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New Approaches for Improved Service Delivery in Rural Settings

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Abstract

The health status of the people in rural areas is faced with challenges primarily due to availability, acceptability, financial accessibility to healthcare services. These include traditional and cultural beliefs, behavioural norms that explain community viewpoints of social roles and various community members' functions. Rural and remote areas are medically underserved, access to healthcare services is difficult sometimes. Distance covered to access the nearest available health facility by some rural dwellers is discouraging. Thus, moving critically ill or injured persons is hampered because of long-distance or poor transportation means. In the end, many prefer to use traditional medicine than travel that long distance for medical treatment. Recently, healthcare delivery systems have focused on innovative approaches to improve health outcomes, control costs, and foster achieving the Sustainable Development Goals (SDGs). One of these innovations is mHealth (Short Messaging Service) [SMS] texts, which have peculiar attributes, making it particularly suitable for health care in rural and hard-to-reach areas in Low and Middle-Income Countries (LMICs). Moreover, text-messaging interventions are uniquely suited for underserved populations. This chapter highlights some interventions on the uses and benefits of SMS text applications in healthcare service delivery.

Keywords: mHealth, reminders, text message, rural areas, health care

1. Introduction

The term “rural area” or “rurality” is difficult to define as there is no standard definition of a rural area. There is no standard universal definition of rural area or rurality. Countries or individuals define rural areas, characterised by the main activities such as farming, type, and size [1, 2]. A rural area is considered “a place with agricultural orientation; the houses are farmhouses, barns, sheds and other structures of similar purposes” [3]. He noted that population is the main characteristic differentiating rural from urban areas, especially in developing countries. This definition and description of the rural area may seem adequate; however, this measure might not adequately capture what rural areas means to different people in different countries [3]. There are various categories of rural areas, depending on their ease of access from urban centres. These range from rural-urban fringe to remote rural areas [4]. Rural areas change over time, and these changes are triggered by three factors, namely:

- i. Economic factors—tourism income, farming profitability, primary sector jobs
- ii. Environmental factors—land use, pollution, conservation
- iii. Social factors—population change and migration, leisure time, retirement population [4].

It has been found that most rural areas are heterogeneous. Thus, defining rural areas based only on people and or one economic activity (commonly agriculture) is not enough to classify areas or regions as rural [2, 5]. Due to the difficulties in getting a unified standard definition of rural areas, census commissions or agencies at the national levels, development partners/organisations and academics in various disciplines turn to and adopt selected approaches in their definitions. However, these definitions also have their limitations [2]. Researchers and international organisations developed typologies and indicators to understand better rural areas [2, 5]. In 2018, about half (49.7%) of the population in Nigeria lived in rural areas [6]. Udo and colleagues noted that each compound houses a man, his immediate family, and some relatives in the rural areas. Some compounds make up the village, usually inhabited by people claiming a common ancestor, often the village's founder. Villages are rural areas, and they share similar characteristics along the line of various ethnic groups in Nigeria [6].

Studies on rural areas and rural residents' health is not new [7]. Freeman & Lumsden [8] reported an outbreak of typhoid in rural Virginia, USA, and some early researchers called out the need to approach health in rural areas differently. This is because rural and remote areas have scarce resources, inadequate supply of physicians and health workers, limited access to service, and an inadequate health-care delivery system [9–16]. Knowing that rurality reflects a range of demographic, culture, social, economic, and health systems, it may be appropriate to measure these characteristics rather than using a geographic definition of rurality only [7].

2. Rural people's health status

In most developing countries, there are cultural differences between rural communities and urban centres. Even in the rural areas, there are significant cultural differences from community to community, and these reflect in the social roles and functions they are engaged in [17, 18]. So, health is a low priority, which often means that medical services and hospitals are the last resort [18, 19]. This is due to different norms, long traditions and religious practices, culture and beliefs the rural dwellers hold on to and previous experiences with healthcare workers [20–22]. One other important factor is accessibility to rural and remote communities. This is due to the physical structure and topography, with mountains, deserts and jungles of these areas, consequently creating difficulties for transportation and often complicated by varying natural disasters. Hence, no means of transportation and evacuation of critically ill or injured patients is impossible in some rural areas [18, 23].

