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DIGITAL TECHNOLOGY AND REPRODUCTIVE HEALTH: ENHANCING OUTCOMES FOR WOMEN IN NIGERIA

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ABSTRACT

Reproductive health is a foundational aspect of public health and human rights, yet millions worldwide particularly in low-resource settings continue to face significant barriers in accessing quality services. This paper examines the transformative role of digital technology in addressing these disparities and improving reproductive health outcomes. It explores innovations such as mobile health (mHealth) applications, telemedicine, wearable technologies, artificial intelligence and Short Message Services (SMS) based interventions, highlighting their impact on healthcare access, education and policymaking. Drawing on recent evidence, the paper demonstrates how technology enhances autonomy, privacy and service efficiency while identifying key challenges such as digital literacy, infrastructure gaps and data privacy concerns. It argues that inclusive, ethically governed technological interventions are essential for achieving universal health coverage and advancing Sustainable Development Goal 3: Good Health and Well-being. A rights-based, user-centred approach to digital health is imperative to ensure equitable reproductive care for all.

Keywords: Reproductive Health, Digital Technology, mHealth, Access to Care, Health Equity

Introduction

Reproductive health remains a critical dimension of global public health and human rights, yet it continues to face entrenched barriers ranging from cultural taboos and legal restrictions to inadequate infrastructure and workforce shortages. These challenges are especially pronounced in low-resource and rural communities, where access to essential services like antenatal care, contraception and safe delivery is often limited or altogether absent. According to the World Health Organisation (WHO), over 700 women die every day from preventable causes related to pregnancy and childbirth, while millions more lack access to modern contraceptives, safe abortion care and accurate reproductive health information

(WHO, 2023). Efforts to address these disparities align with Sustainable Development Goal 3 (SDG 3), which seeks to ensure healthy lives and promote well-being for all by 2030. A major target under this goal is the reduction of maternal mortality and the universal access to sexual and reproductive healthcare services (United Nations Children's Fund (UNICEF), 2023). However, the pace of progress has been uneven, with many countries struggling to integrate reproductive health into national programmes or provide inclusive, equitable service delivery.

The term digital technology refers to gadgets like computers tablets and cell phones as well as the plethora of digital activities that people use (Omokhabi, 2021). Digital technology has been useful in offering users a variety of tools, services and usage patterns that have expanded and are drastically altering people's lives (Omokhabi,2023)..Digital technology has emerged as a powerful enabler, offering new avenues to strengthen reproductive health systems and reach underserved populations. As noted by WHO (2023), digital tools have expanded access to essential services such as contraception, fertility awareness, safe abortion, maternal health and sexual expression through platforms that promote privacy, autonomy and real-time support. Digital heath apps and tools like mobile health, mobile apps, Short Message Services (SMS)-based interventions, telemedicine and wearable health trackers are empowering individuals particularly women and adolescents to make informed reproductive choices while navigating restrictive or stigmatising environments. Digital health systems also contribute critical data for health planning, enabling governments and organisations to develop responsive, evidence-based interventions. As technology becomes increasingly embedded in daily life, its strategic use offers unprecedented potential to improve reproductive health outcomes provided that digital solutions are inclusive, rights-based and aligned with public health goals. This study explores reproductive health in the digital era, outlining its definition and scope and examining the shift from conventional to digital methods in sexual and reproductive health (SRH). It highlights the role of various digital tools in improving reproductive health, underscores their significance and explores the barriers users may face in their adoption.

Reproductive Health in the Digital Age

Digital health technologies (DHTs) involve the use of information and communication tools in medicine and healthcare to prevent, manage and treat health conditions while also promoting overall well-being. This field covers a wide range of innovations, including wearable gadgets, mobile health (mHealth) apps, telehealth services, Electronic Health Records (EHRs) and telemedicine. The five pillars of Sexual and Reproductive Health and Rights (SRHR) include: eradicating unsafe abortions, improving antenatal, perinatal, postpartum and neonatal care, providing high-quality contraception and infertility services, preventing and treating Sexually Transmitted infections (STIs) including Human Immunodeficiency Virus (HIV) and reproductive tract infections and preventing cervical cancer (Tamrat et al.,

2024; World Health Organisation 2024 in Omokhabi et al., 2025). The growing interest in digital health is driven by its potential to expand access to care, minimise inefficiencies in healthcare delivery, enhance the quality of services, reduce costs and offer more tailored and patient-centred healthcare solutions (WHO,2021; WHO, 2024).

