Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

CHAPTER 11

m-Health in Public Health Practice: A Constellation of Current Evidence

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1 INTRODUCTION

Public health practice and research has benefitted tremendously from the expansion and growth of m-Health technologies. Not only has m-Health revolutionized service delivery in key areas related to family health, it has also improved approaches to prevention and control of non-communicable diseases (NCDs), including mental health. The capacity for epidemic or pandemic preparedness and response has improved disease surveillance, outbreak detection and management with the advancement of better communication platforms and monitoring systems through m-Health. More than ever before, m-Health has expanded the capacity for knowledge dissemination, health behavior change and better self-health practices at the individual, community and population level matrices. This has undoubtedly improved community participation in disease prevention programs as well as advocacy and policy dialogues for effective health promotion. Table 11.1 summarizes the context in which m-Health has been successfully applied in public health practice.

The availability of local infrastructure such as reliable networks (cellular, broadband and wireless) and advances in technology (mobile devices and apps, network solutions, interoperability of platforms and health information systems, diversity of contents etc) will continue to enable public health practitioners to leverage m-Health solutions through advanced mobile functions.

2 M-HEALTH BENEFITS IN PUBLIC HEALTH PRACTICE

2.1 Community-Related Approach to Service Delivery

2.1.1 Maternal and child health

2.1.1.1 Antenatal and postnatal care attendance, skilled midwifery and antenatal health. According to 2016 UNICEF data, only about 50% of women worldwide receive the recommended level of care during pregnancy. The report revealed a global disparity between the proportion of pregnant women who received antenatal care with a skilled health personnel at least once (86%) and those who attended the recommended minimum of four visits (62%), with wider disparities observed in sub-Saharan Africa (52%) and South Asia (46%) where maternal mortality rates are highest [1]. Literature has highlighted successful applications of m-Health technologies in improving antenatal, midwifery and post-natal care in low-to-middle income countries (LMICs) [2]. Evidence from RCTs and other studies conducted in Zanzibar, Thailand, Malawi, Sierra Leone and Nigeria [3–7] suggests that the use of text-messaging and/or voice messaging (singly or in combination with ancillary interventions such as provision of call vouchers, toll-free case management hotline, finance vouchers, micro health insurance etc) to provide health education and appointment reminders to pregnant mothers significantly improved antenatal care visits, skilled attendance at birth,

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TABLE 11.1
Common Contexts of m-Health Application in Public Health Practice.

Context/Purpose	BASIC MOBILE PHONES		SMART PHONES			
	Basic Text Message	Voice Calls	Special Apps	Wearable Devices[a]	Smart Text/Instant Messaging/Chats	Others[b]
MATERNAL HEALTH						
ANC attendance	✓	✓			✓	
PNC attendance	✓	✓			✓	
Skilled birth attendance	✓	✓			✓	
Family planning	✓	✓	✓		✓	
Health education	✓	✓			✓	
CHILD HEALTH						
Immunization	✓	✓	✓		✓	
Nutrition	✓	✓			✓	
NON-COMMUNICABLE DISEASES						
Physical inactivity	✓	✓	✓	✓	✓	✓
Diet control	✓	✓	✓		✓	✓
Smoking	✓	✓	✓		✓	✓
Alcohol use	✓	✓	✓		✓	✓
Sleep patterns	✓		✓	✓	✓	✓
Health education, promotion and disease prevention	✓	✓	✓	✓	✓	✓
COMMUNICABLE DISEASES						
Surveillance	✓	✓	✓		✓	✓
Outbreak detection and management	✓	✓	✓		✓	✓
Diagnosis	✓	✓	✓		✓	✓
Monitoring and treatment	✓	✓	✓		✓	✓
Occupational Health	✓	✓	✓		✓	✓
Other areas[c]	✓	✓	✓		✓	✓