Globally, rural people's health status is worse than urban areas [18]. Although much progress was made in the Health for All target by 2000 and the Millennium Development Goals (MDGs), some of these goals have not been attained. This is evident in the rural and remote areas where most of the world's population live [18]. In some African countries, infant mortality rates in rural and remote areas are usually higher than those obtained in urban centres [24, 25]. Children in rural and remote areas are more likely to suffer from one health challenge or the other compared with their counterparts in the urban centres [18, 26, 27].

The health status of the people in rural areas worldwide is faced with many challenges primarily due to availability, acceptability, financial accessibility to healthcare services. These include poverty resulting in low health status and high disease burden; one of the main factors responsible for rural-urban drift, traditional and cultural beliefs, behavioural norms that explain community viewpoints of social roles and various community members' functions [18]. Topography most time affects accessibility to rural and remote communities, making it difficult for transportation and sometimes complicated by varying harsh climatic conditions. As a result, moving critically ill or injured persons is hampered because of poor or no transportation means in rural and remote areas.

2.1 Limited funding and other resource constraints

Another factor affecting health services in rural and remote areas is limited funding and other resource constraints. It is a known fact that rural and remote areas are medically underserved, access to healthcare services is difficult sometimes. Some health facilities are understaffed, and in some instances, the health facilities do not have essential equipment or consumables. Distance covered to access the nearest available facility by some rural dwellers is discouraging. Many people living in rural areas have to travel or walk some kilometres from their homes to get to the nearest healthcare facilities. In the end, many prefer to use traditional medicine than travel that long distance for medical treatment.

2.2 Healthcare workers' attitude to patients

The attitude of healthcare providers is another factor influencing the health status of rural community members. There have been concerns about the attitudes of healthcare workers towards their patients in health facilities. Healthcare workers, especially nurses, sometimes do not treat patients or clients well, use abusive words on patients, and be rude and harsh. In some other instances, healthcare workers were accused of giving preferential treatment to patients they knew [28]. Studies show trends in the unprofessional behaviours and attitudes of healthcare workers towards their patients. A study in Nigeria found healthcare workers showing discriminatory attitudes and engaging in unethical behaviour towards patients with HIV/AIDS [29, 30]. In a related study, some pregnant women in South Africa expressed their hesitations in delivering in the hospital due to previous experiences of being shouted at, beaten or neglected by nurses [31, 32].

Another study revealed that healthcare workers in some hospitals also exhibited these unprofessional behaviours and attitudes by using education level as a yardstick for high-quality services [33–35]. Patients with little or no education considered “villagers or rural dwellers” were treated with impatience and disrespect, given less information, and accorded less attention [33–35].

2.3 Healthcare access in rural communities

Rural areas in developing countries, especially in Africa, are plagued with persistent social inequality, poverty, unemployment, a heavy burden of disease, and healthcare service provision's inequitable quality [36]. Inequitable quality of healthcare service bothers on accessibility, affordability, and acceptability. Accessibility and affordability of healthcare services are crucial to good health, yet rural residents face various access barriers. Access is defined as “the timely use of personal health services to achieve the best possible health outcomes” [37]. That means the rural residents should access primary care, dental care, behavioural health,

emergency care, and public health services conveniently and confidently. Rural residents face serious difficulties in accessing healthcare services which are usually found in urban centres. This is a true and common feature across rural communities in most African countries. For some people who live in rural areas, the nearest health facilities are some kilometres away from their villages or townships, as the case may be. For instance, 56% of South Africa rural communities live 5 km from a health facility; and 75% of South Africa's poor people live in rural areas [36, 38].