Reproductive Health: Definition and Scope

Reproductive health is a state of complete physical, mental and social well-being in all aspects of the reproductive system, not just the absence of illness. It ensures individuals can have a safe and satisfying sexual life, the ability to reproduce and the freedom to decide if, when and how often to have children (International Conference On Population and Development (ICPD), 1994).This includes access to quality, affordable, lawful family planning and maternal care and services that support healthy pregnancies and parenthood (United Nations (UN) 1995). Reproductive health care involves a range of services that promote well-being, prevent and treat reproductive issues and improve sexual health beyond reproduction. Both sexes should have access to accurate information and suitable services that respect their choices. Reproductive rights are part of fundamental human rights, allowing individuals to make informed decisions about childbearing without discrimination, coercion, or violence. Women's autonomy and shared responsibility in relationships are vital for gender equality (UN, 1995). Because it affects their reproductive anatomy reproductive health and behaviour is significant in every household. Women were not given the chance to voice their opinions on issues about their own lives in Nigeria and other parts of the world which made them vulnerable (Olajide & Omokhabi, 2014). As development agents they often face challenges like limited access to healthcare education and credit (Omokhabi & Fajimi, 2023). Despite this, many face barriers such as stigma, misinformation, cost, lack of confidentiality and cultural or religious restrictions (Cook & Dickens, 2014; Wahyuningsih et al., 2024; Olajubu et al., 2025). Recognised as both a public health and human rights issue, reproductive health remains unequal globally, with women in developing regions most affected (Fathalla & Fathalla, 2017).

The World Health Organisation (WHO 2010) defines reproductive health as a state of complete physical, mental and social wellbeing in all areas of the reproductive system including sexual health. Omokhabi and Egunyomi (2016) assert that development depends on advancing and ensuring women's health particularly reproductive health. Akanbi and associates (2024) submitted that reproductive health was acknowledged by the United Nations (UN) as a lifelong aspect of general health and well-being and as a necessary condition for social, economic and human development .Reproductive health includes family planning, sexual health and maternal health. Women who want to engage in these health-related activities must be in good physical and mental health. According to Omokhabi (2014) this suggests that family planning, safe motherhood, safe and fulfilling sex,

prevention and treatment of Sexually Transmitted Infections (STIs) and reproductive tract infections and the decision-making authority related to these are the most crucial aspects of reproductive health. Since reproductive health behaviour describes the somatic emotional ,intellectual and social aspects of sexual being in ways that positively enrich and enhance an individual's personality it refers to a positive approach to women's sexuality and aims to equip women for physical, mental and social well-being rather than just being disease-free (Osakinle 2007 in Omokhabi, 2016)

Covering the full life cycle, reproductive health includes sexual health, maternal and child care and must be accessible in all contexts including emergencies while respecting cultural values and human rights (United Nations High Commissioner for Refugees (UNHCR), 1999). According to ICPD (1994) the scope of reproductive health includes:

Family Planning Services: these entail teaching people and couples about birth control options and assisting them in determining the ideal number and spacing of children. To prevent unintended pregnancies, lower maternal and infant mortality and enhance the quality of life for women and their families family planning or FP is essential (Kavanaugh & Anderson 2013). Using family planning has advantages outside of the medical field. According to Sonfield Hasstedt Kavanaugh and Anderson (2013) in Omokhabi (2020) unequal access to contraceptives for example will help guarantee a decrease in unintended pregnancies which will in turn support greater female education, women's empowerment, poverty reduction and even environmental sustainability.

Maternal and Child Health: includes prenatal, antenatal and postnatal care aimed at ensuring safe pregnancies and healthy infants.

