eHealth: The Mainstay of Healthcare Delivery in the 21st Century

Miracle Ayomikun Adesina [1,2,3]*, Adesola Oyinkansola Abiodun [1]

[1] *Department of Physiotherapy, University of Ibadan*, Ibadan, NIGERIA
[2] *Cephas Health Research Initiative Inc*, Ibadan, NIGERIA
[3] *Slum and Rural Health Initiative*, NIGERIA

***Corresponding Author:** miracleadesina5@gmail.com

ABSTRACT

The demand and cost of healthcare are on the rise, but it is still important to optimize the care of all patients, while containing the cost of healthcare. There is an increasing need to develop systems that deliver good-quality health care and are cost-effective, especially in developing countries. Due to technological advancements, new healthcare delivery models are being developed to improve healthcare accessibility, especially to distant areas and for emergencies. One of these models of healthcare delivery is eHealth. There is a wide variability in the scope and focus of eHealth. eHealth is an umbrella term that includes telemedicine, mHealth, telecare, ePublic health, eMental health or telehealth. Artificial satellites, internet, mobile communication and cloud communication are some of the several ways that have been identified to be used for providing eHealth services, all with their benefits and applications. The use of eHealth in the delivery of healthcare has a wide range of identified benefits for the service users (clients and patients) and service providers (health professionals). Various barriers to healthcare delivery are set to be broken by the optimal utilization of eHealth. In spite of all these benefits, eHealth is not without its potential risks and challenges. To improve the viability of eHealth in the market and increase its use globally, authors therefore recommend that the risks have to be minimized and barriers lifted.

Keywords: eHealth, Healthcare delivery, 21st century technology, telehealth, ePublic health

INTRODUCTION

The demand and cost of healthcare are on the rise. This has been largely attributed to the world aging population and inadequate resources (funds and manpower) to sustain the continuous increase (American Hospital Association, 2002; Sneha and Straub, 2017; Sneha and Varshney, 2006). In spite of this increase demand for healthcare services, it is still important to optimize the care of all patients, while containing the cost of healthcare (Miyazaki et al., 2012). To assess quality of care provided to patients, a system that is patient-oriented is fundamental (Rao, 2002). There is an increasing need to develop systems that deliver good-quality health care and are cost-effective, especially in developing countries (Rao, 2002).

Kielland Aanesen and Borras (2013) explained that advances in treatment methods, the world aging population and improved accessibility to healthcare service are rapidly changing healthcare delivery around the world. There is an increasing need to develop cost-effective methods that can be used to deliver optimal healthcare services to a large number of people (Jai Ganesh, 2004). Due to technological advancements, new healthcare delivery models are being developed to improve healthcare accessibility especially to distant areas and for emergencies (Kielland Aanesen and Borras, 2013). Models of improving healthcare through information and communication technology

methods are being developed to meet the demand of healthcare services. One of these models of healthcare delivery is eHealth.

Literature suggests that there is a wide variability in the scope and focus of eHealth, as shown in definitions of different authors. Ossenbaard and Van Gemert-Pijnen (Ossenbaard and Van Gemert-Pijnen, 2016) defined eHealth as the use of information and communication technology to reinforce health and healthcare through the delivery of preventive, educative, diagnostics and therapeutic services, independently of time and place. It is also defined as "patients and the public using the internet or other electronic media to disseminate or provide access to health and lifestyle information or services" (Gustafson and Wyatt, 2001). More elaborately, Eysenbach (2001) explained that eHealth is "an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the internet and related technologies." In a broader sense, the term, eHealth, is viewed as a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve healthcare locally, regionally, and globally, through the use of information and communication technology. Although variations in definition exist, it is opined that communication is the general theme of eHealth (Marcus and Fabius, 2005). eHealth is an umbrella term that includes telemedicine, mHealth, telecare, ePublic health, eMental health or telehealth (Mea, 2001; Ossenbaard and Van Gemert-Pijnen, 2016).

Technological advancements have been remarkable in the past two decades. Since the advent and popularization of the internet in the 1990s, several subject matters have been popularly searched, one of which are health-related topics (Ossenbaard and Van Gemert-Pijnen, 2016). This popularity has led to an exponential growth of eHealth in the last 15 years, despite concerns that health officials may have (Institute of Medicine (US) Committee on quality of health care in America, 2001). Over the years, the eHealth industry has evolved from focusing on hardware, systems architectures and databases to the use of ICT to facilitate communication with healthcare professionals and decision making, with emphasis on organizational and human factors (Pagliari et al., 2005).

