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mHealth

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Synonyms

Mobile health; m-Health

Definition

mHealth refers to the use of mobile devices, such as mobile phones, tablet computers, and personal digital assistants (PDAs), to provide medicine, public health, and health services. The purpose of mHealth is to improve population health outcomes, quality, safety, access, and efficiency of health services and health research (Istepanian et al. 2006; Kay et al. 2011).

Overview

mHealth, a rapidly expanding subset of eHealth (See ▶"Digital Health/eHealth"), focuses on the utilization of mobile and wireless information and communication technologies (ICT) to support the achievement of health objectives. The ICT applications in mHealth include, but are not limited to, real-time voice and short message service (SMS) provided by mobile phones, more complex functionalities and applications based on general packet radio service (GPRS), third- and fourth-generation mobile telecommunications (3G and 4G technologies), global positioning system (GPS), sensor and Bluetooth technologies provided by smartphones, or other smart devices (See ▶"Mobile Technology") (Kay et al. 2011). Although mHealth cannot solve all problems in healthcare, it can lead to major advances in improving the access to healthcare services (See ▶"Telemedicine/Telehealth/Telenursing/Telerehabitation"), decision making, chronic disease prevention/management, and emergency care (Varshney 2014).

The driving force of mHealth is the limited human resources available for delivering continuous healthcare services for community-dwelling consumers suffering from chronic diseases, especially for the disabled and aging population (Yu et al. 2006). mHealth has increasingly been recognized as a potential alternative in providing same quality but low-cost medical and healthcare services. It can also enable the shifting of

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investment in healthcare from treatment to prevention of age-related diseases, which is a long-lasting goal of population health (Helbostad et al. 2017). With the increased capability to support consumer self-management of own health, such as tracking health records, acquiring relevant information, communicating with healthcare providers or peers, or being reminded about health status, mHealth fits with the emerging patient-centered healthcare model (Eze et al. 2016; Petersen et al. 2015; Song et al. 2019). As older people face high risks of social isolation, chronic diseases, and poor health conditions, mHealth also meets the need for innovative solutions to empower them to take care of their own health and function, and thus enable them to age at home independently instead of being placed in institutions at the end of their lives.

Key Research Findings

Development History

Short message service, the first-generation text messaging, made its debut in 1992 (Terry 2008). In early 2000, the original concept of mHealth emerged implicitly as "wireless telemedicine" or "unwired E-MED" (See ▶ "Telemedicine/Telehealth") (Laxminaryan and Istepanian 2000). In 2003, the term "mHealth" was first coined and defined as "emerging mobile communications and network technologies for healthcare." This marked the evolution of eHealth technologies from the wired telemedicine platform to wireless mobile mode (Istepanian and Lacal 2003).

In 2006, two exciting development opportunities were opened for mHealth: the convergence of 3G and 4G technologies and the potential application of biosensors and computing in mHealth systems. Meanwhile, the security and privacy issues were also emerged (Istepanian et al. 2006).

In 2007, Fogg presented his creative idea of applying mobile technologies to change consumer behavior in a landmark Mobile Persuasion Conference. This led to a Texting4Health Event, marking its entrance of SMS in healthcare (Terry 2008). In the same year, iPhone 2G and its customizable operating system (iOS) were released, allowing consumers to download apps, such as games and other utilities, and to publish their own apps to the community. The new mobile platforms such as Android, BlackBerry, and Symbian also emerged. These developments accelerated the applications of smartphones and mobile apps in various health areas (Silva et al. 2015). Up to 2017, there were more than 318,000 healthcare apps available worldwide (Aitken et al. 2017).

Characteristics of mHealth

Davis et al. (2016) summarize four essential characteristics of mHealth for the design, implementation, and adoption of mHealth solutions. They are (1) the penetration into or adoption by consumers, (2) the availability and form of apps, (3) the availability and form of wireless broadband access to the Internet, and (4) the fit with individual needs and preferences.

Penetration into or adoption by consumers is essential for the visibility and viability of mHealth. Despite the popularity of mobile phones and the purpose of mHealth, to date, there is a lack of adoption and use of mHealth in the older population (Matthew-Maich et al. 2016). The availability and form of apps include functionalities for data acquisition, transfer and analysis, ease of user access to the system, and connection to other health information systems (see ▶ "Wearable Technology") (Baig et al. 2015). The availability and form of wireless broadband access is vital to device connectivity and performance of data communication in mHealth solutions (Matthew-Maich et al. 2016). The fit with individual needs and preferences is important not only for supporting personalized medicine or public health interventions but also for reducing delay of communications (Davis et al. 2016; Lienhard and Legner 2017).