Sexually Transmitted Infections (STIs) Prevention and Management: the spread of diseases like syphilis, gonorrhoea and Human Immunodeficiency Virus (HIV) /Acquired immunodeficiency syndrome (AIDS) can be stopped with early detection, treatment and education. Essential elements of women's reproductive health include menarche, menstruation fertility, pregnancy, childbirth, gynaecological problems, cancer, sexually transmitted Diseases (STDs) sexuality and sexual health and function (Omokhabi, 2024).

Adolescent Reproductive Health Education: providing age-appropriate, accurate sex education to teenagers to prevent early pregnancy and promote healthy sexual behaviour.

Infertility Management: access to medical services and counselling to help couples who experience difficulty conceiving.

Menstrual Health and Hygiene: menstruation is the term for the cyclical physiological process that occurs in females of reproductive age during the menstrual cycle during which the uterine endometrium sheds through vaginal bleeding. According to

Howard et al. (2025) the hypothalamic-pituitary-ovarian axis coordinates changes in oestrogen and progesterone levels which are primarily responsible for controlling this. The menstrual cycle which lasts for two to seven days and happens to women every 21 to 35 days, is a physiological and health-related natural cyclical event which causes bleeding of approximately 25 to 80 mL per menstruation (The Lancet Child Adolescent Health, 2018). Women between the ages of 12 and 50 face practical challenges because of their monthly menstrual cycle (Omokhabi, 2025). Making sure women and girls have access to menstrual products and correct information to improve hygiene and lessen stigma

Contraceptive Access and Counselling: Helping individuals select safe and effective contraceptive methods based on personal and medical factors.

Reproductive Rights Awareness: Educating individuals, especially women, about their rights related to sexual and reproductive health to reduce coercion and discrimination.

The Shift from Traditional to Digital Approaches in Sexual and Reproductive Health (SRH)

Traditionally, sexual and reproductive health (SRH) services were delivered through in-person clinics, community outreach and face-to-face education. These methods, while useful, often excluded marginalized groups due to distance, stigma, cost and lack of culturally appropriate care (Wahyuningsih et al., 2024). With the rise of digital technology, SRH service delivery has evolved. Digital health, using Information Communications Technology (ICT) to promote health now supplements or replaces traditional approaches through tools like mobile apps, telemedicine, online counselling, chatbots, SMS education, wearable devices, electronic medical records and AI-driven data tools (Ronquillo et al., 2017; WHO, 2023). Mobile platforms provide a means to obtain contraceptive guidance, appointment reminders, virtual consultations, educate youth on sensitive topics like menstruation, consent and safe sex, often more effectively than traditional methods (Lund et al., 2014; Abdul Hamid Alhassan et al., 2025; Otu et al., 2025; Zheng et al., 2025).

Digital technologies, especially mobile health (mHealth), are transforming how individuals interact with healthcare systems. mHealth leverages mobile apps and wireless tools to expand access, improve care quality and support health education and behaviour change. It enables services like fertility tracking, pregnancy monitoring and contraceptive reminders, empowering users to take charge of their well-being (WHO, 2018; Haider et al., 2019). Mobile health refers to the delivery of health services and information through mobile phones, tablets and similar devices (Rodríguez et al., 2018). mHealth supports secure, cost-effective healthcare using digital tools. Mobile tools are especially impactful due to their widespread use and accessibility by 2015, over 7 billion mobile subscriptions existed globally, with over 70% in low- and middle-income countries (LMICs), where phones are often more available than basic services

(WHO, 2018). mHealth apps promote behaviour change, disease prevention, chronic condition management and self-care (Varshney et al., 2022; Amer et al., 2022). They offer more convenience, interactivity and personalisation than traditional eHealth platforms (Luo et al., 2021) and have been linked to better mental well-being and psychological resilience (Wang et al., 2021). By fostering autonomy, these tools improve quality of life and reduce healthcare costs (Alaiad et al., 2019). Although these innovations support improving health issues like digital literacy, data privacy and access there is also the possibility of deepening inequalities if not well implemented.

