Impact of eHealth on Medication Adherence: A Review

Noor Cahaya[1*], Oskar Skarayadi[2]

[1]Department of Pharmacy, Faculty of Mathematics and Science, Universitas Lambung Mangkurat, Indonesia
[2]Department of Pharmacy, Faculty of Pharmacy, Universitas Jenderal Achmad Yani
*Coresponding author: noorcahaya@ulm.ac.id
Phone: 085348026041

Abstract: Non-adherence is one of the focus areas that has been developed using eHealth. Numerous eHealth interventions were developed with the aim of improving medication adherence. The aim of this research was to describes eHealth interventions impacts on medication adherence. This study was conducted in a review. Data was obtained from Pubmed and Google Scholar. Nine articles were included in this review article. Four of the nine articles obtained showed that the eHealth intervention did not improve medication adherence, while the rest showed a positive effect on increasing medication adherence. It can be concluded that eHealth showed positive impact on medication adherence, but there are still many challenges in the implementation of eHealth. More efforts are needed to increase the effectiveness of eHealth interventions in improving medication adherence.

Keywords: non-adherence, adherence, eHealth, Review

1. Introduction

Adherence is defined as how extensively a person's behaviors follow the accepted advice from their healthcare professional (WHO, 2003). Patients who refuse their medications will not experience any benefits. This accurate remark emphasizes the significance of drug adherence. The effectiveness of therapy is dependent upon the efficacy of medication and adherence with medication. Non-adherence is a severe issue that has an impact on both the patient and the healthcare system. Patients who don't take their medications as prescribed experience significant illness progression, mortality, and increased health care costs (Jimmy & Jose, 2011).

Numerous interventions have been developed to improve medication adherence. The most promising intervention techniques are those that increase patients' treatment engagement and their capacity for drug control. The use of Internet-based interventions to enhance medication adherence has grown significantly during the past ten years (Car et al., 2017). Because they are influenced by multiple factors, these interventions have not all shown success in improving medication adherence (Jeminiwa et al., 2019). As a result, it is required to conduct a study to determine which interventions have a positive impact on improving adherence so that health professionals and healthcare facilities can develop interventions that will be implemented to improve better medication adherence.

The World Health Organization (WHO) broadly defines eHealth as the use of information and communication technologies (ICT) for health, including patient treatment, research, education of healthcare professionals, and public health monitoring (Toney et al., 2015). This "eHealth" category encompasses a number of technological areas, including: 1) mHealth, which

is exemplified by clinical interventions supported by mobile devices; 2) telehealth, which frequently calls for the use of telephone or electronic technology to facilitate health care or distance education; 3) social media, which frequently incorporates interactive web-based platforms; and 4) the use of electronic health records (EHRs) to guide patient care (Jeminiwa et al., 2019). Studies have revealed that eHealth interventions improve patient outcomes, drug use, care accessibility and quality of life while being cost-effective for both patients and providers (Jeminiwa et al., 2019; Miller et al., 2017).

In this review, we will review the types of eHealth interventions that have been developed and their impact on medication adherence.

2. Materials and Methods

A narrative literature review was conducted to evaluate the impact of eHealth on medication adherence. Articles that were relevant to the topic were searched. The literature searches were conducted in two databases, PubMed and Google Scholar. The considered inclusion criteria for studies included in this review are as follows (i) articles published in English from 2010 to the present; (ii) full text articles; (iii) study involved comparison groups: control group or pre-intervention and intervention group or post-intervention; and (iv) studies reported the measured outcomes. All the potential citations were reviewed by title and abstract and only relevant citations were retrieved. From 484 records, 9 articles met the selection criteria and related to the relevant topics of eHealth and medication adherence.