Key Stakeholders of mHealth

Petersen et al. (2015) summarize nine types of stakeholders of mHealth: (1) patients, (2) families and caregivers, (3) healthcare professionals, (4) healthcare facilities, (5) mHealth researchers, (6) policy actors, (7) payors and purchasers, (8) employers, and (9) others, which may include all vendors in the supply chain, system developers, as well as consultants. Of these, patients, healthcare

professionals, and system developers are the three key stakeholders who are directly related to or impacted by mHealth (Davis et al. 2016; Eze et al. 2016).

mHealth is particularly useful to provide a similar level of healthcare services to the patients who live in remote communities and rural regions without extra cost (Yu et al. 2006). Conversely, healthcare professionals can use mHealth solutions to provide patients with healthcare services, to access patients' health/medical records, to utilize computerized physician order entry, and to prescribe/adjust medications electronically 24 h a day, 7 days a week. By providing alternatives for patient-doctor interactions, and health knowledge, system developers act as bridges to bring patients to healthcare professionals (Eze et al. 2016).

Design of mHealth Applications

Principles of Designing mHealth Applications for Older People

In general, mHealth developers need to understand what issues need to be resolved, why mHealth is the optimal solution, who the target audiences are, and how users can use mHealth to address their health problems.

As the aging process is often associated with the gradual degeneration and impairment of sensory, physical, and cognitive functions (Holzinger et al. 2007), the design of mHealth applications is required to fit with the special needs of the older people. With difference from the younger people in terms of health status, memory, motivation, speed of reaction and action, learning ability, and error rate, older people need more control, independence, and visibility in the use of mHealth technologies (Kruse et al. 2017). For example, older people are subject to a higher level of anxiety without knowledge of their health status; therefore, by allowing self-monitoring and self-management of health conditions, mHealth can improve their health awareness, so that they can live more independently. Moreover, making the analysis results visible can also increase older people's interest in tracking their own health status, which results in a better understanding of their health conditions and options.

Wildenbos (2015) identifies seven design principles of mHealth for older people. They are simplicity, forgiveness and feedback, naturalness, effective use of language, efficient interaction, effective information presentation, and preservation of context.

mHealth Content

The following contents are found to satisfy mHealth consumer needs: health education, referral and problem-solving method, motivational content which provides encouragement, incentive, peer support for continuous use of mHealth app, and recommendation or reminding content that gives periodic recall or warning to enable a client to stay on healthy track (Song et al. 2019).

mHealth Functionality

Lienhard and Legner (2017) propose four functional building blocks of mHealth apps for end users: (1) instructions that help to understand the use and benefits of mHealth app; (2) setup that allows consumers to input personal data and other context-specific information to facilitate measurement and analysis; (3) measurement that provides various tests for investigating consumers' health indicators; and (4) analysis and timely feedback about the measurement results, as well as targeted suggestions for further improvement.

mHealth Technologies

mHealth not only relies on traditional voice-only communication and 2G-based SMS and Multimedia Messaging Service (MMS) technologies provided by a mobile phone, but can also be built on more complex technologies such as GPRS, 3G and 4G systems, GPS, sensor network and Bluetooth technologies provided by smartphones like iPhone, or other smart devices to support the achievement of health objectives (See ► "Technology and Telemedicine") (Istepanian et al. 2006; Kay et al. 2011).

mHealth User Interface Design

As the user interface (UI) is the only place for humans to interact with machines, its design is critical for user acceptance and use of mHealth applications. A well-designed UI could create

efficient and satisfactory interactions between a user and the relevant healthcare services, and vice versa (Baig et al. 2015; Matthew-Maich et al. 2016). In principle, UI needs to be simple, easy to use, and functional. For old people, mHealth solutions with touchscreen-based UI should be fit for dealing with the physical and cognitive constraints faced by them, such as providing higher color contrast and larger font size and button and to simplify the navigation options for searching health information (Lienhard and Legner 2017).

mHealth Implementation

mHealth Delivery Mode

Common modes of mHealth delivery are SMS text messaging, mobile apps, and interactive voice response (Song et al. 2019). Compared with the latter two, text messaging is more acceptable for older people because it is simple and easy to operate (Marcolino et al. 2018). Lienhard and Legner (2017) recommended that interactive voice response may be a better alternative to deliver mHealth solutions to older people as it can avoid the limitation of the low level of literacy or poor eyesight that is more likely to happen to this population group.