MEANS OF PROVIDING eHealth SERVICES

eHealth is a broad concept, delivering healthcare through different systems. Artificial satellites, internet, mobile communication and cloud communication are some of the several ways that have been identified to be used for providing eHealth services (Srivastava et al., 2015). Satellites have been especially useful in developing countries where internet accessibility is still poor (Amble et al., 2004; Chronaki et al., 2007; Malik, 2007; Rajashekhar and Ayyangar, 2012; Lach and Vazquez, 2017; Sachpazidis et al., 2008; Sangal et al., 2004; Storetmann, 2014; Tyrer, 2009). Due to the explosive use of mobile phones across the globe, mobile communication is the most popularly used mode of eHealth services (Akter et al., 2013; Huang et al., 2012; O'Reilly and Spruijt-Metz, 2013; Rubrichi et al., 2014). All the different means of providing eHealth services have their advantages and disadvantages (Srivastava et al., 2015), these have to be considered before selecting the best method to be used. At present, the internet has proved to be one of the major sources of health information and means of providing eHealth services (Connolly and Crosby, 2014).

BENEFITS OF eHealth

The use of eHealth in the delivery of healthcare has a wide range of benefits for the service users (clients and patients) and service providers (health professionals). A major benefit that has been identified is the empowerment of patients (Kontos et al., 2014; Kreps and Neuhauser, 2010). Through the use of the various means of providing eHealth services, healthcare providers can communicate with patients easily and more frequently, and can address their health concerns. eHealth has promoted public health considerably in the past decade, as public health concerns can be easily addressed (Kuijpers et al., 2013; Lindsay et al., 2009; Smith et al., 2009; Steele et al., 2009; Vuong et al., 2012). Cobb et al. (2011) also stated that support groups are formed to give necessary support to eHealth users. Through the use of eHealth, health information can be provided to service users, individuals can book or alter their hospital appointments, get their prescriptions and sufficiently interact with other service users and health care providers (Sudbury-Riley, 2018).

Furthermore, eHealth has been proven to be beneficial in improving the efficiency of healthcare practitioners (Car and Sheikh, 2004; Katz et al., 2003). It reduces waiting time in clinics and time of burdensome consultations (Jennett et al., 2003). Literature also suggests that it helps to avoid unnecessary referrals, hospital visits and hospitalizations. It is opined that this is because patients can be adequately monitored, patients' information can be easily accessed and decisions can be made earlier (Martinez et al., 2006; Pare et al., 2007; Seto, 2008; Wade et al., 2010). Ammenwerth and Shaw (2005) also stated that eHealth is expected to reduce the rate of medical errors

and violations that cause harm to patients. It aims to improve the record-keeping, retrieval and sharing of patients' information (Pagliari et al., 2007). Proper implementation of eHealth has also shown to increase co-operation among service providers and partnering between several healthcare organizations (Miyazaki et al., 2012).

Various barriers to healthcare delivery are set to be broken by the optimal utilization of eHealth. Studies have shown that eHealth is effective in reducing the time to diagnosis, ensuring access of individuals in remote areas to healthcare and improving quality of life and patients' satisfaction (McLean et al., 2013). Literature suggests that eHealth may deliver healthcare services at more effective costs, and may ensure that health care is delivered to relatively remote areas (Bashshur et al., 2013; De la Torre-Diez et al., 2015; Elbert et al., 2014; Eysenbach, 2001; Meier et al., 2013; Ross et al., 2015; Smith et al., 2015). More effective and efficient healthcare services would be delivered to several citizens, providing easy access to information and self-care (Scholz, 2015). eHealth may help to improve access to healthcare globally, if its potentials are properly harnessed.

RISKS AND CHALLENGES OF eHealth

In spite of all these benefits, eHealth is not without its potential risks. Some health care professionals have concerns about the use of eHealth services. One of these concerns is the safety of eHealth. A dysfunctional eHealth system may issue erroneous patients' information, advice and even support (Fernando et al., 2004). How secure are information stored via eHealth? How private are patients' data kept? These are questions that are yet to be answered. The system had been identified as not sufficiently secure (Car et al., 2007). Data stored may be manipulated, and this may cause erroneous judgements to be made (Miyazaki et al., 2012).