NOTE: Some of the above interventions are used singly or in combination with other range of non m-Health related interventions, and with varying degrees of success.
[a] These include watches, wristbands (accelerometers, pedometers, etc.), cutaneous patches, and clothing with smartphone-enhanced connectivity.
[b] Includes digital workplace interventions, virtual reality, desktop-based applications, web-coaching, video messaging and other behavioral therapies.
[c] Includes mobile job aids for healthcare workers, drugs and commodity logistics and supply chain management system.

post-natal care and health facility utilization rates. In addition, these interventions enhanced communication between healthcare workers and pregnant women, and between healthcare workers and traditional birth attendants [6]. Variable results regarding the effectiveness of these interventions in improving antenatal care knowledge [8,9] or breast-and infant feeding practices [10,11] have also been reported.

These evidences have underpinned the conceptualization and implementation of several health intervention programs that addresses a wide range of barriers to maternal and health care services such as lack of

information at the community level about locally available services, forgetting clinic appointment schedules, difficulty in reaching health facilities (large distance to facilities and lack of affordable transport), and ineffective communication between patients and community-based or facility-based healthcare workers [12–16]. For example, the United Nations Foundation-funded WAHA International's m-Health program implemented in the Tambacounda region in eastern Senegal employed a comprehensive communication and transportation support strategy in which a mass communication campaign via SMS was provided to the general community to sensitize them on the locally available maternal and neonatal health services, while targeted SMS communication campaign was provided to pregnant women and new mothers to inform them of the importance of ANC visits, delivery with a skilled birth attendant, and postnatal care. The project addressed transportation barriers through the implementation of a motorcycle ambulance system, a call center to efficiently manage the referral system, and provision of mobile phones to ambulance drivers to coordinate the referral process. Additionally, women who attended ANC consultations were provided with a mobile phone SIM card for receiving informational messages or for contacting a healthcare worker at the call center, in addition to receiving additional credit as an incentive for attending their antenatal care consultation at the health care facility [12]. Where such interventions are fully integrated with the existing health care system, the potential to achieve project outcomes and sustainability while also meeting clients' expectations are further enhanced.

2.1.1.2 Family planning. As at 2010, a worldwide contraceptive prevalence of 63.3% and an unmet need for family planning of 12.3% was reported among women aged 15–49 years who were married or in a union [17]. By 2015, the global contraceptive prevalence had marginally increased to 63.6%, while the unmet need for family planning dropped to 11.9% [18]. Unmet need is especially higher among adolescents, migrants, urban slum dwellers, refugees and women in the postpartum period. These less than desirable statistics on family planning, the projected growth in the number of contraceptive users worldwide worsened by severe shortages in skilled providers, has catalyzed the need for increased investments and more innovative solutions to address the gaps, with m-Health offering promising results in this regard.

The adoption of m-Health technologies in providing the information that couples need to make informed family planning decisions or address their concerns regarding same, has been largely successful [19]. For example, the United Nations foundation-funded Mobile for Reproductive Health (m4RH) [20] and Mobile Alliance for Maternal Action (MAMA) [15] projects provide evidence-based results in this area. FHI360's m4RH – implemented in Kenya and Tanzania – developed family planning text messages based on best practices from health communication programs, guided by international and context-specific standards. The SMS were delivered to men and women through an automated, interactive and on-demand text message (SMS) system that provides essential facts about contraception while addressing common misconceptions. In addition, the system allowed users to locate nearby family planning clinics. Similarly, MAMA developed and disseminated adaptable messages based on WHO and UNICEF guidelines, to extend hospital-based support provided to pregnant women by providing them with health information and promotional messages regarding pregnancy, postnatal and child care.