An important consideration in sending mHealth notification is timing and frequency of delivery. Although it was found that timing did not matter, frequency did in terms of consumer's use of mHealth applications (Fischer et al. 2010; Morrison et al. 2017). There is almost no difference among different timing of notifications (user-designated timing, predetermined timing, sensor-driven timing, and random timing) (Fischer et al. 2010). Morrison et al. (2017) suggested that more frequent delivery of notifications can provide users with more exposure to intervention content, which may lead to their increased use of the mHealth solution.

In addition, mHealth solutions need to fit with both routines of patient and healthcare professional. Patient's use needs to comply with the clinical requirements for the mHealth solution to work (Lienhard and Legner 2017).

Processes for Delivering mHealth Services

Eze et al. (2016) define four processes for delivering mHealth services: mPrevention/Education, mData-Collection, mDiagnosis, and mTreatment. mPrevention/Education refers to the use of mHealth method to provide patients with preventative and educational information before or at the early stage of their illnesses. mData-Collection refers to the collection of patient data to inform other aspects of healthcare delivery. It will enable healthcare professionals to understand patients' needs and to detect problems quickly. mDiagnosis is the process of identifying the cause of health deterioration by healthcare professionals. mTreatment is the use of mHealth method to provide healthcare interventions for patients.

mHealth Benefits

Varshney (2014) summaries four benefits of mHealth. First, it provides consumers with necessary healthcare information anytime anywhere. This opportunity overcomes disparity in access caused by geographic location and time difference. It is especially helpful for older people living in rural and remote areas. For example, it can be used to integrate high-quality medical resources across borders to improve disease prevention and treatment. This could enable consumers in underdeveloped regions to receive better healthcare services (Sun et al. 2016). As older people may respond to a sensory stimulus relatively slowly, mHealth solutions are widely acceptable and accessible by giving them more time and flexibility to digest information.

Second, mHealth can improve the decision-making process as well as healthcare outcomes. For example, a mHealth app, Stroke Emergency Mobile (STEMO) could conduct pre-hospital diagnosis to determine the stroke type quickly and accurately, so as to improve triage of patients with cerebrovascular events to specialized hospitals (Wendt et al. 2015). Lim et al. (2011) found that HbA1c level was significantly improved through SMS-enabled diabetes mellitus education for old diabetic patients.

Third, mHealth improves the management of chronic health conditions. Through a systematic review, Marcolino et al. (2018) found that mHealth

has been applied in consumer self-management of the common chronic diseases including asthma, cardiac rehabilitation, congestive heart failure, chronic lung diseases, chemotherapy symptoms, diabetes, HIV, hypertension, coronary artery disease, and weight loss. Sun et al. (2016) introduced mHealth apps to manage five typical aging-related neurological diseases: stoke, sleep disorders, cognitive dysfunction, epilepsy, and fall.

Fourth, mHealth provides consumers with essential access to healthcare in emergency conditions. For example, a mHealth app called HealthVault allowed consumers to create their medical records particularly for accidental hospital visits, or for notifying first responders in emergencies (Bouri and Ravi 2014).

Elavarasan and Pugazhendhi (2020) proposed that another benefit of mHealth is the ability to track infected people and their travel paths to control the spread of infectious diseases, such as the coronavirus (COVID-19) pandemic in 2020. For example, the Singapore government launched a mobile app, TraceTogether, which leveraged Bluetooth technology to identify the potential coronavirus carriers who may be in close contact with others (CNBC 2020). In China, people were required to use the health code generated by Alipay, an app that was usually used for mobile payment, on their smartphones to decide whether they should be quarantined or allowed to enter subways, shopping centers, and other public places during the coronavirus outbreak (Mozur et al. 2020). These applications had positive effects in protecting safety of people, especially the older adults who are more vulnerable to COVID-19 viral infection

mHealth Challenges

Challenges for mHealth come from five aspects: policy, people, technology, application, and economy.