Asides the risks that have been attributed to the adoption of eHealth for healthcare delivery, there have also been challenges that have been identified. Sustainability of the eHealth system, education and training of all service users and providers, availability and acceptance of necessary technology have been suggested as possible bottle necks that need to be resolved before eHealth can be fully implemented globally (Miyazaki et al., 2012).

More noteworthy, is the fact that in spite of the wide coverage of eHealth, there is still a considerable disparity in equity of access (Viswanath and Kreuter, 2007). This is attributed to poor technological advancements in middle- and low-income countries. In addition, a lot of individuals in this country have been reported to be less likely to seek health information from online sources (Gibbons et al., 2011; Viswanath, 2006; Zach et al., 2012). This may be due to poverty or low levels of education.

CONCLUSION

The eHealth system holds a lot of benefits in the world of healthcare delivery. These benefits can be harnessed properly to improve healthcare delivery in most parts of the world, especially in developing nations. However, the system has to be evaluated to minimize its risks. Minimization of potential risks will improve its viability in the market and increase its use globally.

REFERENCES

Akter, S., D'Ambra, J. and Ray, P. (2013). Development and validation of an instrument to measure user perceived service quality of mHealth. *Info Manage, 50*(4), 181-195. https://doi.org/10.1016/j.im.2013.03.001

Amble, R., Comparini, A., Kumar, K. R., Dahlgren, R. and Lurie Y. M. (2004). Delivering low-bandwidth telemedicine services over hybrid networks in developing countries. *Proceedings of the 26th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (IEMBS '04)* vol 2, San Francisco, Calif, USA, September, 2004. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1404500&isnumber=30463

American Hospital Association (July, 2002). *Health Leaders Fact file: Rising Cost Comes as No Surprise.*

Ammenwerth, E. and Shaw, N. T. (2005). Bad health informatics can kill-is evaluation the answer? Editorial. *Methods Inf Med*, 1-3. Available at: http://iig.umit.at/dokumente/z29.pdf

Bashshur, R. L., Shannon, G., Krupinski, E. A. and Grigsby, J. (2013). Sustaining and realizing the promise of telemedicine. *Telemed J E Health, 19*(5), 339-345. https://doi.org/10.1089/tmj.2012.0282

Car, J. and Sheikh, A. (2004). Email consultations in health care: 2-Acceptability and safe application. *BMJ, 329*(7463), 439-442. https://doi.org/10.1136/bmj.329.7463.439

Car, J., Koshy, E., Bell, D. and Sheikh, A. (2007). Telephone triage in out of hours call centres. *BMJ, 337*, e1167. https://doi.org/10.1136/bmj.a1167

Chronaki, C. E., Kontoyiannis, V., Mytaras, et al. (2007). Evaluation of shared HER services in primary healthcare centres and their rural community offices: The twister story. *Proceedings of the 29th Annual International Conference*

of IEEE Engineering in Medicine and Biology Society (EMBC '07), 6421-6424, IEEE, Lyon, France, August 2007. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4353826&isnumber=4352185

Cobb, N. K., Graham, A. L., Byron, M. J., Niaura, R. S. and Abrams, D. B. (2011). Workshop participants online social networks and smoking cessation: A scientific research agenda. *J Med Internet Res, 13*(4), e119. https://doi.org/10.2196/jmir.1911

Connolly, K. K. and Crosby, M. E. (2014). Examining eHealth literacy and the digital divide in an underserved population in Hawaii. *Hawaii J Med Public Health, 73*(2), 44-8.

De la Torre-Diez, I., Lopez-Coronado, M., Vaca, C., et al. (2015). Cost-utility and cost-effectiveness studies of telemedicine, electronic, and mobile health systems in the literature: a systematic review. *Telemed J E Health, 21*, 81-5. https://doi.org/10.1089/tmj.2014.0053

Elbert, N. J., van Os-Medendorp, H., van Renselaar, W., et al. (2014). Effectiveness and cost-effectiveness of ehealth interventions in somatic diseases: a systemic review of systematic reviews and meta-analyses. *J Med Internet Res, 16*, e110. https://doi.org/10.2196/jmir.2790

Eysenbach, G. (2001). What is e-health? *J. Med. Internet Res, 3*(2), e20. https://doi.org/10.2196/jmir.3.2.e20

