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Health technologies as innovative tools to prevent cervical cancer in low -and-middle income countries

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Abstract

Introduction: Cervical cancer's mortality and morbidity, as well as the prospect of effective screening-based prevention, make it a critical area of intervention attention. By engaging social support groups in health education, participation in cervical c cancer screening and early diagnosis of the illness in the community is enhanced. In the continuous efforts to enhance cervical cancer prevention, control, and management, technology, and digital health will play a significant role. As a result of mHealth educational activities in this region, knowledge of cervical cancer risk factors, warning signs and symptoms, and information on HPV vaccination improved. By boosting screening rates, raising awareness, and encouraging early diagnosis, mHealth methods can help reduce the symptoms of cervical cancer. These initiatives use mobile technology to give targeted and individualized information, reminders, and support, allowing individuals to be proactive in cervical cancer prevention and screening.

Objective: This study shows that e-health interventions can improve cervical cancer screening awareness, intention, and uptake. It indicates that electronics may be used to reach out to poor and medium-income countries as well as minority populations all around the world.

Conclusion: The mobile health age has shown promising promise for more efficient health care delivery throughout the world. The term "mobile" connotes the freedom and flexibility to complete any work, anywhere and at any time, as it may be utilized to prevent cervical cancer in women by raising public awareness about Pap smear screening. It is critical to stress that the use of health technology in cervical cancer screening programs should be accompanied by suitable infrastructure, training, and supporting policies to enable long-term sustainability and equal access to services.

Keywords: *mHealth, telemedicine, Pap smear, cervical cancer, challenges, screening, low and middle-income countries, HPV.*

Introduction

Telemedicine also known as telehealth, is a healthcare technology that uses communications and networks to deliver medical education, medical follow-up and monitoring, consultations, and other services such as diagnosis and treatment despite large geographic distances that were once thought to be a barrier between physicians and their patients (1). It has been recognized as a tool used by professionals and healthcare providers all over the world to exchange information about people's health status and provide a variety of clinical services, including the management of physician-patient meetings (2, 3), particularly in patients with cancer and those undergoing systematic anti-cancer treatment and experiencing distressing side effects and symptoms as a result of chemotherapy,

radiotherapies, and targeted therapies (4). In this article, we primarily focused on the effects of mobile health technology (mHealth), which is recognized as an integrated application in telemedicine involving the use of mobile devices and handheld computers with internet access to manage medical care operations in managing medical data, analyzing medical-related data, and improving overall patient experience in female cervical cancer patients in terms of prevention, follow-up, and improving aspects of symptom control (5). These technologies include those utilized in the healthcare sector, including instruments, drugs, vaccinations, procedures, and systems, as well as computer-supported information systems. Women in low or middle-income countries typically present with advanced stages of cervical cancer as a result of a lack of screening, appropriate referral of women with cervical diseases, and HIV-HPV (human immunodeficiency virus-human papillomavirus) co-infection (6, 7). In light of this, healthcare professionals have begun to use smart applications to track cancer patients' symptoms, management, complications, and survival (8, 9), particularly in emergency situations (10). In turn, patients with cervical cancer tend to use this technology as an alternative practice, such as in face-to-face communication to obtain dietary information about the use of various drugs, improve drug compliance, strengthen pain management through video conferences or other internet applications, and screening as a preventive method, thereby improving their quality of life (11, 12). Advances in medical health technology, such as fast diagnosing, providing a feedback system to monitor health status, promoting healthy behavior and encouraging changes to dysfunctional behaviors, providing easy access to treatment and rehabilitation, receiving electronic prescriptions, or obtaining informed consent quickly, thereby reducing waiting times, have been discovered to have enormous potential for improving health care quality, particularly for dually diagnosed patients (13, 14, 15).

The COVID-19 pandemic has had a negative impact on primary care practice cancer screening, as many centers have reduced access to routine visits in order to avoid crowded waiting rooms and, in particular, to reduce the infection risk for oncologic patients (16). As a result, many positive cases of cervical cancer were registered and many were potentially missed, and patients newly diagnosed with the disease were frequently found to be in more advanced stages as a result of women's limited access to essential and non-invasive investigations for cervical cancer diagnosis, as well as pandemic conditions making cancer care more difficult to access (17). As a result, mHealth was considered a new strategy adopted for routine surveillance both during and after pandemics due to the wide range of services and opportunities it provides to patients, such as sharing medical information, welcoming patients and discussing their symptoms, learning about treatment options, acquiring medical images, interacting with teams, enabling phone and video appointments, prevention, follow up, and most importantly (18, 19). However, despite its potential benefits, mHealth has a number of drawbacks, particularly in low-income countries, such as misdiagnosis, incorrect clinical decision-making, insufficient or inefficient medicines, financial issues, and wide disparities and inequalities within the population itself (20).