Technological Tools Used in Reproductive Health

Digital technologies are reshaping reproductive health by improving access, quality and user autonomy. Various tools offer flexible, discreet solutions especially for underserved groups and a wide range of functions to support disease management, wellness and preventive care. Apps, tools, devices and services such as:

- Fertility tracking apps, such as Clue and Flo, assist users in monitoring menstrual cycles, ovulation and fertile windows for family planning purposes.

- Pregnancy and parenting apps like What to Expect and Baby Tracker offer guidance and support throughout pregnancy and early child-rearing.

- Sexual health education apps, including sexual disease and infection, family planning sexual health tips provide information on STIs, contraception and healthy relationships.

- Menstrual health apps, such as Period Tracker and My Calendar, help users track their periods and manage Pre Menstrual Syndrome-related symptoms. These digital tools promote informed decision-making and self-care in reproductive health.

Telemedicine and e-Consultation: Telemedicine, or telehealth, uses digital technology to deliver healthcare remotely through video calls, phone, or messaging. It improves access for people in rural or underserved areas by removing geographic and logistical barriers. This approach supports timely emergency care, reduces delays and enhances clinical decision-making (Kamal et al., 2024). Additionally, telemedicine enables personalised services, easier access to specialists and more efficient data sharing among providers. It also minimises travel for clinicians, allowing them to focus more on patient care (Haleem et al., 2021).

SMS and Voice Messaging Services: Short Message Services (SMS) are increasingly utilised in mobile health (mHealth) programmes to provide essential reproductive health information to individuals. Mobile messaging is increasingly being utilised to enhance

reproductive, maternal, neonatal and child health outcomes. Studies show that various communication methods such as SMS and voice messages consistently lead to high user satisfaction, strong comprehension and the acquisition of valuable information (Lund et al., 2014). SMS, in particular, stands out as the most cost-effective and efficient method due to its lower costs, higher delivery success and greater potential to drive behaviour change Ronquillo et al., 2017; WHO, 2023). However, many users lack access to personal mobile phones, making voice messages often accessed via shared or community devices a crucial alternative. Providing diverse communication channels has proven essential for reaching broader audiences, especially those who are not literate or do not own mobile phones (Crawford et al., 2014).

Wearable Devices and Remote Monitoring: Wearable technology is becoming an important innovation in healthcare, especially for improving real-time monitoring and preventive care in sexual and reproductive health. Devices like smart watches and fitness trackers are now used to monitor vital reproductive health indicators such as ovulation cycles, hormone levels and menstrual patterns. These tools also help in the early identification of issues like sexually transmitted infections (STIs) and menstrual irregularities, promoting timely medical intervention. By enabling more personalised care, wearables empower users to take greater control of their health. Nonetheless, concerns around data privacy, device accuracy and accessibility must be resolved to maximise their benefits. While wearables show great promise in reproductive health care, further research is needed to address these challenges and ensure broader, equitable use (Ronquillo et al., 2017; WHO, 2023; Negara, 2024).

Artificial Intelligence (AI) and Chatbots: .Ojokheta and Omokhabi (2023) noted that among the most cutting-edge technological instruments of the fourth industrial revolution (4lR), Biotechnology Robotics, Web3, Blockchain ,Cloud computing, Quantum computing, Internet of Things (IoT) ,3D printing ,Virtual Reality (VR) Augmented Reality and Artificial Intelligence (AI) are all widely utilised in human endeavours. Furthermore Artificial intelligence (AI)-related technologies are developing rapidly with important ramifications for multiple industries (Farahani & Ghasmi 2024 cited Ajiye & Omokhabi, 2025). AI tools support predictive analytics, identifying high-risk pregnancies, guiding timely interventions, enhancing fertility care and improving early disease detection (Gbagbo et al., 2024). AI and Chatbots are transforming reproductive healthcare by providing personalised, accessible and round-the-clock support. Chatbots offer anonymous, non-judgmental SRH information, helping users engage with sensitive topics and connect to services (Mills et al., 2023), while AI chatbots show high accuracy and safety, risks like misinformation highlight the need for ongoing oversight and further research across diverse populations (Latt et al., 2025).

