre-eclampsia were identified which shown significantly elevated prediction performances of the risk of pre-eclampsia [34]. Early detection of pre-eclampsia is a global burden that should be addressed. The study developed a wearable device to monitor women at risk of pre-eclampsia using the identified risk factors and blood monitoring the prototype yielded good results for identification of the biomedical signals. However, comparison of the methodology is still to be done with another facility [35].

Digital health can overcome access limiting factors and lack of trained HCP in low-resourced settings through mHealth solutions. Studies have evidently proven mHealth can benefit pre-eclampsia women through early detection and symptoms control. mHealth has a great potential for improving clinical practice as positive results were reported on maternal health improvement through digital health [28]. The use of digital health such as electronic health (eHealth) showed improved efficiency and suitability of care, moreover had an effect on mortality, readmissions, and total costs [36]. Furthermore, the use of digital health such as mobile technology through self-monitoring of blood pressure amongst women at risk of pre-eclampsia reduces perinatal and maternal mortalities and morbidities due to pre-eclampsia and reduces the number of hospitalisations [37].

7. Digital health in health and maternal care

Digital health is a comprehensive category entailing mobile health, electronic health, and telehealth and health data. It strengthens health systems through bringing such services directly to their homes and unprivileged communities; further map illness outbreaks and digital tool integration to make health care to be more productive and approachable [38]. Over the past 20 years, digital health technology has been splendidly growing to improve health and maternal health. Furthermore, the digital health technologies vary some are client-focused meaning they provide women enhanced capabilities to raise their health and risk consciousness, self-participated monitoring and management in preconception, antenatal and postnatal period. In addition, provides awareness of any pregnancy-related complications such as pre-eclampsia and treatment as well as lifestyle and health choices [39].

While some digital health technologies are provider-focused digital health technologies; they enable substantial management of obstetric complications during primary consultation, admission and referral process. Telemedicine and telecare are the common examples of digital systems that encompass access to specialist services behind the limitations of the clinic. In addition, the systems are developed for healthcare professionals and introduced into the high-risk patients, i.e. pre-eclampsia women [39]. Digital health innovations are not the replacements for the health system in place, however, they empower and enhance the components of the health systems to make an informed decisions and optimise health outcomes [40]. The national department of health (NDoH) on the national digital health strategy for South Africa for 2019–2024 (NDHSSA) substantiated that digital enable support for

health sectors for a health life for the population through health systems strengthening to enable service delivery. Moreover, further enables effective patient care and personal empowerment needed to achieve universal health coverage (UHC), [41]. A case study to improve maternal health through digital health using mobile technology indicated that maternal mortality remains a burden across SSA. Corroborated that mobile communication encourage the provision of fast and accessible care. Moreover, it was found that digital health through mobile devices increase workplace efficiency and enable faster decision making amongst health care providers (HCP) [42].

In South Africa the public health system distorted to more comprehensive and cohesive health systems [43]. The use of public health services across the scale of care was highest in SSA. Approximately 94% of pregnant women attended ANC and 76% attended the recommended ANC visits showing active utilisation of such services to achieve the MDG 5. However, this use of public services was linked to digital health initiatives such as mom connect [43].

8. Purpose, implications and impact of digital health

Digital health primarily aims to provide widespread reachable and digestible information to all stakeholders. It provides high-quality information essential to researchers, patients, health care providers, social scientists, industries and government [44]. Digital health includes variants of sets such as mobile health, telehealth, telemedicine, health information technology, wearable devices and personalised medicine. Digital health can improve the diagnosing and treating of illnesses, further heightening the rendering of health care for each person [45]. The use of digital health can assist in reaching well-informed decisions with one's health and provide alternative options for facilitating prevention, early diagnosis of life-threatening diseases, and management of diseases outside the health care facilities. The stakeholder's implications with regards to utilisation of digital health were that optimise patient care and personalise individual's care through reduction of inefficiencies and costs, improved accessibility, optimal quality and more patient-oriented care [45, 46].

A qualitative perspective of community health workers on using health mHealth to improve health care delivery in India revealed that mHealth was accepted by community health workers because it sought of improving their status in their communities [47]. However, there was a mix of negative and positive perceptions surrounding the use and impact of the mHealth software such as underlying mistrust, socio-economic barriers in engagement and technological barriers in implementation [47].