Fernando, B., Boki, S. P., Savelyich, A., Avery, J., Sheikh, A., et al. (2004). Prescribing safety features of general practice computer systems: Evaluation using simulated test cases. *BMJ, 328*, 1171-1172. https://doi.org/10.1136/bmj.328.7449.1171

Gibbons, M. C., Fleisher, L., Slamon, R. E., Bass, S., Kandadai, V. and Beck, J. R. (2011). Exploring the potential of Web 2.0 to address health disparities. *J Health Commun, 16*(Suppl), 177-89. https://doi.org/10.1080/10810730.2011.596916

Gustafson, D. H. and Wyatt, J. C. (2001). Evaluation of ehealth systems and services. *BMJ, 328*(7449), 1150. https://doi.org/10.1136/bmj.328.7449.1150

Huang, L., Xu, Y., Chen, X., Li, H. and Wu, Y. (2012). Design and implementation of location based mobile health system. *Proceedings of the 4th International Conference on Computational and Information Sciences (ICCIS'12)*, 919-922, Chongqing, China. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6300545&isnumber=6299898

Institute of Medicine (US) Committee on quality of health care in America. (2001). Crossing the quality chasm: A new health system for the 21st century. Washington: National Academies Press.

Jai Ganesh, A. U. (2004). E-health- drivers, applications, challenges ahead and strategies: a conceptual framework. *Ind J Med Inform, 1*(1), 39-47.

Jennett, P. A., Affleck, H. L., Hailey, D., Ohinmaa, A., Anderson, C., Thomas, R., Young, B., Loenzetti, D. and Scott, R. E. (2003). The socio-economic impact of telehealth: A systematic review. *J Telemed Telecare, 9*(6), 311-320. https://doi.org/10.1258/135763303771005207

Katz, S. J., Moyer, C. A., Cox, D. T. and Stern, D. T. (2003). Effect of a triage-based E-mail system on clinic resource use and patient and physician satisfaction in primary care: A randomized controlled trial. *J Gen Intern Med, 18*(9), 736-744. https://doi.org/10.1046/j.1525-1497.2003.20756.x

Kielland Aanesen, H. A. and Borras, J. (2013). E-Health: The future service model for home and community health care. 2013 7th IEEE International Conference on Digital Ecosystems and Technologies (DEST). Menlo Park, CA, 172-177. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6611349&isnumber=6611297

Klasnja, P. and Pratt, W. (2012). Healthcare in the pocket: mapping the space of mobile-phone health interventions. *J Biomed Inform, 45*(1), 184-198. https://doi.org/10.1016/j.jbi.2011.08.017

Kontos, E., Blake, K. D., Chou, W. S. and Prestin, A. (2014). Predictors of eHealth usage: Insights on the digital divide from the health information National trends survey 2012. *J Med Internet Res, 16*(7), e172. https://doi.org/10.2196/jmir.3117

Kreps, G. L. and Neuhauser, L. (2010). New directions in eHealth communication: Opportunities and challenges. *Patient Educ Couns, 78*(3), 329-336. https://doi.org/10.1016/j.pec.2010.01.013

Kuijpers, W., Groen, W. G., Aaronsen, N. K. and van Harten W. H. (2013). A systematic review of web-based interventions for patient empowerment and physical activity in chronic diseases: Relevance for cancer survivors. *J Med Internet Res, 15*(2), e37. https://doi.org/10.2196/jmir.2281

Lach, J. M. and Vazquez, R. M. (2017). Simulation model of the telemedicine program. *Proceedings of the Winter Simulation Conference (WSC '04)*, 2, 2012-2017, IEEE, Washington, DC, USA, December, 2004. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1371563&isnumber=29990

Lindsay, S., Smith, S., Bellaby, P. and Baker, R. (2009). The health impact of an online heart disease support group: A comparison of moderated versus unmoderated support. *Health Educ Res, 24*(4), 646-654. https://doi.org/10.1093/her/cyp001

Malik, A. Z. (2007). Telemedicine country report- Pakistan. *Proceedings of the 9th International Conference on e-Health Networking, Application and Services (HEALTHCOM '07)*, 90-94, Taipei, Taiwan, June 2007. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4265805&isnumber=4265779

Marcus, E. and Fabius, R. (2005). Primer for American College of Physicain Executives. Tampa, FI, USA. Available at: http://www.acpenet.org/Forums/Topical/Ehealth/Primer.htm