Benefits of Digital Tools for Reproductive Health

The integration of digital tools into reproductive health care has transformed how

individuals access information, monitor health and receive medical services. As global health systems increasingly adopt technology-driven approaches, digital innovations are improving the reach, quality and personalisation of reproductive health services. These tools play a crucial role in addressing barriers related to geography, stigma and resource limitations, especially in underserved communities. Below are the key benefits of digital tools for reproductive health.

Enhanced Access to Information and Services: Digital technologies have improved access to reproductive health by breaking barriers such as distance, stigma and limited infrastructure (Bacchus et al., 2019). Tools like mobile health (mHealth) apps, SMS reminders, telemedicine and digital education platforms provide timely, accurate and confidential reproductive health information especially benefiting women and adolescents. mHealth interventions have increased uptake of family planning, antenatal care and menstrual health services. For instance, Akande et al. (2024) reported improved SRH knowledge and decision-making among adolescents using mHealth tools. Telemedicine further expands access by enabling remote consultations and discreet services, supporting autonomy and reducing health disparities.

Increased Access to Care in Underserved Areas: Digital technologies like telemedicine, mHealth apps and SMS platforms expand reproductive health services to remote regions by overcoming distance, infrastructure gaps and workforce shortages. They connect users to reliable information, remote consultations and prenatal support, even without nearby clinics. These tools lower costs, ensure confidentiality and improve SRH education especially for adolescents through accessible mobile and internet-based platforms (WHO, 2024; Zettergren, 2024; Mohamed, 2025).

Increased User Engagement and Empowerment: Digital technologies have significantly increased user engagement and empowerment in healthcare by making information and services more accessible, interactive and personalised. Mobile apps, health portals and wearable devices allow users to actively monitor their health, track progress and make informed decisions. These tools foster greater involvement in care, encourage healthy behaviours and support self-management of conditions. By giving individuals more control over their health, digital technologies promote autonomy, confidence and better health outcomes (Bacchus et al., 2019; Khosla et al., 2023; WHO,2024).

Improved Reproductive Health Outcomes: Digital technologies have enhanced reproductive health by improving access to information, services and support. Tools like mHealth apps, telemedicine and online resources provide timely guidance on contraception, fertility and maternal care, empowering women and adolescents to make informed choices. Telehealth reduces care delays, especially in remote areas, while mobile reminders boost antenatal visits and contraceptive use (Bacchus et al., 2019; Khosla et al., 2023). These platforms also

ensure privacy, helping users access services free from stigma. Overall, digital tools promote early intervention, better health behaviours and improved outcomes, including safer pregnancies and greater reproductive autonomy (Alawiye,2024;WHO, 2024).

Better Management of Reproductive Health and Enhanced Privacy: Digital technologies empower women and adolescents by offering private, stigma-free access to reproductive health information and services. Tools like mobile apps, telehealth and secure messaging support informed, independent decision-making, especially in restrictive cultural settings (WHO, 2024). AI-driven platforms further enhance autonomy by delivering personalised, accurate health guidance, helping marginalised groups overcome barriers to care and education (Bacchus et al., 2019; Khosla et al., 2023).

Empowerment through education and self-management: Digital technologies in reproductive health empower women by providing accessible education and tools for self-care. Mobile apps, SMS services and online platforms offer vital information on contraception, menstrual health and maternal care, enabling women to make informed decisions. These tools promote autonomy, improve health outcomes and support women in managing their reproductive health with confidence and independence. DHTs empower women by promoting autonomy and actively involving them in making informed decisions about their treatment options, health management, preventive care and lifestyle choices(Bacchus et al., 2019; Goh et al., 2022; WHO, 2024).