Discussion

Cervical cancer is the fourth most common type of cancer and the fourth leading cause of death from cancer in women. In contrast to developed countries, it is a leading cause of mortality in women in low to middle-income countries due to a lack of regular cervical screening programs (21). One of the main causes of female cervical cancer is the human papillomavirus. Oral contraceptives, decreased immunity, smoking and alcoholism, beginning sex at a young age, and having multiple sexual partners are additional risk factors. Genetic predisposition plays a significant role in the pathogenesis of cervical cancers. The HPV testing for cervical screening is typically followed by a histopathological examination, which is frequently supplemented by radiological imaging (22). Surgery, chemotherapy, radiotherapy, hormone therapy, and immunotherapy are among the treatment options. Most cases may be asymptomatic at first, but later symptoms may include abnormal pain and vaginal bleeding, which is frequently exacerbated by sexual intercourse (21). Mobile health technology, a subset of eHealth, is the use of mobile technologies for health promotion and illness management (23). mHealth has provided women with early warning symptoms and indicators, as well as greater awareness about numerous risk factors, HPV vaccination, and treatment options. Furthermore, learning about health-promoting knowledge may inspire people to implement recommended, scientifically supported behavioral adjustments, such as screening, which will reduce cancer-related morbidity and death (24, 25). However, the goal of the article is to explore the efficacy of mobile health interventions in raising cervical cancer prevention, screening awareness, intention, and uptake, particularly in low and middle income countries. As a

result, this article has been presented in a narrative form to explain the function of mHealth in cervical cancer screening in low and middle-income countries.

Cervical cancer is a major public health problem, and mobile health (mHealth) initiatives have emerged as viable strategies for increasing screening rates and preventing cervical cancer. Several research has been conducted to investigate the efficiency of various mHealth tactics in boosting the adoption of cervical cancer screening by detecting cervical cancer precursors as well as preventing it by detecting early symptoms, thereby lowering cancer incidence and mortality (26).

Health technologies provide novel screening procedures that can improve the accuracy and efficiency of cervical cancer screening in low- and middle-income countries. Point-of-care testing equipment and portable colposcopes, for example, can give real-time data and visual evaluation of the cervix, allowing for prompt diagnosis and appropriate referral for further therapy (27). The traditional screening method, the Pap smear, is well-known in high-income countries; however, in low- and middle-income countries, this approach is limited due to a lack of financial resources (28). As a result, the VIA (visual inspection of acetic acid) screening method is widely used in low and middle-income countries because it is inexpensive and uses few resources (29). VIA is an alternative screening procedure to cystoscopy and is placed in the field of Gynocular (mobile colposcope and microendoscope) which is a portable low costlow-cost colposcope that is comparable in efficacy to the standard colposcope and part of telemedicine (30). The cervix is treated with 4 to 5% acetic acid, which causes dysplastic, neoplastic, and certain types of normal epithelium to transiently appear white, while normal cervical squamous epithelium appears pink (31). Gynocular imaging is useful for capturing static images of the cervix (photographic inspection with acetic acid, PIA) and in-person VIA (32). The images for remote evaluation were taken with a mobile phone and sent via MMS, where an expert colposcopist could view them from a distance (33). In addition to this colposcopic technology, MobileODT has created the Enhanced Visual Assessment (EVA) system, which is a mobile colposcope embedded in an Android smartphone and designed for use in low-resource settings. This digital colposcope may outperform VIA alone in terms of sensitivity, and it is linked to a mobile phone app that allows for image storage and sharing, potentially improving access to expert colposcopists in low and middle-income countries (34, 35). When compared to colposcopy, digital cameras have the advantages of portability, ease of use, and low cost (36). The use of smartphones to transmit VIA images to experts in locations remote from a clinical setting, without the need for additional technology, can allow for the safe expansion of cervical screening programs in resource-limited low and middle-income countries, as well as improve training and support for those potentially lower-level health care workers providing the screening (37, 38).