Beyond these, m-Health technologies have been leveraged to improve accessibility and quality of family planning services, addressing commodity logistics, and monitoring and evaluation of family planning services in several parts of the world including Tanzania and India. Results from a project implemented in Shinyanga region of Tanzania by D-tree International and Pathfinder International indicate that not only does m-Health (specific mobile phone family planning app with or without financial incentives) improve workflow and quality of family planning services provided by community health workers, it also improved client registration and follow-up, as well as clients' adherence to and satisfaction with their chosen contraceptive method [21]. In India, the United Nation Foundation-funded Institute for Reproductive Health's CycleTel offers Standard Days Method of family planning service to eligible women through text messages [22]. Through this service, women are alerted of their unsafe (fertile) days each month through SMS and encouraged to use a barrier method or abstain from sex during this period. In addition, reproductive health information is provided to the women through this platform.

Despite these evidences, not much is known regarding the potential efficacy of m-Health interventions on post-abortion family planning (PAFB) [23], an area requiring more systematic approaches and studies to establish its efficacy or otherwise [24]. Further, literature suggests that interventions comprising a variety of daily educational text-messages and oral contraceptive (OC) reminders [25] were more effective compared to

simple text message interventions (contraception reminders) alone [26,27]. It is imperative for program managers, public health practitioners and policy makers to conduct social diagnosis and formative research to understand the unique socio-cultural determinants of family planning coverage and service utilization among their population, in order to successfully tailor m-Health strategies that may benefit them.

2.1.1.3 Childhood immunization. The World Health Organization (WHO) 2017 report estimates that about 2−3 million annual deaths from vaccine-preventable diseases (VPDs) are saved by immunization [28]. Despite the obvious benefits of vaccination, global vaccination rates have stalled at 86% for the past few years, a situation requiring concerted efforts by all stakeholders to address the gaps in coverage by reaching an estimated 19.5 million infants who currently miss out on basic immunization services. As with under-5 mortality rate, the challenges facing expansion of childhood immunization coverage are more evident in developing countries.

Like earlier systematic reviews [29], a recent study by Abdulrahman and Olaosebikan [30] which examined literature evidences regarding the efficacy of m-Health interventions in improving childhood immunization coverage, suggested a global consensus from high quality studies (RCTs) regarding the efficacy of m-Health interventions − used singly or in combination with other interventions − in improving childhood immunization coverage (uptake and completion rates) in many parts of the world.

Most notably within the scope of public health programming, m-Health has been deployed in many parts of the developing world to improve immunization coverage (uptake and completion rates), timeliness of receipt, commodity logistics and monitoring by digitizing the entire cascade using mobile phones or computers [31−34]. While majority of these innovations have explored the ubiquitous availability of mobile phones to target pregnant women and new mothers with simple SMS reminders on immunization clinic appointments, others have employed specialized mobile apps that enhance real-time update and reporting of vaccination records, as well as vaccination schedule and stocks monitoring. For example, the United Nations and WHO worked in partnership with stakeholders in Vietnam [31], Nepal [32] and Pakistan [33] to address the issue of poor vaccination coverage using variety of m-Health solutions described above. In one of such robust systems implemented by PATH in Ben Tre Province, Southern Vietnam, the project sought to enhance real time access to immunization data, and also allow timely generation of reports at the community health center and district level. The project implemented a digital immunization registry system comprising of a web-based application accessible via smartphone or computer, allowing mother-infant pairs to be registered and receive SMS reminders on immunization clinic appointments and also track the vaccines received. The system also improves the quality and efficiency of services provided by the healthcare workers by generating reports on the number and types of vaccine they need to administer every month as well as the list of individuals due for vaccination, thereby reducing the chances of stock-out of essential vaccines and commodities and minimizing drop-outs or loss to follow up. In the long-term, the project aimed to replace the existing paper-based immunization registry system with a more efficient and reliable digital system that improves performance and confidence in the health care system.

Today, in many parts of Asia, Africa and South America, the use of m-Health (particularly SMS reminders for immunization clinic appointments) is gaining popularity as a quick win, yet sustainable and cost-effective approach to improving immunization coverage, timeliness of receipt, commodity logistics and monitoring.