Improves data for healthcare planning and interventions: Digital technologies play a critical role in improving healthcare delivery by supporting data collection, analysis and communication. Tools such as telemedicine provide real-time access to patient records and promote teamwork among healthcare professionals, which contributes to better clinical outcomes (Hollander, 2020). Similarly, mobile health applications integrated with clinical decision support systems help healthcare providers make informed, evidence-based choices, as shown in the findings of (Laranjo et al., 2018). Reliable and up-to-date data is essential for planning healthcare services and implementing targeted interventions. Advanced data systems including electronic health records (EHRs), digital health exchanges and centralised registries enable health authorities to track disease patterns, manage resources effectively and respond based on evidence (Hollander, 2020). Access to real-time data also helps identify public health risks early and improves targeted responses, especially in maternal and child health (Aderaldo et al., 2023; Sinha et al., 2024). In the field of reproductive health, high-quality data can reveal gaps in service coverage and help ensure equitable access to care (Cantor et al., 2022; Kusyanti et al., 2022). Additionally, data integration across platforms enhances coordination among providers, which leads to improved care continuity and patient outcomes (Alawiye, 2018; Adeniyi et al., 2024). Ultimately, robust health data systems equip healthcare

institutions to meet population needs more efficiently and effectively.

Timely and Efficient Service Delivery: The integration of digital technologies into reproductive health service delivery has improved timeliness and efficiency, especially in low-resource settings. Tools such as mobile health (mHealth) apps, EHRs and telemedicine help overcome barriers like distance, staff shortages and limited information access. mHealth interventions such as SMS reminders enhance appointment adherence and contraceptive uptake (Bossman et al., 2022; Coleman, 2020), while EHRs facilitate quicker diagnoses through better patient data access (Labrique et al., 2013). Telemedicine proved vital during the COVID-19 pandemic, maintaining access to reproductive services remotely (WHO, 2022). Additionally, digital platforms streamline data collection, support real-time program monitoring (Sinha, 2024) and aid health workers through training and decision tools (Fitzpatrick, 2023). Overall, digital technologies strengthen reproductive health systems by improving efficiency, access and outcomes.

Digital tools are transforming reproductive healthcare by improving access, empowering individuals and enhancing overall reproductive well-being. By leveraging the potential of technology, we can create a more equitable and effective system for reproductive health for all.

Barriers to Adoption and Use of Reproductive Health Technologies

While digital technologies offer immense potential to improve access to reproductive health information and services, several barriers hinder their widespread adoption and effective use particularly in low- and middle-income settings. These obstacles stem from structural, socio-cultural, technological and individual factors that limit the reach and impact of digital health innovations. Understanding and addressing these barriers is crucial to ensuring that digital solutions are inclusive, equitable and responsive to the diverse reproductive health needs of women, adolescents and marginalised populations. The following are some of the barriers encountered:

Digital literacy and accessibility gaps: Low levels of digital health literacy and inadequate access to digital tools pose major challenges to accessing quality reproductive health services. People who are unable to use digital platforms or understand online health content particularly in disadvantaged communities often lack access to essential services such as contraceptive advice, maternal care and sexual health education. Additionally, limited availability of smartphones, poor internet connectivity and non-inclusive digital interfaces further marginalise groups like women, adolescents and persons with disabilities (López, 2023). The digital divide marked by poor internet access, limited digital skills and high costs intensifies existing reproductive health disparities (Saeed et al., 2023; Fitzpatrick, 2023). Tackling these issues through low-cost internet solutions, accessible digital platforms and localised digital training

initiatives is vital to fostering digital inclusion and supporting reproductive health equity (WHO, 2024).

Internet and mobile connectivity limitations: Limited internet and mobile connectivity continues to obstruct access to reproductive health information and services, especially in rural and underserved communities. Without stable network access, individuals are unable to fully utilize digital tools like telemedicine, mHealth apps, or online counselling platforms that offer essential services such as family planning, prenatal care and STI education. These challenges restricting ability to make informed reproductive health decisions. Enhancing digital infrastructure is crucial for achieving equitable access to care. Although mobile phone ownership is high, actual usage for accessing sexual and reproductive health (SRH) services remains low due to barriers such as service costs for young women (Akinfaderin-Agarau, 2012; WHO, 2024).