Martinez, A., Everss, E., Rojo-Alvarez, J., Figal, D. and Garcia-Alberola, A. (2006). A systematic review of the literature on home monitoring for patients with heart failure. *J Telemed Telecare, 12*(5), 234-241. https://doi.org/10.1258/135763306777889109

McLean, S., Sheikh, A., Cresswell, K., Nurmatov, U., Mukherjee, M., Hemmi, A. and Pagliari, C. (2013). The impact of telehealthcare on the quality and safety of care: A systematic overview. *PLoS One, 8*(8), e71238. https://doi.org/10.1371/journal.pone.0071238

Mea, V. (2001). What is e-health (2): The death of telemedicine. *J Med Internet Res, 3*(2), e22. https://doi.org/10.2196/jmir.3.2.e22

Meier, C. A., Fitzgerald, M. C. and Smith, J. M. (2013). eHealth: extending, enhancing and evolving health care. *Annu Rev Biomed Eng, 15*, 359-82. https://doi.org/10.1146/annurev-bioeng-071812-152350

Miyazaki, M., Igras, E., Liu, L. and Ohyanagi, T. (2012). Global Health through EHealth/Telehealth, eHealth and Remote Monitoring, El Hassani A.H., InTechOpen. Available at: https://www.intechopen.com/books/ehealth-and-remote-monitoring/global-health-through-ehealth-telehealth

O'Reilly, G. A. and Spruijt-Metz, D. (2013). Current mHealth technologies for physical activity assessment and promotion. *Am. J. Prev. Med, 45*(4), 501-507. https://doi.org/10.1016/j.amepre.2013.05.012

Ossenbaard, H. C. and Van Gemert-Pijnen, L. (2016). *Int J Qual Health Care, 28*(3), 415-419. https://doi.org/10.1093/intqhc/mzw032

Pagliari, C., Detmet, D. and Singleton, P. (2007). Electronic personal health records emergence and implications for the UK: A report to the Nuffield Trust. London. Available at: http://nuffieldtrust.org.uk/ecomm/files/Elec%20Personal%20Records%20II.pdf

Pagliari, C., Sloan, D., Gregor, P., Sullivan F., Detmer, D., Kahan, J. P., Oortwijn, W. and MacGillivray, S. (2005). What is eHealth (4): A scoping exercise to map the field. *J Med Int Res, 7*(1), e9. https://doi.org/10.2196/jmir.7.1.e9

Pare, G., Jaana, M. and Sicotte, C. (2007). Systematic review of home telemonitoring for chronic diseases: The evidence base. *J. Am Med Inform Assoc, 14*(3), 269-277. https://doi.org/10.1197/jamia.M2270

Patrick, K., Griswold, W. G., Raab, F. and Intille, S. S. (2008). Health and the mobile phone. *Am J Prev Med., 35*(2), 177-181. https://doi.org/10.1016/j.amepre.2008.05.001

Rajashekhar, S. L. and Ayyangar, G. (2012). Satellite technology to reach the unreached (India-a case study). *Proceedings of the IEEE Global Humanitarian Technology Conference (GHTC '12)*, 186-191, Seattle, Was, USA, October 2012. https://doi.org/10.1109/GHTC.2012.68

Rao, G. N. (2002). How can we improve patient care? *Community Eye Health, 15*(41), 1-3.

Ross, J., Stevenson, F., Lau, R., et al. (2015). Exploring the challenges of implementing e-health: a protocol for an update of a systematic review of reviews. *BMJ Open*, 5e006773. https://doi.org/10.1136/bmjopen-2014-006773

Rubrichi, S., Battistotti, A. and Quaglini, S. (2014). Patients' involvement in e-health services quality assessment: A system for the automatic interpretation of SMS-based patients' feedback. *J Biomed Inform, 51*, 41-48. https://doi.org/10.1016/j.jbi.2014.03.003

Sachpazidis, I., Rizou, D. and Menary, W. (2008). Satellite based health network in Peru and Brazil. *Proceedings of the 5th International Conference on Information Technology and Applications in Biomedicine (ITAB '08)*, 309-314, Shenzhen, China, May 2008. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4570664&isnumber=4570483

Sangal, A. K., Satyamurthy, L. S., Bhatia, B. S. and Bhaskarnarayana, A. (2004, June). Communication satellite-based network for telemedicine in India. *Proceedings of the 6th International Workshop on Enterprise Networking and Computing in Healthcare Industry (Healthcom '04)*, 149-151.