If access to primary healthcare is a fundamental human right, primary healthcare must be brought to rural communities. Asabere reported that the main goal of primary healthcare in most developing countries, including Nigeria, was to make healthcare available, accessible and affordable to all citizens by the year 2000 [39]. This goal has not been achieved yet in most countries, and it seems it will not be soon unless there is a change. For example, despite citing some healthcare centres in rural and urban centres, about two-thirds of the Nigerian population are still medically underserved for many reasons, some of which have been highlighted. Suttle reported that accessing, delivering, or providing healthcare services in rural areas presents unique challenges [40]. Some rural dwellers may travel between two to 3 h to get to the closest health facilities.

Despite the huge gap between developed and developing countries, the main point is that rural health is the same worldwide [41]. The major rural health challenges are availability, accessibility, affordability, and inadequate health workers [15, 42]. Even in countries where most of the population lives in rural areas, the resources are concentrated in the cities [15, 43, 44]. With the concentration of poverty, low health status, and high disease burden in rural areas, there is a need to re-strategize the healthcare delivery systems. Attention must be paid to improving people's health in rural and remote areas if the rural-urban drift (a common trend now) is reversed remarkably [18].

3. New approaches to improving health services delivery in the rural areas

With the concentration of poverty, low health status and high burden of diseases in rural areas, there is a need to focus specifically on improving people's health in rural and remote areas, particularly if the urban drift is to be reversed. A paradigm shift in the healthcare delivery system focuses on finding new and innovative approaches and organisational frameworks to improve health outcomes, control costs, and improve population health. Lunze, Higgins-Steele, Simen-Kapeu, Vesel, Kim and Dickson [45] pointed out that "innovative approaches have the potential to accelerate progress and to lead to better health outcomes", especially in medically underserved areas. In addition, to achieve the Sustainable Development Goals (SDGs), designing and implementing innovative approaches in the health systems is germane. For instance, immunisation is one of the best global health investments, and it is of great import in achieving 14 of the 17 SDGs. As one of the most far-reaching health interventions, it closely reflects the ethos of the SDGs, "leaving no one behind". Other proven interventions that reduce the burden of diseases and mortality are well established; these interventions are not implemented on a large scale in most Low-and-middle-income countries (LMICs) [45–47].

Improvements in technology and new approaches to organising healthcare delivery are occurring quickly. Information and Communication Technologies (ICTs) are now integrated into existing facilities to stimulate development and enhance service delivery [48]. For example, ICT is integrated into service delivery to manage conditions, monitor progress, improve patients' health, and use reminders for clinic

appointments and service uptake, disaster management, and emergency. It is also used in seeking feedback from patients in developed and developing nations [49]. Information and Communication Technologies improve service delivery in various ways, such as increasing accessibility to basic needs and increasing efficiency by increasing connectivity and knowledge sharing [50]. The inclusion of different forms of ICTs into health workers daily routines and their patients is common worldwide [51]. The health status of the masses in developing countries is very poor and providing healthcare services to people living in rural and remote areas is a challenge [52]. This is due to inadequate planning for the populace, predominantly rural areas, rising poverty levels, cultural beliefs, inadequate human resources for health in most rural areas, and increased population size [52].

About half of most countries live in rural areas with a high disease burden and are always left behind during planning and budgetary allocation. Nyasulu and Chawinga pointed out that 11% of the world's population is projected to be in Africa, with a global disease burden estimated to be 22% [48]. To take care of this population, additional 1.5 million health workers must fill the existing human resource for health gap. Information and communication technologies have a growing influence on all areas of human life, and the health care sector can leverage this [53]. They can transform health services delivery [54].

4. Delivery of healthcare services via technologies

Technology drives the world today, and new technologies are making a significant impact on healthcare delivery. Transformation in healthcare will be driven by future technological innovation. While development in new drugs and treatments, new machines and devices, smartphones, new social media platforms for healthcare, etc., will drive innovation, human factors will remain one of the stable limitations of these innovations [55]. Personal electronics used for communication and social networking are ubiquitous, spreading into mobile healthcare (mHealth) [56]. In Mobile Health News, Jeffrey Shuren, director of the US Food and Drug Administration's Center for Devices and Radiologic Health, was quoted thus, "the use of mobile medical apps on smartphones and tablets is revolutionising health care delivery" [57]. Thus, we can leverage this to improve healthcare access and delivery in rural areas. Mobile Medical Applications (MMAs) tools can be useful in managing or preventing some health conditions. With smartphones everywhere and their revolution in our day-to-day activities, the thousands of MMAs currently available can take some of the strain off the healthcare system [57].