9. Digital health methods

Approximately 3–10% of pregnancies are complicated by hypertensive disorders [48]. Around 30,000 women yearly due to hypertensive disorders in pregnancy [49]. This shows that the use of digital and telehealth can considerably benefit women at risk of hypertensive disorders and ensure early detection of symptoms and treat the symptoms and improve maternal and perinatal outcomes during and after pregnancy [28, 50]. A randomised controlled trial study to improve maternal and neonatal health in Bangladesh, corroborated that using digital health such as mobile can make great contributions in reducing maternal and neonatal mortalities

[51]. The digital methods below will be client-focused and provider-focused from global, SSA and South Africa.

However, below are the digital health methods used by various countries to strengthen the maternal digital health system for high risk and low-risk pregnancies;

9.1 Mobile initiatives

9.1.1 International

- Text4Baby

Text4baby is a mHealth initiative in the United States that provides timely messages to pregnant women and puerperia's with regards to their wellbeing. Furthermore, the mHealth addressed the prenatal and postnatal being of the women with messages addressing the pregnancy, labour, nutrition and when to reach health care [52]. Text4Baby is one of the patient education strategies to help curve the rise of maternal and perinatal morbidity and mortality due to pre-eclampsia [53].

- Smart mom

Smart mom is a Canadian mHealth initiative focused on prenatal education on pregnant women through text messages. Smart mom guide women throughout pregnancy by the provision of evidence-based information developed by experts in maternal and child health [54].

- Mobile4Health

In response to significantly high maternal mortality rates in Bangladesh due to maternal pregnancy-related conditions such as pre-eclampsia, the Mobile4Health initiative was developed. The mobile health initiative aimed to provide pregnant women with information via messages for self-care relating to their conditions and postpartum care [42].

9.1.2 Sub-Saharan Africa

- Pigia daktari

Pigia daktari is a Tanzanian telemedicine mobile app developed for use by HCP and patients to access specialised care especially for patients in communities with no specialised care. Moreover, it encourages the utilisation of referral systems and its user-friendly interactive box; it aims to identify and solve existing barriers to access and provide consistent and timely optimised health services [55].

- Wazazi Nipendeni

Wazazi Nipendeni is a mHealth initiative used by Tanzanian pregnant women to receive tailored messages with regards to pregnancy and gestational age as well as the health of their infant. The mHealth was implemented to reduce high Tanzania's maternal and infant mortality ratio [56].

9.1.3 South Africa

- Mom connect

Mom connect is a South African client-focused digital mHealth initiative utilised by pregnant women and puerperia's through any mobile device integrated with maternal and child health services via messages in all 11 official languages [57]. Mom connect has registered over more than 60% of gravid women nationally and registered approximately 1.7 million subscribers since 2014, maternal health service will improve maternal health services and most patients were enthusiastic about utilisation of the mHealth [58].

- Essential Medicine guidance

Essential medicine (EM) guidance is a provider-focused digital health app initiative that encompasses 12 local clinical guidelines and decision-making tools for HCP. Moreover, EM guidance assists the HCP in accurately diagnosing and management of conditions such as pre-eclampsia utilising South Africa's comprehensive evidence-based medicine sources [59].

9.2 Telemedicine and telehealth

- SAFE@HOME

SAFE@HOME is a digital health platform designed to monitor daily blood pressure monitoring and symptoms amongst women with chronic hypertension, history of pre-eclampsia and pre-eclampsia in the Netherlands [7]. The evaluation of the care telepath noted a significantly minimal admission amongst women of hypertension and suspected pre-eclampsia with the utilisation of the SAFE@HOME tele monitoring. Moreover, telemonitoring of blood pressure amongst women is feasible in high-risk patient for early detection and has the potential to change antenatal care (ANC) [7].

9.3 Medical social media

Social media platforms are regarded as one of the digital health initiatives widely. A cross sectional study to determine how individuals used social media for evidence maternity care stated that women were highly engaged in utilising social media to access and share maternity information [60]. Furthermore, the utilisation of maternal health care services was significantly higher amongst women who were exposed to mass media across countries and such women were 46–86% likely to receive ANC [61].

A study conducted in Ota, Nigeria to identify sources of maternal health awareness and examine the means of access to maternal information corroborated that the internet was the most used source to access maternal health awareness services at 49% and followed by adverts and campaigns at 30.6% [62]. In addition, apps claim to sanction for greater convenience, connectivity and efficiency. Social media such as Facebook have many users and allow women to access and share information with other moms with regards to their pregnancy [63].