Cultural, religious and gender-based resistance: Cultural norms, religious beliefs and gender-based restrictions often pose significant barriers to accessing reproductive health services. In many communities, discussing topics like contraception, menstruation, or sexual health is considered taboo, which discourages individuals especially women and adolescents from seeking accurate information or care. Religious doctrines may oppose the use of family planning or abortion services, limiting the availability or acceptance of these options. Gender dynamics further exacerbate these barriers, as women and girls may lack the autonomy to make decisions about their reproductive health or require permission from male family members to access services. Such resistance not only perpetuates misinformation but also reinforces stigma, fear and silence around reproductive health issues. Addressing these challenges requires culturally sensitive education, community engagement and empowerment strategies that promote open dialogue and support gender equality (Akinfaderin-Agarau, et al 2012; Agbenyo, et al., 2022; Jonayed & Rumi, 2024; Abdul Hamid Al Alhassan, et al., 2025).

Data privacy and security: Data privacy in health technology involves safeguarding individuals' personal and medical information through specific practices and regulations. Given the sensitivity of health data including medical histories, genetic profiles and behavioural information it is essential that such information is securely managed to prevent breaches, unauthorised access, or misuse.The collection of procedures and safeguards to protect digital systems networks and data from unwanted access, interference or manipulation is known as cyber security in healthcare settings. Cyber security in the healthcare industry goes beyond conventional IT issues it includes safeguarding telehealth platforms, medical devices, electronic health records (EHRs) and the complex network of interconnected systems that serve as the foundation for contemporary healthcare delivery (Sardi Rizzi Sorano & Guerrieri 2020: Argaw et al. 2020). Ensuring data privacy goes beyond technical safeguards; it is also about maintaining ethical standards,

legal compliance and patient trust. When individuals feel confident that their data is secure, they are more likely to utilise digital health services, thereby enhancing health outcomes. Particularly when dealing with vulnerable populations like adolescents, safeguarding sensitive reproductive health information is a human rights obligation. Digital health initiatives must incorporate strong data protection systems and provide users with guidance on staying safe online (Miller, 2024; WHO, 2024). Healthcare technologies now handle vast amounts of personal health information every day. Without solid privacy frameworks, these systems risk exposing users to identity theft, data exploitation, or discrimination. When trust in data protection is low, users may avoid digital health platforms altogether, limiting the benefits these innovations can offer (Al Meslamani, 2023). Therefore, clear and enforceable data privacy policies are essential to protect users and support the responsible use of digital health technologies.

Affordability and infrastructure challenges: Al-Worafi (2023) notes that the implementation of DHTs faces several obstacles, including inadequate infrastructure, limited access to digital tools, low levels of health literacy and regulatory constraints. These issues are further intensified by socioeconomic disparities, particularly in digital health, where access to devices, internet connectivity and digital skills significantly influence health outcomes. Populations in rural or low-income areas are especially affected by poor connectivity, lack of mobile devices and limited digital literacy, which restricts their ability to benefit from digital health initiatives (van de Vijver, 2023). However, by developing digital health solutions tailored to the unique challenges of underserved communities, there is potential to reduce these inequalities and improve equitable healthcare access (Huisman, 2022). WHO has emphasized the need for integrating health financing strategies into national health policies, along with comprehensive service delivery plans (Kutzin, 2012). Despite global agreement on the importance of strengthening national health financing systems to support sustainable and inclusive healthcare, many low- and middle-income countries (LMICs) still depend heavily on out-of-pocket spending for healthcare access. This financial burden limits access to essential services and contributes to high rates of preventable mortality (Kurk et al., 2018; Awosiku, 2025).