Despite the increasing development trend of mHealth, the governments in many countries are not actively promoting it, which hinders its penetration into healthcare (Lam et al. 2018). Another challenge is a lack of regulations and standards that can keep pace with mHealth development (Sun et al. 2016; Whittaker 2012).

The challenges for consumers include their resistance to use mHealth apps or nonadherence to the recommended use. They may concern about privacy, and whether mHealth can support well-being (Baig et al. 2015; Gurupur and Wan 2017; Varshney 2014). The challenges for healthcare providers include availability, responsibility, speed and quality of decision-making and healthcare delivery using mHealth solutions, their concerns about medical errors and cost associated with mHealth usage, and finally the difficulty for them to shift their role from control to collaboration in mHealth landscape (Baig et al. 2015; Varshney 2014).

Technology-related challenges for mHealth include reliability, usability, device, system integration, network access, and security (Gurupur and Wan 2017; Sun et al. 2016). For example, although the current 4G network can provide connectivity among patients and healthcare professionals, mHealth solutions can fail to provide them with necessary information due to technical failure, such as insufficient network coverage, limited bandwidth causing delay, device malfunction, and disconnection with other health information systems (Sun et al. 2016; Varshney 2014). Also, a lack of information exchange standard can lead to data isolation instead of sharing between systems.

Application-related challenges for mHealth are primarily its effectiveness and implementation (Varshney 2014). One stumbling block is that some mHealth solutions had little effect on the consumers, which is opposite with the original expectations (Arora et al. 2014; Cottrell et al. 2012; Witkiewitz et al. 2014). Some mHealth applications could not provide adequate functions to meet consumers' needs. Another issue is that there is a lack of understanding about the optimal frequency of information delivery. Too often mHealth intervention may bore consumers and turn them off. On the contrary, not enough intervention may not deliver the intended effect of the mHealth applications.

The economic challenge for mHealth is the payment mechanism (Whittaker 2012). In the absence of sound evidence to prove cost-effectiveness, investors, and decision makers are not convinced about the usefulness of mHealth. This lack of sustainable business model further hinders adoption and use of mHealth in the routine healthcare systems.

Future Directions of Research

There is still a long way to go before mHealth can be successfully integrated into routine healthcare delivery systems. First, the optimal way to design and implement mHealth needs to be worked out. Since older people can benefit enormously from mHealth solutions, research needs to focus on their preferences and needs for these solutions, as well as the facilitating factors for them to adapt to use the solutions. Therefore, mHealth development needs to learn from the other research fields such as computer-supported collaborative work, group dynamics, peer support mechanisms, and social networks (See ▶ "Health 2.0/Health 3.0") (Meng et al. 2019; Silva et al. 2015). The long-term effects of mHealth use also need to be understood, as well as cost-effectiveness.

To ensure the sustainability of mHealth, further cooperation between industry and research organizations are encouraged to co-design, develop, implement, and evaluate mHealth solutions in health delivery systems and to generate lessons and insights for future success (Matthew-Maich et al. 2016; Silva et al. 2015).

Summary

mHealth offers the opportunity to increase the capability of healthcare delivery systems to provide consumers with anywhere, anytime access to health information, personal health monitoring, chronic disease management, and participating in health decision making. Therefore, it provides an effective mechanism to reach consumers beyond hospital to achieve person-centered care within cost containment. mHealth can also support older people to age at home, self-manage chronic diseases, and reduce social isolation. These benefits have seen mHealth initiatives being continuously designed and implemented all over the world.

To ensure the acceptance and use of mHealth innovation by the target population, particularly older people to achieve positive outcomes, mHealth designers and implementers need to understand the characteristics of the key stakeholders, and carefully design the contents, functionalities, technologies, and particular user interfaces, to fit with their characteristics. The implementation processes also need to be carefully planned, executed, and evaluated. To promote the advancement of mHealth, future research can focus on its acceptance, use, and integration into the healthcare delivery systems, the resulting outcomes, and sustainability.