9.4 Digitised health record platforms

Digitised health records systems are technological innovations adopted by numerous health institutions. A study indicated that the use of electronic medical records for maternal and child care and health most like improve health care; as supported by the results that the women who had prenatal care visits with the HCP who adopted the electronic health record (EHR) were most likely to have well-child

visits [64]. A qualitative analysis of the user of EHR in the maternity care environment described it as being favourably, whilst other midwives are shown limited understanding of the EHR [65]. However, a systematic review in South Africa to identify success factors for the implementation of EHRs identified social, technical and environmental barriers, i.e. lack of supporting infrastructure, political influence, legislation and regulations, user's training and commitment, and lack of structure implementation and management [66].

10. Challenges, barriers and knowledge of digital health

Despite the standard benefits and implications of digital health in clinical practice to diagnose, treat, disease management and prevention and wellness; challenges and issues arose such as doctors not having adequate information for prescription and use digital health technologies [46]. A perspective review on critical perspectives on digital health technologies reported a number of complexities on patients' perspective on the use of digital health such as telehealth; some patients felt that they had slight control over their doctors' decision to use technologies and wish to continue using the ordinary patient-doctor model [67]. A digital health: a path to validation review conducted in the United States of America (USA) stated that the concept of digital health continues to evolve and digital health technologies are being used worldwide in medicine to diagnose, treat and clinical decision support [68]. The impact of digital health technologies on optimising individuals' health and well-being is extraordinary as the technologies have transformed clinical practice from prevention to disease management and self-management [69]. However, despite the uprising of digital health in clinical practice, challenges were noted during the path to validation of digital health hindering the extensive implementation of evolving approaches such as health digital scorecard and requirements-driven approach [68]. Three challenges were noted namely; conceptual, financial and organisational and operational challenges.

In a study conducted in the United States, lack of technical support, lack of authentication of expertise and lack of expertise usability were the barriers to implementation of digital health by patients with hypertension [70]. There is a number of contributing factors hindering the implementation of electronic health (e-Health) programmes in Uganda such as poor coordination and communication, untrained health personnel, loss of network connection, lack of knowledge and skills about telehealth, illiterate community and people financial status [71]. A study in the implementation of digital health technology such as mHealth applications in Botswana aiming to reduce patients and HCP barriers inaccessibility to care and knowledge, respectively, indicated that numerous social and technical challenges were faced; such as cultural misalignment between the Information technology (IT) and HCP, unreliable IT, infrastructure accidental damage to mobile devices and malfunctioning mobile devices [72]. There are unravelling barriers in adoption of digital health at the primary health care level in African Countries by health care providers such as lack of technology knowledge, lack of innovation acceptance, limited knowledge and abilities of utilisation of digital health, absence of enthusiasm and poor organisational and management level [73]. Furthermore, study conducted in Iran shown significant poor knowledge of health care providers in utilisation of digital health and most probably due to lack of training [73].

Approximately 79% of pregnant women utilising mom connect in the year 2017 asked questions related to health and others were about disrespect and abuse from the midwifery practitioners, showing significant utilisation of digital health [58]. Further showing that improper communication amongst the midwifery

practitioners and gravid women can further hinder the utilisation of digital health by gravid women. However, despite the improper communications, approximately 2.5 million pregnant women registered for the digital health initiate by 2019. Evidence shows effective usage of digital health amongst pregnant women [41]. The working conditions can hinder optimal midwifery care to the patient such as the implementation of digital health; this supported [74] that absenteeism, shortage of staff, work overload of staff and overcrowding of patients in healthcare facilities are contributing factors to perinatal morbidity and mortality. This significantly remains a major common barrier in the provision of standardised care such as improper teaching of pregnant women such as the utilisation of mom connect.

11. Conclusion

Despite the digital health initiatives and digital health methods utilisation growing expandable across the globe, the empirical evidence pertinent to digital health utilisation to maternal health services to early detect and treat pre-eclampsia was limited. The extensive literature review showed significant extensive existence of research gaps in digital health utilisation in maternal services. Therefore, it remains within the jurisdiction of the department of health and researchers to research beyond to identify facilitators and impediments of strengthening maternal digital health systems amongst high-risk pregnant women in South Africa, to develop quality standards and more evolved digital health initiatives supporting the maternal and child health. Moreover, for South Africa to achieve the UHC goals more context-rich digital health solutions need to be developed to improve the accessibility of services and further achieve the millennium developmental goal 5.

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