2.1.1.4 Maternal and child nutrition. In many developing countries, undernutrition remains a very important cause of mortality among children under 5 years, accounting for nearly 50% of all deaths in this age group (about 3 million annual deaths) [35]. Not only does undernutrition increase the risk of children dying from common infectious diseases, it also worsens the frequency, severity and chances of recovery from these diseases, with increased potential for worse outcomes among undernourished children less than 1000 days old. Child undernutrition has a very important association with nutritional status of their mothers. Children whose mothers are underweight (with a body mass index less than 18.5 kg/m^2) are much more likely to be stunted, wasted and underweight than other children [36].

Whereas poor nutrition among mothers and children are largely preventable through concerted multisectoral efforts that include poverty alleviation, food security and women empowerment, public health approaches aimed at providing nutritional education, early detection and referral, nutrition and growth monitoring of children have been shown to yield better outcomes at population level. The emerging use of m-Health in addressing the challenge of maternal and

child undernutrition has shown promising results and offers hope to public health programmers in this regard. One of such innovative use of m-Health is the United Nations Foundation-funded Society for the Elimination of Rural Poverty's (SERP) mobile Nutritional Day Care Centers (mNDCC) project implemented in rural Andhra Pradesh India [37] to improve monitoring and reporting between local and state-level actors, enhance tracking of nutrition, health status and behavior of clients enrolled in the program. The project uses the mNDCC device – a mobile handset with several modules – to survey, enroll, track and report the health (hemoglobin level, immunization status, antenatal care and prenatal care), nutrition (feeding practices, growth monitoring) and behavior (daily attendance at the NDCCs) of enrollees. Based on the information inputted into the system, relevant health-related action can be taken based on software-generated alerts as well as decision-making on other program-related matters including financial information. The mNDCC provides real-time data to guide timely decision-making on the functionality and performance of the women's self-help groups (NDCC).

2.2 Non-Communicable Diseases Prevention and Risk Factor Modification

In the last decade, most LMICs have witnessed a progressive increase in the prevalence of NCDs and its risk factors believed to result from increasing life expectancy, industrialization and westernization of lifestyle. Two-thirds of all NCD deaths (most importantly from cancer, cardiovascular and respiratory disease as well as diabetes) occur in these countries and coupled with the high prevalence of communicable diseases such as TB, this "dual burden of disease' exerts significant negative effect on the health care system and economy of these countries [38]. Experts have called for innovative approaches of curbing and reversing this trend.

A range of digital interventions have been developed to support these efforts [39]. Widely described as digital health, these tools exist in various forms including text messaging, mobile and desktop-based applications, wearables (watches, wristbands, cutaneous patches, and clothing), digital workplace interventions, and virtual reality. The beneficial effects of these tools are believed to include improved access, efficient communication, affordability as well as an increase in efficiency and value of health care [40]. Although the evidence-base to support the efficacy of these tools is still emerging, however, there appear to be a consistency of evidence suggesting beneficial effects in reducing cardiovascular risk [39] and potentially CVD outcomes [41].

2.2.1 Physical inactivity

About 1 in three adults worldwide were physically inactive, with proportions ranging from 17% in Southeast Asia to about 43% in the Americas and the Eastern Mediterranean [42]. A 2015 RCT conducted in Baltimore USA utilized a wearable triaxial accelerometer with a Bluetooth-enabled connectivity to participants' smartphones to track their daily physical activity levels and also deliver smart text prescriptions by physicians to motivate respondents toward achieving the 10,000 steps/day goal. The study findings suggest that a fully automated tracking-texting intervention increased physical activity with, but not without, the texting component [43].