Cross-References

- ▶ Digital Health
- ▶ eHealth
- ▶ Health 2.0
- ▶ Health 3.0
- ▶ Mobile Technology
- ▶ Technology and Telemedicine
- ▶ Telehealth
- ▶ Telemedicine
- ▶ Telenursing
- ▶ Telerehabilitation
- ▶ Wearable Technology

References

Aitken M, Clancy B, Nass D (2017) The growing value of digital health: evidence and impact on human health and the healthcare system. IQVIA Institute for Human Data Science. https://www.iqvia.com/institute/reports/the-growing-value-of-digital-health

Arora S, Peters AL, Burner E, Lam CN, Menchine M (2014) Trial to examine text message-based mHealth in emergency department patients with diabetes (TExT-MED): a randomized controlled trial. Ann Emerg Med 63(6):745–54.e6. https://doi.org/10.1016/j.annemergmed.2013.10.012

Baig MM, GholamHosseini H, Connolly MJ (2015) Mobile healthcare applications: system design review, critical issues and challenges. Australas Phys Eng Sci Med 38(1):23–38. https://doi.org/10.1007/s13246-014-0315-4

Bouri N, Ravi S (2014) Going mobile: how mobile personal health records can improve health care during emergencies. JMIR Mhealth Uhealth 2(1):e8. https://doi.org/10.2196/mhealth.3017

CNBC (2020) Use of surveillance to fight coronavirus raises concerns about government power after pandemic ends. https://www.cnbc.com/2020/03/27/coronavirus-surveillance-used-by-governments-to-fight-pandemic-privacy-concerns.html

Cottrell E, Chambers R, O'Connell P (2012) Using simple telehealth in primary care to reduce blood pressure: a service evaluation. BMJ Open 2(6):e001391. https://doi.org/10.1136/bmjopen-2012-001391

Davis TL, DiClemente R, Prietula M (2016) Taking mHealth forward: examining the core characteristics. JMIR mHealth uHealth 4(3):e97. https://doi.org/10.2196/mhealth.5659

Elavarasan RM, Pugazhendhi R (2020). Restructured society and environment: A review on potential technological strategies to control the COVID-19 pandemic. Sci Total Environ p.138858. https://doi.org/10.1016/j.scitotenv.2020.138858

Eze E, Gleasure R, Heavin C (2016) Reviewing mHealth in developing countries: a stakeholder perspective. Procedia Comput Sci 100:1024–1032. https://doi.org/10.1016/j.procs.2016.09.276

Fischer JE, Yee N, Bellotti V, Good N, Benford S, Greenhalgh C (2010) Effects of content and time of delivery on receptivity to mobile interruptions. In: Proceedings of the 12th international conference on human computer interaction with mobile devices and services. ACM, pp 103–112. Lisboa, Portugal

Gurupur VP, Wan TT (2017) Challenges in implementing mHealth interventions: a technical perspective. mHealth 3:32. https://doi.org/10.21037/mhealth.2017.07.05

Helbostad J, Vereijken B, Becker C, Todd C, Taraldsen K, Pijnappels M, Aminian K, Mellone S (2017) Mobile health applications to promote active and healthy ageing. Sensors 17(3):e622. https://doi.org/10.3390/s17030622

Holzinger A, Searle G, Nischelwitzer A (2007) On some aspects of improving mobile applications for the elderly. In: International conference on universal access in human-computer interaction. Springer, Berlin, Heidelberg. pp 923–932

Istepanian RS, Lacal JC (2003) Emerging mobile communication technologies for health: some imperative notes on m-health. In: Engineering in medicine and biology society, 2003. Proceedings of the 25th annual international conference of the IEEE. IEEE, San Diego, California, USA. pp 1414–1416

Istepanian RSH, Pattichis CS, Laxminarayan S (2006) Ubiquitous M-health systems and the convergence towards 4G mobile technologies. In: M-Health. Springer, Boston, pp 3–14

Kay M, Santos J, Takane M (2011) mHealth: new horizons for health through mobile technologies, vol 64. World Health Organization, Geneva, Switzerland. pp 66–71

Kruse CS, Mileski M, Moreno J (2017) Mobile health solutions for the aging population: a systematic narrative analysis. J Telemed Telecare 23:439–451. https://doi.org/10.1177/1357633X16649790

Lam JA, Dang LT, Phan NT, Trinh HT, Vu NC, Nguyen CK (2018) Mobile health initiatives in Vietnam: scoping study. JMIR Mhealth Uhealth 6(4):e106. https://doi.org/10.2196/mhealth.8639