Kabachinski also noted that, as the number of all cadre of health workers continues to shrink, the sick and elderly Americans continue to increase. mHealth and other innovations can readily be deployed to mitigate these frightening developments [56]. Today, it is remarkable to see how mobile devices and applications are incorporated into healthcare systems to deliver effective and improved services. Almost all health workers have smartphones, and their ownership is expected to increase yearly. Many health workers with multiple mobile devices use them at the point of care [58]. Mobile technology is making a significant impact on human life today, and its application in healthcare systems is on the increase. Some of the apps in the mobile devices have been applied in various areas of health services delivery ranging from enquiry/consultation, clinic appointment reminders, adherence, diagnosis to treatment. Specifically, apps malaria diagnosis, check blood pressure and blood sugar levels are common today, thus providing quick feedback to patients. Unlike before, the waiting time for clinic consultation or appointment is always long, and the results of some tests or investigations take longer to be ready. Learning

through the mobile app is on the increase in the healthcare community. Apart from its primary use, today's mobile devices have apps that allow patients to complain to doctors, refill prescriptions, or find the nearest healthcare facility. Efforts are being made to leverage mobile technology for improved communication in healthcare systems [56].

In developing countries, healthcare services and product uptake face barriers, particularly in rural areas. Therefore, emphasis should be on the adoption of cost-effective and cost-efficient and user-friendly technology for sustainability. Mobile devices such as mobile phones fall into this category and have been used effectively in various health programmes or interventions. These include improvement in service delivery and uptake, disease surveillance, prevention, diagnosis, management and behaviour modification [59, 60]. Some patients used their mobile phones to remind themselves to take medication or attend their clinic appointments; some patients and health workers accessed websites and used social media to gather health information [61, 62]. Schwebel and Larimer presented a summary of a systematic review on the impact of reminders messages on the targeted health outcomes [63].

5. Prospect of mHealth and mobile phone text messages in public health interventions in rural areas

There is an increased mobile phone usage with Short Messaging Service (SMS) applications in interventions to deliver health care services. With high success rates in previous intervention in developed countries, Short Messaging Service (SMS) texts have peculiar attributes, making it particularly suitable for health care in rural and hard-to-reach areas in Low and Middle-Income Countries (LMICs). Moreover, text-messaging interventions are uniquely suited for underserved populations. This section highlights some interventions on the uses and benefits of SMS text applications in healthcare service delivery. These interventions are categorised into three major areas, namely

1. SMS used to enhance the efficiency of healthcare service delivery
2. SMS used to improve diagnosis, treatment and rehabilitation of illness
3. SMS used in public health programmes

5.1 SMS used to enhance the efficiency of healthcare service delivery

Mobile text messaging communication has proven to be an effective way to foster desired behaviour change in patients and improve the way care is delivered. A review shows many ways SMS enhances healthcare service delivery efficiency; some of these are highlighted below.

5.1.1 Appointment reminders

Atun, Sittampalam and Mohan reported that missed appointments in England led to substantial costs for many health systems and the National Health System (NHS) [64]. These costs are due to direct costs involved in arranging the appointment and the opportunity cost of missed appointments. For instance, in 2019, about 307 million were sessions scheduled with doctors, nurses, therapists and other practise staff every year, and 5%—one in twenty, 15.4 million—are missed

without enough notice to invite other patients [65]. Most of the doctors pointed out that patients missed clinic appointments due to forgetfulness [64]. Almost all the respondents stressed that patients who missed clinic appointments wasted NHS resources. Most doctors also stated that these behaviours from patients have negative impacts on running the NHS efficiently. Most doctors, therefore, noted that they would consider de-list patients who missed clinic appointments repeatedly. However, most doctors opined that charging patients for missed appointments might reduce the challenge [64, 66].