2.2.2 Diet control

According to a 2016 Global Burden of Disease report [44], poor/sub-optimal diet is the second leading risk factor for deaths and DALYs globally, accounting for nearly one-fifths of all deaths. Other diet-related risk factors include high blood glucose, high blood pressure, high BMI and high total cholesterol. The risk associated with sub-optimal diet exists in two extremes of malnutrition among poor people and unhealthy diet among the rich. The study reports the biggest driving factor of dietary risk is that millions of people are eating a diet which consists of too much salt and saturated fat, and not enough fruit, vegetables, nuts, seeds, omega 3, and whole grains.

Beyond the traditional approaches of in-person or telephone counseling on dietary habits, recent advances regarding the use of m-Health technologies in improving dietary risk awareness and driving behavioral change toward healthy eating have shown promising results [45]. For example, the use of supportive mobile phone text-messaging to encourage healthy eating is gaining wider acceptability because of its relative inexpensiveness and capacity for wider reach even among populations with limited access to smartphones or internet connectivity. In one prospective cohort study (mDiabetes study) [46] conducted among 1925 mobile phone subscribers in India, the authors sent 56 text messages (twice-weekly messages containing facts and behavioral modification content regarding diabetes, healthy eating and physical activity) in one of 12 languages to 982 randomly selected Nokia subscribers over 6 months, and compared the results against 943 controls (non-Nokia subscribers who received no text messages) with respect to changes in 4 health behaviors that lessen diabetes risk: engagement in exercise, avoidance of fat foods, fruit intake of 2 servings a day or more, and vegetable intake of 2 servings a day or more.

The authors reported a differential positive improvement in diabetes preventive behaviors among intervention compared to control group, especially with regards to improved fruit and vegetable intake and reduced fat intake.

Current trends tend toward the use of m-Health technologies for multiple behavior change interventions including dietary education, promoting healthy eating and physical activity simultaneously [47]. Although an emerging area of research, early findings are encouraging and point toward beneficial effects.

2.2.3 Smoking

Smoking (all forms) is a leading cause of death and DALYs worldwide, accounting for 7.1 million deaths and 177.3 million DALYs in 2016 [44]. m-health technologies offer a glimpse of hope in combating the burden of tobacco. Of available m-Health interventions, text-messaging for smoking cessation appear to be the most popular approach, and also yields comparable results to other types of smoking cessation interventions such as telephone quit lines, web-coaching, video messaging, counseling and behavioral therapies or nicotine replacement therapy (NRT) [48]. A recent meta-analysis on the efficacy of SMS text messaging for smoking cessation found that quit rates was 35% higher in the intervention group as compared to the control group [48]. While this area of research has witnessed significant evolution and yielded promising results, important determinants/moderators of the efficacy of this approach are believed to include frequency of messaging (fixed vs. decreasing/variable schedules), length of follow-up ($\leq$3 months or $\geq$6 months), intervention design (text alone vs. text and additional interventions) and variations in content. Other factors include message direction and initiation, extent of message tailoring and availability of on-demand messaging support features [49,50].

2.2.4 Alcohol use

Alcohol was estimated to be the seventh leading cause of death and DALYs in 2016 [44]. A variety of m-Health approaches are available for addressing alcohol misuse or dependence, many of which rely on the different functionalities of mobile phones available to clients [51], the most basic and popular approach being text messaging. While the evidence regarding the efficacy of text messaging in achieving alcohol abstinence have been largely variable [51–54], newer approaches of using smartphone-based alcohol abstinence apps have been shown to be more effective [55]. Many such apps exist, and while systematic studies evaluating their comparative efficacy in promoting reductions in alcohol consumption or treating Alcohol Use Disorders (AUD) are relatively sparse, initial evidence suggest beneficial effects in this regard [56,57]. For example, the Alcohol – Comprehensive Health Enhancement Support System (A-CHESS) which is a relapse prevention app for individuals in recovery for alcohol dependence who have been recently discharged from residential care, is reported to provide the strongest evidence of efficacy [58] compared to other apps for AUD (such as Location-Based Monitoring and Intervention system for Alcohol use disorders (LBMI-A), Promillekoll, PartyPlanner, HealthCall-S, and Chimpshop), with participants in a recent RCT who received A-CHESS reporting significantly fewer risky drinking days over a 12-month period as well as higher likelihood of abstinence than controls [56]. The A-CHESS is GPS-enabled and has a number of inbuilt support features to encourage sobriety, such as a warning noise when users get too close to a bar, and a panic button that the user can press if they're thinking about drinking or buying alcohol. The button contacts the user's closest peers and medical professionals who can reach out and discourage the person from relapsing (Fig. 11.1). While the patient is waiting for a response, it offers them links to potentially helpful materials such as tutorials on relaxation exercises.