For women with pre-malignant and malignant pathology, screening would be ineffective without effective connections to safe treatment options. Telemedicine or mHealth has supported the phase of post-treatment as an addition to usual care for the monitoring and management of physical effects, psychosocial effects, and health promotion and disease prevention (39). Numerous studies have been carried out to demonstrate the significance of mhealth in cervical cancer prevention through early screening. However, little research has been conducted on the feasibility of mHealth in cervical cancer follow-up and management. Because low to middle-income countries have limited resources and barriers to implementing screening programs, raising awareness, or providing vaccines, there was a significantly higher uptake of pap smears due to mHealth services that used short text messages SMS to promote awareness and notify them of upcoming screening appointments (40, 41). Thereby increasing cervical screening through education (dissemination of information) and video education with multiple sessions (42, 43). HPV vaccinations are the primary means of preventing HPV infection and thus the development of cervical cancer in young adults aged 9 to 26. A study in economically disadvantaged urban communities discovered that the introduction of the NOWIKNOW mobile application, which includes information, motivational content, a discussion forum, and vaccine completion reminders, has the potential to promote vaccine completion, correct young adult women's knowledge, and reduce cancer disparities by reaching these areas electronically (44). Mobile technologies were also shown to be feasible and cost-effective methods of reaching populations with low cervical cancer screening rates, as they increased screening knowledge and uptake. This is due to the widespread use of mobile phones and the internet, both of which overcome time and location constraints (45). SMS services address barriers such as a lack of awareness and education, as well as fear of tests and outcomes (46). Here, it is obvious that mHealth technology can improve public health and community development by raising public awareness. As a result,

women from low to middle-income countries can easily benefit from these services, which are scientifically applicable, reasonably priced, and less expensive to local community women.

It also offers an outstanding platform for local community health care providers and policymakers (including government and non-governmental organizations) to provide their services in a scientifically efficient manner, thereby advancing cervical cancer prevention in these countries. When addressing cervical prevention, the terms primary and secondary prevention are usually used.

mHealth, especially in low and middle-income countries, has provided the opportunity to improve health outcomes in this area. Primary prevention includes human papillomavirus vaccination, lowering the incidence of risk factors through education and raising awareness, as well as early detection of symptoms (47). Secondary prevention includes screening. The most typical STD affecting sexually active people is the human papillomavirus. It has a close connection to vaginal, vulvar, and cervical cancer (48). Vaccination against the human papillomavirus is used to stop the infection. By encouraging HPV vaccine uptake, mHealth—defined as medical and public health practice assisted by the use of mobile devices such as mobile phones, smartphones, tablets, and computers—has been hailed as a crucial tool for enhancing health outcomes (49, 50).

Text messaging and interactive voice messages are employed to serve as a reminder for HPV vaccination (51). Specifically in low- and middle-income countries where women are thought to be at a higher risk of cervical cancer due to unequal access to screening centers, their contents include information about cancer risk factors, screening benefits, facts about cervical cancer, such as incidence and mortality, and the importance of vaccine as a preventive method (52). By exchanging images, videos, and audio messages, chat applications like WhatsApp, Facebook Messenger, and others have assisted in increasing awareness (53). Additionally, mHealth has proven effective in promoting HPV vaccination by raising participants' awareness of HPV and HPV vaccination, cultural attitudes toward cervical cancer prevention and screening (fatalism), and intent to receive the HPV vaccine (54). This was accomplished by sharing pertinent stories from participants about their HPV vaccination experiences. In the mHealth age, the creation of mobile applications like Vaccipack has enhanced motivation for HPV vaccination uptake (55). These free and easy-to-download applications are considered a trustworthy resource of knowledge and a trusted tool for making educated vaccination decisions. The objective of mHealth in promoting HPV vaccination uptake is seen as a beneficial tool for encouraging healthy lifestyle choices, understanding vaccination and factors influencing vaccination, and increasing motivation for all adolescent vaccines with more in-depth content specifically on the beginning and finishing of the HPV vaccine series (56). Additionally, mHealth has an important role to play as part of a preventative plan, particularly in poor and medium-income countries, to increase cervical cancer prevention. Patients need to be informed about the early symptoms and indications of cancer because it raises their understanding of the condition and drives home the need to get tested and examined (57). Mobile phones and smartphones, as well as audio and visual forms, have made the transmission of educational material in terms of indications and symptoms simpler to grasp compared to communicating through words alone (58).