According to the report, the estimated cost of a GP appointment is £18, while that for a nurse is £7 [64]. Thus, in England, the annual direct cost of missed appointments to the NHS is £180 million for GP appointments and £34 million for practice nurse appointments [64, 66]. Hence, in England, missed appointments cost the NHS £789 million a year. To reduce the extent of the problem, the Department of Health (DOH) in England issued a Missed Appointment Guidance, which identifies ways GP surgeries can improve attendance rates for hospital and GP appointments [67]. To address this problem, some pilot trials, which use mobile phone SMS to remind patients to attend NHS appointments, were launched in England in 2003. Some of these pilots reported success or benefits [64, 67], while others identified organisational factors influencing the uptake and adoption of the reminder messages. Poor healthcare service uptake influenced by ineffective administrative staff stuck to the business-as-usual idea could be enhanced when clinicians sign up patients to the innovations on health-related mobile apps [68].

Reminder SMS is now used in imaging diagnostics [69], paediatrics, sexually transmitted infections, maternal health, antenatal clinics, child, adolescent and mental health, and dental services [64]. Reminder SMS was used for mothers of infants in rural areas on appointment keeping of routine immunisation in Nigeria [54]. The intervention using reminder SMS enhanced infant immunisation timely uptake, completion and service delivery.

5.1.2 Improving communication between healthcare workers

Short Messaging Service has been identified as a useful communication tool between surgeons with enhanced coordination of patient care, improved efficiency of administrative activities, greater accuracy of messages, and even increased responsiveness to urgent cases. Communication problems between health care professionals were observed to be one of the factors that lead to errors within healthcare systems, which adversely affect patients' well-being [64, 70]. According to Atun and colleagues, it was noted then that much of the clinical information used by doctors come from peers, personal notes on patients or diagnostic tests [64]. Doctors prefer to seek the opinion of experts rather than consult guidelines, manuals or computer-aided decision systems. SMS is now used to enhance communication among healthcare workers [64, 67, 71].

5.1.3 Managing queues

It has been observed that long waiting times and queuing when accessing health care services led to customer dissatisfaction. Hence, efficient waiting times and queue management are critical to improving service quality and user satisfaction [64, 72–75]. One of the hospitals in England, for instance, has reduced patients waiting time for drug refill and collection of dispensed drugs. Patients receive a text message to inform them when their prescription is ready for collection [76]. This has reduced long waiting times in the hospital and provided much the flexibility to return any time during the day to collect their medication [64].

5.1.4 Contacting blood donors

Customised SMS is used to invite older adolescents and young adults for blood donation. The providers also use the opportunity to develop a database on blood groups of individuals so that donors can be contacted in emergencies, particularly blood of rare groups is needed [77, 78]. In addition, in India, evidence shows that when a blood centre issued a text message-based request to potential donors for blood to help a young patient with leukaemia was made, 150 calls were received offering donations within an hour [79].

5.1.5 Enhancing access of disabled people to services

Narasimhan and colleagues reported that people with disabilities, such as the deaf and hard of hearing (DHH) or mute, could benefit from SMS-based applications to contact emergency services [80]. Yousaf, Mehmood, Saba, Rehman, Rashid, Altaf, and Shuguang modelled and evaluated a mobile phone application that utilises speech-to-text and text-to-sign language to visualise the sign language using an avatar and convert the sign language to text [81]. This enables DHH individuals and hearing people communicate. Text messaging services to contact emergency and health services for the deaf and hard of hearing have been launched in some countries, such as Poland. Findings from this intervention show that without this solution, a deaf person would, in many cases, not be able to call for help [82].