2.3 Communicable Diseases

2.3.1 Surveillance, outbreak detection and management

In the last decade, the world has witnessed several pandemics/epidemics from emerging and re-emerging infectious diseases such as Avian Influenza, MERS-CoV, Ebola, Zika, etc causing morbidity and mortality of devastating proportions especially in developing countries. Emerging zoonoses underscores the growing need for all countries to develop capacities to rapidly detect, contain, respond to, and cope with such pandemics. Central to achieving this is the development and maintenance of a robust surveillance, outbreak detection and management capacity. Traditional approaches to surveillance, outbreak detection and management are often too cumbersome and faced with a lot of challenges and inefficiencies in communication, contact tracing, skilled manpower and other infrastructural issues, that militate against rapid containment of outbreaks, hence resulting in devastating outcomes.

Lessons learnt from the 2014/2015 Ebola Viral Disease (EVD) outbreak in West Africa suggest that more robust surveillance and outbreak management infrastructure are needed [59]. Incidentally, the burden of

FIG. 11.1 A-CHESS app main menu and panic button. (Courtesy GoWireless, 2017. Available from: https://www.gowireless.com/blog/study-smartphone-app-may-help-people-overcome-alcoholism#more-4284. Reproduced with permission from original work of D.H. Gustafson, F.M. McTavish, M.Y. Chih, A.K. Atwood, R.A. Johnson, M.G. Boyle, M.S. Levy, H. Driscoll, S.M. Chisholm, L. Dillenburg, A. Isham, D. Shah, A smartphone application to support recovery from alcoholism a randomized clinical trial, JAMA Psychiatry 71 (5) (2014) 566–572, https://doi.org/10.1001/jamapsychiatry.2013.4642.)

these infectious diseases is highest in developing countries where capacity for rapid containment is often limited. The high penetration of mobile phones in these countries offer a significant opportunity to leverage m-Health technologies in overcoming many of the communication, transportation and outbreak management challenges in these settings [60,61]. A variety of m-Health tools and apps with diverse functionalities have been developed and tested for many diseases such as EVD, H1N1, polio, dengue fever, SARS, MERS-CoV, malaria, measles etc, including with general disease surveillance functionalities. For example, the open source "SORMAS" [62], "Ebola Sense Followup" [63] and "CommCare" [64] tools were tested during the EVD outbreak and included functionalities such as surveillance notification, contact tracing, case management, automated GPS tracking, tailored health-specific user profiles with variable functionalities, laboratory function and rumor management, enabled on smartphones and/or tablets.

The development and deployment of the "Ebola Sense Followup" tool (Fig. 11.2) contributed significantly to the timely containment and control of the EVD outbreak in Nigeria by providing valuable platform for early warning and timely action. More of such tools are in development, and initial evidence of their successful application serves as a reference point of their efficacy in infectious disease surveillance and management. Future areas of improvement include the need to fully integrate these tools with the existing Health Management Information System (HMIS) infrastructure in these countries, which enhances overall sustainability.