Moreover, mHealth (mobile health) strategies have been utilized to improve screening rates and lower the symptoms of cervical cancer. Many cervical cancer patients experience distressing symptoms such as excessive vaginal discharge, lower abdominal pain, post-coital vaginal bleeding, and dyspareunia (25). Due to the inability of these patients to attend clinic visits for high costs, particularly in middle and low-income countries, telemedicine or mHealth has provided the services of remote symptom management and support (59). Pain is the most common cancer-related symptom, but it is frequently undertreated in low and middle-income countries. As a result, mHealth or telemedicine has demonstrated effectiveness in cervical cancer pain management and has been able to meet the needs of these patients through an online connection, video conferences, phone calls, or web-based real-time chat between them and healthcare providers (60). Furthermore, several studies in cervical cancer patients have demonstrated the efficacy of telemedicine as a healing-at-a-distance tool by improving mood, symptom interference such as less nausea, vomiting, pain, fatigue, and stress, self-efficacy, self-esteem, and emotional functioning (61, 62, 63).

Nonetheless, despite its benefits in screening, mHealth has a number of drawbacks. When searching for information such as symptoms online, people now have access to a wide range of online medical information without the need for a medical

background or supervision. This can lead to anxiety and uncertainty, negatively impacting their mental health, and they may even begin to experience symptoms unrelated to their condition (64). Furthermore, poorly developed mHealth applications, combined with unqualified health information, endanger human health by potentially misdiagnosis, inadequate or inefficient medicines, or delaying face-to-face medical consultation (65, 66). At the time of diagnosis or treatment, cervical cancer patients conduct internet searches for diagnosis, prognosis, and therapies. Despite the fact that superficial depth and a lack of data are significant constraints in cervical cancer resources, a significant number of gynecological cancer patients claim that this information influences their treatment decisions, thus influencing clinical decisions as well (67). Furthermore, multiple studies have found that the most common reasons for not getting a pap screening are a lack of education, a lack of understanding about cervical cancer and the Pap smear test, and a negative attitude toward inspection. They are all the result of inaccurate information. As a result, the prevalence of cervical cancer will be less under control (68). Because there are so many medical applications being developed these days, authorities are finding it difficult to analyze and adequately examine these apps. There is currently no control or regulation over an app developed by a pharmaceutical or medical manufacturing company that can propose diagnoses that will result in the use of the company's goods (69).

In general, technical constraints and a lack of technological proficiency were identified as significant barriers to successful telemedicine integration (70). Many constraints, such as internet speed and coverage, the cost of technological equipment, and safety concerns, obstruct adequate and equitable integration of mHealth into society in low-income countries (71). When assessing the barriers to mHealth integration, socioeconomic differences between people in low and high-income countries, as well as inequalities within the same low-income country, must be considered (72). As a result, even within low-income countries, wealthier people have greater access to telehealth than poor people, despite the fact that poor people make up the majority of the population (73). It is important to note that one of the major barriers in low-income countries is a lack of reimbursement (74). Numerous tools, as well as insurance from institutions, well-experienced clinicians, and patients, are required to create a good mHealth system that is updated and can work successfully. Unfortunately, low-income countries lack these components. Furthermore, poor internet signal and coverage are significant barriers to mHealth engagement and access to information (75). As a result, poor and middle-income countries will have insufficient healthcare resources, as well as less education and information, increasing illness frequency.

Conclusion

Cervical cancer is viewed as extremely unexpected since most women in low- and middle-income nations are uninformed about the disease's mortality and morbidity statistics, as well as its etiology and prevention. Cervical cancer may only be avoided and conquered with adequate awareness and health consciousness. There is a rising interest in recognizing the relevance of understanding the pathophysiology of cervical cancer and its prevention. mHealth technology is recognized as a very promising and valid technique for boosting awareness and decreasing the overall incidence of cervical cancer in women. This requirement has been adequately illustrated in various papers connected to global oncology. By providing individuals with timely and individualized information, the introduction of mHealth applications and tactics has the potential to favorably benefit cervical cancer prevention efforts. These initiatives can assist in raising awareness about the necessity of screening, encourage regular screenings, and boost cervical cancer discovery early. mHealth treatments can overcome constraints such as lack of knowledge, restricted access to healthcare institutions, and transportation challenges by leveraging mobile technology, particularly in impoverished communities.

Furthermore, mHealth programs have shown efficacy in enhancing cervical cancer preventive awareness among women, particularly those from low-socioeconomic-status social support groups. These interventions have the potential to empower women by providing accurate and easily available information on cervical cancer prevention, risk factors, and screening procedures. mHealth initiatives promote informed decision-making and proactive participation in preventative actions by enhancing information and awareness.

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