5.2 SMS used to improve diagnosis, treatment and rehabilitation of illness

5.2.1 Improving adherence to health advice and medication

Adherence is the extent to which a patient's actions are consistent with the advice given by his or her doctor or nurse. According to Kalogianni [83] and Demoz, Berha, Alebachew Woldu, Yifter, Shibeshi and Engidawork, 50% of patients with chronic diseases do *not* use their *medications as* recommended, particularly problematic for long-term conditions which require daily medication [84]. Adverse health outcomes are always the consequences for patients and lead to significant expenses to the health systems. Non-adherence to treatment/medication often result to relapse in patients' health condition leads to hospital admission. This interruption of treatment for infections may result in the emergence of resistant strains. Reminder SMS would be useful to remind patients of the need to use their medication at the right time. The same reminder SMS would be useful in encouraging and reminding patients of the benefits of treatment regimens completion for a wide range of conditions, including acne, asthma [85], diabetes [86, 87], tuberculosis, and AIDS [88, 89] and teenagers on contraceptive [90]. A study was conducted among a cohort of 32 young adult asthma patients. They used SMS text messages written in 'txtspk' from a fictitious friend 'Max' (e.g., "yo dude, it is Max reminding U2 take ur inhaler"). A stream of celebrity gossip and horoscope messages accompanied the SMS and was reported to be successful. Findings showed that participants described the service as acceptable and said they had developed a rapport with Max's fictitious character [91].

A double-blind, randomised clinical trial in Spain, which involved 26 primary healthcare centres, analysed the effect of printed information followed by two SMS text messages (on lifestyle or a reminder to take the medication) on adherence and lifestyle changes in patients with hypertension. Although there was no difference in the rate of non-adherence in both groups, the experimental group could control blood pressure and bodyweight reduction better [92]. Another study from Spain

involved the administration of hepatitis A and B vaccines to patients, patients in the intervention group received reminder SMS for follow-up vaccination. Those in the control group did not receive any reminders. Results showed that the vaccination completion rate was higher in the intervention group than the control group, and this difference was statistically significant [93].

5.2.2 Monitoring of illness and medical interventions

In 2005, the World Health Organisation noted that effective monitoring of medical conditions, especially chronic illness, improves health outcomes and reduces health care costs [94]. SMS applications are being used in various settings to monitor acute and chronic conditions and monitor the effectiveness of health interventions. For instance, a rheumatologist experimented with a patient reporting system that uses SMS. Patients who received corticosteroid injections for joints of soft tissue inflammation are to report whether injections were beneficial in alleviating pain or improving movement. This allowed remote monitoring and reduced the need for follow-up clinic appointments, thus reducing treatment costs [95]. Reminder SMS was also used in South Africa in monitoring people living with HIV and who receive anti-retroviral drugs. Affected persons can use the app in reporting side effects directly to health workers [96]. In Italy, cancer patients used SMS applications, which enabled them to report their symptoms systematically from home to doctors. Thus, reducing the need for hospital admission for monitoring [64]. Moreover, SMS has enabled improved self-monitoring by diabetic patients and more regular reporting to clinicians in England, France and Thailand [64].

The monitoring of patients in the intensive care unit has been improved through an innovative application. The nurses will send alerts to clinicians through SMS when specific changes are noticed in the patient's physiological status. Through this application, the clinician received a quick update about critical patients' conditions compared with pagers [97]. Furthermore, the feasibility and impact of using SMS to improve asthma self-care by reminding patients of their medication, recording symptoms, measuring peak flow rate and completing an SMS-based asthma diary to send to clinicians were tested in Denmark. Findings from the study showed that patients could effectively use the SMS-based asthma diary and gave them excitement. This gave them more control over their condition [98].

A randomised control trial evaluated the impact of the use of SMS on asthma symptom profile monitoring. The intervention was requested to send the peak flow results to their clinicians daily through SMS and a matched control group who were only counselled to monitor theirs. Findings show that the symptom profiling in the intervention group was better than that in the control group. It was also noted that the patients found the intervention suitable [64].

5.2.3 Provision of psychological support

The literature indicates that some health conditions, such as bulimia, can be better managed and improved if healthcare providers maintain continuous support through mobile apps. For patients on hospital admissions who have restricted interaction with the outside world, for instance, immuno-suppressed patients or those who had an infection and required isolation, psychological supports and interaction with other patients and relatives could have a therapeutic effect. Text messages may be a useful option in such instances.