2.3.2 Enhancing infectious disease diagnosis, monitoring and treatment

m-Health technologies have been exploited to overcome challenges in timely diagnosis and initiation of treatment arising from delays in receipt of laboratory results and poor continuity of care, especially in remote settings with limited communication and transportation infrastructure. m-Health technologies have been successfully deployed to enhance efficiency across the continuum of care in many African countries with basic telecommunication networks. One of such applications is in facilitating early infant diagnosis of HIV and follow-up and retention of mothers and their exposed infants in Nigeria [65], Kenya [66] and Malawi [67]. For example, the United Nations Foundation-funded Clinton Health Access Initiative's (CHAI) "SMS Printers to Accelerate Return of Test Results for Early Infant Diagnosis of HIV/AIDS' (SMART) project implemented

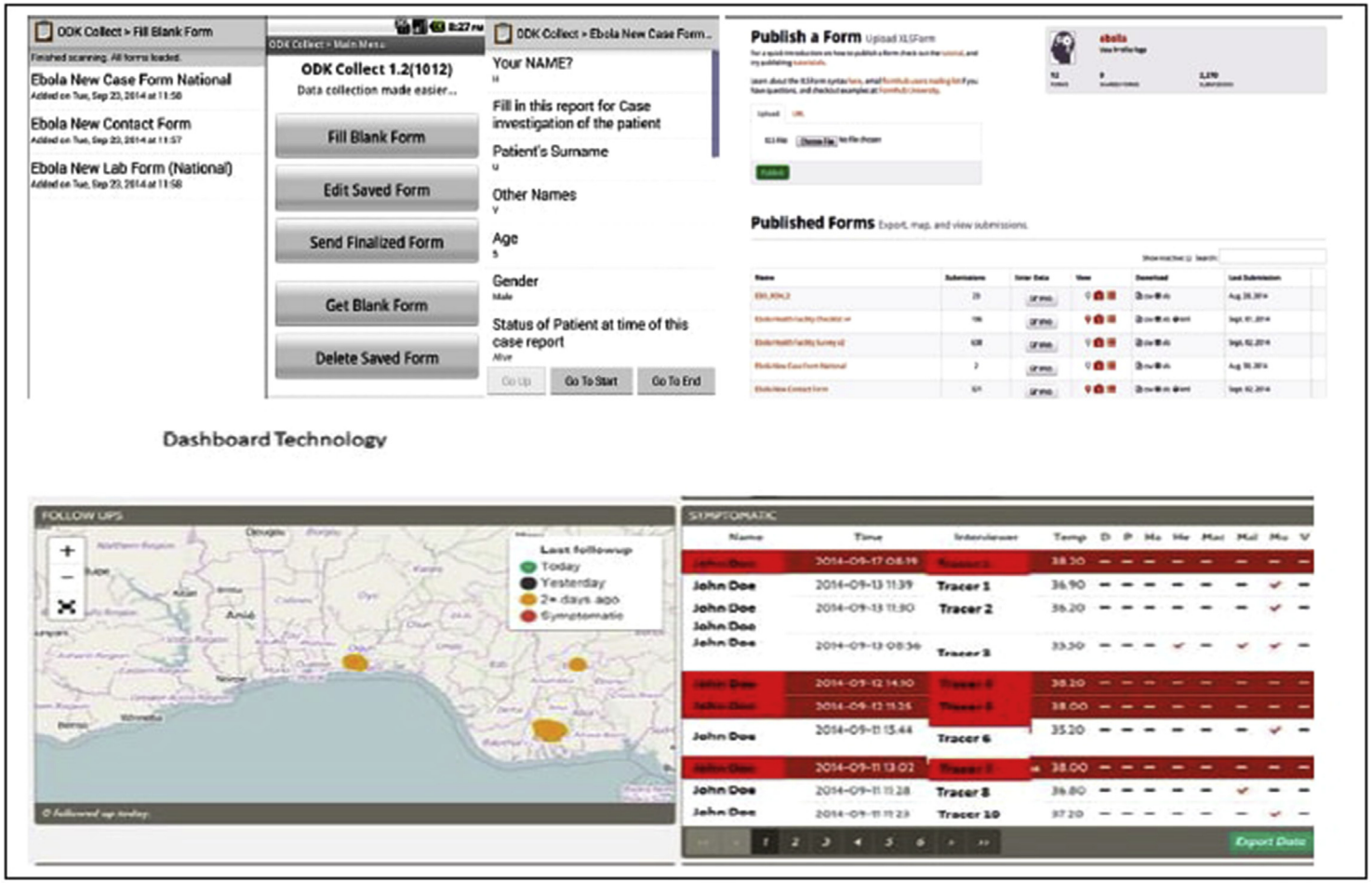

FIG. 11.2 Screen shots from Ebola Sense Followup app and web dashboard. (Reproduced with permission from the original work of D. Tom-Aba, A. Olaleye, A.T. Olayinka, P. Nguku, N. Waziri, P. Adewuyi, O. Adeoye, S. Oladele, A. Adeseye, O. Oguntimehin, F. Shuaib, Innovative technological approach to Ebola virus disease outbreak response in Nigeria using the open data Kit and form Hub technology, PLoS One 10 (6) (2015) e0131000, https://doi.org/10.1371/journal.pone.0131000. Available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0131000.)

in Nigeria utilized text messaging to rapidly communicate infants' HIV test results from laboratories to the health facilities, especially those in very remote hard-to-reach locations with irregular power supply, limited skilled manpower and internet access. This approach has facilitated instant transfer (from the laboratory to health facility) of test results which can be printed out from the battery-operated SMS printers to enhance timely initiation of antiretroviral therapy (ART) and limit loss-to-follow up [68].

2.4 Environmental and Occupational Health

To date, little is known about the prospects and potential application of m-Health technologies to improve occupational and environmental health, apparently because research in this area has been very sparse. However, to stay in conformity with Labor laws and Occupational Safety and Health regulations, employers are increasingly leveraging mobile technologies in form of text messaging and apps to track and report employee vaccination status, report incidents, monitor employee safety and training, keep OSHA records as well as leave and medical management [69]. For employees whose work schedule involves a lot of traveling, employers are now able to use a journey management software program to track employees' movements and receive instant alerts when an employee has not checked-in to their destination at their scheduled time [70]. These tools help to minimize risks and improve employee safety.