Scholz, N. (2015). eHealth-Technology for Health 2015. European Parliamentary Research Service, EPRS. Briefing 1-8. Available at: www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_BRI(2015)551324

Seto, E. (2008). Cost comparison between telemonitoring and usual care of heart failure: A systematic review. *Telemed J E Health, 14*(7), 679-686. https://doi.org/10.1089/tmj.2007.0114

Smith, D. T., Carr, L. J., Dorozynski, C. and Gomashe, C. (2009). Internet-delivered lifestyle physical activity intervention: Limited inflammation and antioxidant capacity efficacy in overweight adults. *J Appl Physiol, 106*(1), 49-56. https://doi.org/10.1152/japplphysiol.90557.2008

Smith, R., Menon, J., Rajeev, J. G., et al. (2015). Potential for the use of mHealth in the management of cardiovascular disease in Kerala: a qualitative study. *BMJ Open*, 5e009367. https://doi.org/10.1136/bmjopen-2015-009367

Sneha, S. and Straub, D. (2017). E-Health: Value Proposition and Technologies Enabling Collaborative Healthcare. *Proceedings of the 50th Hawai International Conference on System Sciences*. pp. 920-929. Available at: http://hdl.handle.net/10125/41260

Sneha, S. and Varshney, U. (2006). Ubiquitous Healthcare: A New Frontier in E-Health. In *Proceedings of the twelfth Americas Conference on Information Systems*, Acapulco, Mexico AMICS. Available at: http://aisel.aisnet.org/amcis2006/319

Srivastava, S., Pant, M., Abraham, A. and Agrawal, N. (2015). The Technological Growth in eHealth Services. *Comput Math Method M.* (894171), 18pages. https://doi.org/10.1155/2015/894171

Steele, R. M., Mummery, W. K. and Dwyer, T. (2009). A comparison of face-to-face or internet-delivered physical activity intervention on targeted determinants. *Health Educ Behav, 36*(6), 1051-64. https://doi.org/10.1177/1090198109335802

Storetmann, K. A. (2014). Scoping global good ehealth platforms: implications for sub-Saharan Africa. *Proceedings of the IST-Africa Conference*, 1-10, May 2014. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6880601&isnumber=6880588

Sudbury-Riley, L. (2018). eHealth technologies: The faster we go, the more we leave behind? *Eur Med J, 2*(1), 56-63.

Tyrer, H. W. (2009). Satellite wide area network for telemedicine. *IEEE-AESM, 24*(2), 20-26. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4798988&isnumber=4798979

Viswanath, K. (2006). Public communications and its role in reducing and eliminating health disparities. In: Thomson G. E., Mitchell F., Williams M. B., eds. Examining the health disparities research plan of the National Institutes of Health: unfinished business. Institute of Medicine; Washington DC, 251-253.

Viswanath, K. and Kreuter, M. W. (2007). Health disparities, communication inequalities, and eHealth. *Am J Prev Med, 32*(5 Suppl), S131-3. https://doi.org/10.1016/j.amepre.2007.02.012

Vuong, A. M., Huber, J. C., Bolin, J. N., Ory, M. G., Moudouni, D. M., Helduser, J., Begaye, D., Bonner, T. J. and Forjuoh, S. N. (2012). Factors affecting acceptability and usability of technological approaches to diabetes self-management: A case study. *Diabetes Technol Ther, 14*(12), 1178-1182. https://doi.org/10.1089/dia.2012.0139

Wade, V., Karnon, J., Elshaug, A. and Hiller, J. E. (2010). A systematic review of economic analyses of telehealth services using real time video communication. *BMC Health Serv Res, 10*, 233. https://doi.org/10.1186/1472-6963-10-233

Yamauchi, K., Chen, W. and Wei, D. (2005). 3G mobile phone applications in telemedicine- a survey. *Proceedings of the 5th International Conference on Computer and Information Technology (CIT)*, 956-960. September, 2005. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1562781&isnumber=33169

Zach, L., Dalrymple, P. W., Rogers, M. L. and Williver-Farr, H. (2012). Assessing internet access and use in a medically underserved population: Implications for providing enhanced health information services. *Health Info Libr J, 29*, 61-71. https://doi.org/10.1111/j.1471-1842.2011.00971.x