Several interventions have been used to encourage young people to access counsellors to seek support on a range of issues, such as bulimia [99, 100], chronic illness, managing stress during end-of-year exams, and receiving advice on health or

relationship problems [64]. A randomised controlled trial was conducted using SMS in supporting and prompting young diabetes patients to keep clinic appointments. A customised reminders SMS in a system called ‘Sweet Talk’ uses progressive goal setting to stimulate health behaviour, help patients set self-management goals, and improve glycemic control. Findings show significant improvement in diabetes control (as measured by metabolic control and self-efficacy) in the intervention group who used “Sweet Talk”, as compared with those who received standard care [101–103]. Finding from another study, which explored the acceptability and feasibility of SMS based psychological support among patients with bulimia nervosa, show that SMS intervention is appropriate for aftercare after hospital discharge [104].

5.2.4 *Communicating results of diagnostic tests*

In recent times, it has been found that traditional approaches used to communicate diagnostic results are time-consuming and inefficient as these often require the patients to return to the provider unit in person to receive the results. Text messaging interventions have been used in developed countries to communicate results of in-vitro diagnostic tests (such as blood or microbiology tests) [105–108] and radiological imaging for breast cancer screening [109], sexually transmitted infection screening [110, 111]. In developing countries, where healthcare services access barriers exist, reminder SMS was used more effectively in sending results to clinics in rural areas [112]. Text messaging has also been used to accelerate communication to employers of occupational health examination results on foreign workers [105, 106].

5.3 SMS used in public health programmes

5.3.1 *Contact tracing and partner notification for communicable diseases*

An increase in the incidence and prevalence of sexually transmitted infections (STIs) is a significant public health challenge worldwide. Partner notification (partner management or contact tracing) is an essential public health strategy in controlling STIs because sexual partners of those with STIs are likely to be infected. If asymptomatic, they might not seek care [113, 114]. Text messages applications are being used to notify partners of individuals with STIs [115] and strengthen control efforts for major global public health problems such as tuberculosis, HIV, and SARS [116–118]. StarHub and the Singapore Tourism Board launched a text alert service named “SARS Contact Tracing SMS” to trace persons in case of future SARS outbreaks in Singapore [119].

Tomnay, Pitts and Fairley reported that clients attending a STIs clinic found calls or SMS to mobile telephones as acceptable and efficient means to contact tracing. Recent sexual partners could be traced, details of a website that had information on the STIs to which he or she can potentially be exposed are provided [120]. On the other hand, an SMS can be sent from the clinic to the client and forwarded to their partner(s)—thereby maintaining the anonymity of the partner [120]. Newell further described how text messaging was used to reach the client’s partner, who was diagnosed with an infection after the initial visit to the STIs clinic. Even though the partner was unaware of why his girlfriend participated in a STIs clinic, the text message he received from her contained the diagnosis code used to initiate appropriate treatment. Therefore, SMS may be adjunct to contact slips for contact tracing in genito-urinary clinics [121].

5.3.2 *Communicating health information to the public*

Short Messaging Service is beneficial for rapid communication of health information to the general public for public health emergencies during an outbreak

of infectious diseases like COVID-19, Ebola, Lassa fever, and avian influenza. It can also be used for rapid communication when a group of people or patients are accidentally exposed to an infectious agent. It has been a valuable tool in rapidly reaching people to recall harmful food products or pharmaceuticals [122–124].

Short Messaging Service has also been used in public awareness campaigns in India to inform and educate the public on WHO tuberculosis control strategy; in Kenya, Nigeria and Mali, to educate the public on HIV and malaria control programmes [116]. It has been used in Iraq to support polio immunisation campaigns targeting about 5 million children [125]. During the SARS epidemic in Hong Kong, one of the mobile telecommunication operators sent SMS to the citizens, educating every one of safety measures that helped reduce the risk of exposure to the virus [126].