2.5 Other Areas

m-Health technologies are increasingly being adapted for other purposes that impact the overall health of populations such as providing mobile job aids to improve efficiency and effectiveness of community health workers and nurses [71,72], improving surveillance, reporting and decision-making by health care workers [73], and improving drugs and commodities logistics and supply chain management system [74]. Whereas m-Health has the potential to improve access to mental health care, the evidence-base to support effectiveness of mobile apps in reducing depression, anxiety, stress and substance use symptoms is still emerging and remains a controversial subject [75].

3 CONCLUSION

m-Health has positively impacted the global public health landscape. The increasing penetrance of mobile devices even among the most vulnerable and lower income populations around the world, has continued to ease most of the challenges faced in "traditional' public health programming – which had hitherto militated against the timely delivery of essential services, implementation of robust surveillance and disease prevention efforts, and health promotion activities using traditional approaches – by offering an acceptable, cost-effective platform and alternative for knowledge dissemination, behavior change communication/interventions, program monitoring, evaluation and research. Not only has m-Health adoption revolutionized awareness creation about health and disease at population-level, it has also improved self-consciousness and encouraged better self-health practices at individual level. Notwithstanding some documented drawbacks of its use, the overarching implication of its application in public health practice is a drive toward an informed, healthier global population and the possibility of achieving the global health targets through coordinated advocacies, policy dialogues and community participation in health programs. m-Health must continue to evolve in its responsiveness to stakeholders' (communities, care providers, health systems, policy-makers) needs and functionalities that address its current drawbacks such as the development of cryptographic technologies to address security and privacy of information.

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