Ethical and Policy Considerations on the Use of Reproductive Health Technologies

As digital tools transform reproductive healthcare, it is crucial to address ethical and policy concerns. While innovations like mHealth and telehealth expand access and empower users, they also raise issues around privacy, consent, user protection and equity especially for vulnerable groups. Strong ethical standards and inclusive policies are essential to safeguard rights, build trust and ensure fair, responsible use. Comprehensive ethical standards such as:

Digital rights and reproductive autonomy: Digital technologies must uphold individuals' rights to privacy, autonomy and informed decision-making in reproductive health. This includes protecting sensitive

health data, ensuring users' control over their personal information and supporting freedom of access to accurate and comprehensive reproductive health content. Ensuring reproductive autonomy through digital tools means users, especially women and adolescents, can make informed choices without coercion, surveillance, or discrimination. Respecting digital rights also requires transparency in how data is collected, stored and used, particularly in contexts with weak data protection laws (Khosla et al., 2023; WHO, 2024).

The Role of Policy in Scaling Equitable Digital Health Access: Policies are critical to ensuring that digital reproductive health services reach marginalised populations. They shape how tools like mobile apps, telemedicine and health information systems are developed and deployed (Khosla et al., 2023). To ensure equity, national strategies must prioritise affordability, infrastructure and digital literacy, while integrating digital health into broader systems (Kutzin, 2012; WHO, 2024). Policies should also support public-private partnerships and local innovations tailored to underserved communities (Sørensen, 2024). Bridging the digital divide requires targeted investment in connectivity and training, as disparities in access and skills can undermine implementation (Van de Vijver, 2023).

Safeguards against Misinformation and Misuse: Misinformation about reproductive health threatens public health, erodes trust in medical systems and can misguide policies. Digital platforms have amplified such misinformation, often lacking adequate content moderation (John et al., 2025). To address this, safeguards such as content verification, partnerships with health institutions and user education are vital. Sørensen (2024) highlights the need for collaboration among regulators, health bodies and tech companies to ensure transparency, ethical standards and data security. Misuse of health data like unauthorised surveillance or harassment also demands strong cyber security and ethical enforcement. Tools like the WHO's digital content repository (WHO, 2025) help platforms deliver accurate, evidence-based family planning information, debunk myths and support informed decision-making.

Conclusion

Technology is reshaping reproductive health by improving access, autonomy and informed decision-making, particularly for women and adolescents. Innovations like mHealth apps, telemedicine, wearables and AI enhance privacy, reduce stigma and strengthen health systems. However, challenges such as digital illiteracy, poor infrastructure, cultural barriers and privacy risks hinder equitable access, especially in LMICs. Realising the full potential of digital health requires ethical, inclusive and rights-based strategies that prioritise user needs and bridge existing gaps.

Enhancing Reproductive Health Outcomes for Women in Nigeria

In order to enhance outcomes for women's reproductive health in Nigeria digital tools should be adopted to improve reproductive health equitably while key barriers must be addressed. The following below outline

actions to enhance access, safety and usability for all, especially marginalised groups.

- **Expand Digital Literacy and Connectivity:** Governments and partners should enhance digital literacy and improve internet and mobile access in underserved areas to ensure inclusive use of reproductive health technologies.
- **Design Inclusive, Culturally Relevant Technologies:** Digital health tools should be user-informed, culturally appropriate and gender-sensitive, with multilingual content and interfaces that accommodate varying literacy and ability levels.
- **Strengthen Data Privacy and Ethical Safeguards:** Implement clear, enforceable policies to protect reproductive health data and promote ethical use, ensuring informed consent and responsible data handling.
- **Foster Public and Private Collaboration:** Partnerships across sectors can drive the development, funding and equitable scaling of tailored digital reproductive health innovations.
- **Monitor, Evaluate and Adapt:** Embed systems for real-time monitoring and evaluation to track impact, improve quality and inform responsive policy and program decisions.
- **Raise Ethical Awareness in Digital Health:** Promote awareness of ethical risks such as data misuse and lack of consent through targeted education for users and providers.
- **Simplify Tool Design for Accessibility:** Ensure digital health solutions are easy to navigate, intuitive and accessible to users with limited digital experience.
- **Creation of Repository Channels:** Reputable healthcare organisations should gather and publish accurate information on all aspects of reproductive health in centralised online platforms, ensuring the public has access to dependable and evidence-based resources.

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