Programmed bulk SMS can also be used for a specific population effectively. After the floods in India, most people in Mumbai were exposed to floodwaters. Through sent text messages, everyone in the area was advised to take 200 mg of doxycycline to prevent leptospirosis infection [127]. In the UK, health promotion advice and information was provided through NHS Direct Interactive text messages to people with long-term conditions like diabetes and asthma [128]. Shortly after, other UK health organisations adopted text messages to address the health challenges of people living in rural areas [116]; health educate students [118, 129, 130]. This interactive text message was used to provide confidential health information to pupils [131], provide teenagers and young people with information on sexual health, anti-smoking education, mental health, pollen count to asthmatics or hay fever sufferers and alerts on high levels of smog and air pollution to high-risk groups [116].

5.3.3 Use of SMS in smoking cessation programmes

Short Message Service has been used in Australia, New Zealand, Spain, and the UK to provide health education, anti-smoking campaigns, and assist behavioural change in people trying to quit smoking [132, 133].

Findings from a randomised control trial on SMS effectiveness in smoking cessation programmes in New Zealand found that the proportion of participants who stopped smoking in the intervention group who received reminder SMS support was significantly higher than the control group [134]. Findings from the follow-up study show similar results [135]. Findings from a cohort study assessing smoking cessation among college students in the US showed higher cessation rates among the group that used Web and text-messaging programmes than those in minimal-contact or self-help smoking-cessation interventions [136]. In conclusion, studies reviewed from the literature demonstrate wide use of SMS-based applications with benefits in health outcomes. These studies also show that SMS-based healthcare applications are acceptable to patients: thus, it can be concluded that SMS can develop new service delivery models.

6. Potential challenges of reminder SMS

No innovation comes without one challenge or the other. The same applies to using reminder SMS or messages in health programmes or interventions. A frequently cited challenge in its use in healthcare treatment pertains to patient confidentiality, especially regarding diseases that run in some families (such as mental illness, genetic diseases), predisposing the bearers to discrimination if made publicly known [63, 137]. Although the confidentiality of patients poses some

risks, some steps can be taken to mitigate the concern. These steps include sending generic and coded reminders informing patients to open messages in a private place and delete messages after reading them [63].

One major obstacle with sending reminder SMS is for individuals not reading the messages they have received. Recipients of reminders SMS may sometimes become annoyed at receiving multiple messages over time.

7. Future directions

Reminder messages show great potential for use across the broad spectrum of healthcare services. They are effective as appointment and drug/medical compliance reminders. Additionally, SMS reminders effectively prompted other health behaviours, including self-medical examinations, socialisation, and goal-directed behaviours. It is currently unclear the most effective dose of reminder messages (i.e., timing, frequency, and the total number of messages) and under what conditions the dosage should be changed over time [63]. Dosage varies between individuals and is impacted by the perceived importance of the reminder (e.g., if something is crucial to one's health or for changing behaviour) [63]. Further research on these areas can help inform future implementations of reminder messages in healthcare service delivery.

8. Conclusion

Accessibility and affordability are the major issues about rural health around the world. In the countries where most of the population lives in rural areas, the resources are concentrated in the cities. Rural areas worldwide are faced with transport and communication difficulties, and they all face the challenge of shortages of doctors and other health professionals in rural and remote areas. Many rural people are caught in a downward spiral of poverty—ill-health—low productivity, particularly in developing countries.

Reminder messages have tremendous and untapped potential in transforming health systems in low- and middle-income countries (LMICs) predicated on the growing availability and use of mobile phones among communities members, families and health care service providers. They are relatively inexpensive, easily customised, sent directly to individuals, and a part of many daily lives. These attributes further explain why many studies utilise SMS as a reminder to help improve healthcare services. Several studies reviewed on reminder messages to improve health outcomes in developed countries show promising results. Adopting and integrating this innovation into existing health delivery systems will have robust health outcomes in rural communities. It presents a convenient and cost-effective method to support healthcare interventions. Reminder SMS can function as a reminder for periodic (e.g., daily medication adherence) and distal, one-time (e.g., to complete a follow-up vaccination 2 months after initial vaccination) behaviours.

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