Laxminaryan S, Istepanian R (2000) UNWIRED E-MED, the next generation of wireless and internetable telemedicine systems. IEEE Trans Inf Technol Biomed 4(3):189–194. https://doi.org/10.1109/TITB.2000.5956074

Lienhard KR, Legner C (2017) Principles in the design of mobile medical apps: guidance for those who care. In: Leimeister JM, Brenner W (eds) Proceedings der 13. Internationalen Tagung Wirtschaftsinformatik (WI 2017), St. Gallen, pp 1066–1080

Lim S et al (2011) Improved glycemic control without hypoglycemia in elderly diabetic patients using the ubiquitous healthcare service, a new medical information system. Diabetes Care 34(2):308–313. https://doi.org/10.2337/dc10-1447

Marcolino MS, Oliveira JAQ, D'Agostino M, Ribeiro AL, Alkmim MBM, Novillo-Ortiz D (2018) The impact of mHealth interventions: systematic review of systematic reviews. JMIR mHealth uHealth 6(1):e23. https://doi.org/10.2196/mhealth.8873

Matthew-Maich N et al (2016) Designing, implementing, and evaluating mobile health technologies for managing chronic conditions in older adults: a scoping review. JMIR Mhealth Uhealth 4:e29. https://doi.org/10.2196/mhealth.5127

Meng F, Guo X, Peng Z, Lai KH, Zhao X (2019) Investigating the adoption of mobile health services by elderly users: trust transfer model and survey study. JMIR mHealth uHealth 7. https://doi.org/10.2196/12269

Morrison LG et al (2017) The effect of timing and frequency of push notifications on usage of a smartphone-based stress management intervention: an exploratory trial. PLoS One 12(1):e0169162. https://doi.org/10.1371/journal.pone.0169162

Mozur P, Zhong R, KrolikIn A (2020) Coronavirus fight, China gives citizens a color code, with red flags. https://www.nytimes.com/2020/03/01/business/china-coronavirus-surveillance.html

Petersen C, Adams SA, DeMuro PR (2015) mHealth: don't forget all the stakeholders in the business case. Med 2 0 4(2):e4. https://doi.org/10.2196/med20.4349

Silva BM, Rodrigues JJ, de la Torre Díez I, López-Coronado M, Saleem K (2015) Mobile-health: a review of current state in 2015. J Biomed Inform 56:265–272

Song T, Qian S, Yu P (2019) Mobile health interventions for self-control of unhealthy alcohol use: systematic review. JMIR mHealth uHealth 7(1):e10899–e10891. https://doi.org/10.2196/10899

Sun J, Guo Y, Wang X, Zeng Q (2016) mHealth for aging China: opportunities and challenges. Aging Dis 7(1): 53–67. https://doi.org/10.14336/ad.2015.1011

Terry M (2008) Text messaging in healthcare: the elephant knocking at the door. Telemed J E Health 14(6):520–524. https://doi.org/10.1089/tmj.2008.8495

Varshney U (2014) Mobile health: four emerging themes of research. Decis Support Syst 66:20–35. https://doi.org/10.1016/j.dss.2014.06.001

Wendt M et al (2015) Improved prehospital triage of patients with stroke in a specialized stroke ambulance: results of the pre-hospital acute neurological therapy and optimization of medical care in stroke study. Stroke 46(3):740–745. https://doi.org/10.1161/STROKEAHA.114.008159

Whittaker R (2012) Issues in mHealth: findings from key informant interviews. J Med Internet Res 14(5):e129. https://doi.org/10.2196/jmir.1989

Wildenbos GA, Peute LW, Jaspers MW (2015) A framework for evaluating mHealth tools for older patients on usability. Stud Health Technol Inform 210:783–787. https://doi.org/10.3233/978-1-61499-512-8-783

Witkiewitz K, Desai SA, Bowen S, Leigh BC, Kirouac M, Larimer ME (2014) Development and evaluation of a mobile intervention for heavy drinking and smoking among college students. Psychol Addict Behav 28(3): 639–650. https://doi.org/10.1037/a0034747

Yu P, Wu MX, Yu H, Xiao GQ (2006) The challenges for the adoption of m-health. In: 2006 IEEE international conference on service operations and logistics, and informatics. IEEE, pp 181–186. https://doi.org/10.1109/SOLI.2006.329059