3. Results and Discussion

Based on the results of a literature search using the PubMed and Google Scholar databases, nine articles related to the themes discussed were obtained. The following are studies that discuss the relationship between eHealth and medication adherence:

Table 1. The effect of eHealth on medication adherence

Author (Year)	Title	Country	Intervention duration	Adherence assessment method	Intervention description	Results
Young et al (2012)	Patient and phaRmacist telephonic encounters (PARTE) in an underserved rural patient population with asthma: results of a pilot study	United States	3 months	Morisky Medication Adherence Scale	Telephone consultations from pharmacists regarding asthma self-management (telepharmacy)	intervention group showed an improvement than control group in asthma control ($p < 0.01$) and medication adherence ($p < 0.01$)
Yap, et al (2013)	Feasibility and acceptance of a pharmacist-run	Singapore	5 days	Respons to Short Message	Pharmacist providing management	During 5 days of surveillance,

172

	tele-oncology service for chemotherapy-induced nausea and vomiting in ambulatory cancer patients			Service (SMS) system by patients or caregiver	counseling for chemotherapy-induced nausea and vomiting (CINV) via SMS method	44 patients (73.3%) experienced an increase in adherence to technology services.
Bender et al., (2015)	Pragmatic trial of health care technologies to improve adherence to pediatric asthma treatment: a randomized clinical trial	United States	24 months	Pharmacy refill	Speech recognition (SR)-based telephone calls for education and reminders of drug refill schedules	the results showed higher adherence in the intervention group (44.5%) compared to the usual care group (35.5%) with p value < 0.001
Eldeib et al., (2019)	The Effect of Telephone-Based Follow-Up on Adherence, Efficacy, and Toxicity of Oral Capecitabine-Based Chemotherapy	Egypt	during the patients' treatment period	pill-count	telephone-based follow-up in Egyptian patients with metastatic colorectal or gastric cancer treated with capecitabine-based chemotherapy regimens	there was no significant difference in overall patients' adherence (98.99% in the intervention group versus 96.83% in the control group)
Mcfarland et al., (2012)	Use of home telehealth monitoring with active medication therapy management by clinical pharmacists in veterans with poorly	United States	6 months	Number of antidiabetic drug change	Care Coordination Home Telehealth (CCHT) program	The results showed that there was a significant difference in the amount of antidiabetic drugs in the intervention group and the control group,

	controlled type 2 diabetes mellitus					so the data also showed that there was a significant decrease in HbA1C in the intervention group and the control group
Chan et al., (2015)	The effect of an electronic monitoring device with audiovisual reminder function on adherence to inhaled corticosteroids and school attendance in children with asthma: a randomised controlled trial	New Zealand	6 months	Electronic monitoring	Audiovisual reminders (AVR)	the results showed that in the AVR intervention group there was a higher increase in adherence (88%) than the usual care group (30%)
Gustafson et al., (2012)	The Effects of Combining Web-Based eHealth With Telephone Nurse Case Management for Pediatric Asthma Control: A Randomized Controlled Trial	United States	12 months	Pharmacy refill and self-report	Phone-based plus web-based health education (eHealth)	There was no significant difference between intervention and control groups.
Johnson et al., (2015)	The feasibility of text reminders to	United States	3 weeks	Self-report	Personal health application	There was an improvement in adherence

						between the treatment and control groups (p = 0.016)
	improve medication adherence in adolescents with asthma					
Macdonell et al., (2016)	The Detroit Young Adult Asthma Project: Pilot of a Technology-Based Medication Adherence Intervention for African-American Emerging Adults	United States	3 months	Self-report	A computerized intervention authoring software (CIAS) with motivational interviewing	There was no significant improvement in adherence between the treatment and control groups (p = 0.9)

Along with the development of digital technology, eHealth has become an important choice in health services. "eHealth" is a form of application of information and communication technology in the field of health services, which can be integrated into the treatment process, including prescribing, dispensing, and administration (Marcelo et al., 2022). Several studies have shown that implementing eHealth into healthcare is a promising step to support treatment safety and better health outcomes (Renzi et al., 2022; Xu BS et al., 2019). Patient non-adherence in treatment becomes an important issue, and in the end, various methods are developed based on eHealth in order to improve adherence. However, the question is whether all the methods developed are able to have a positive impact on medication adherence.

Medication adherence can be improved through the use of eHealth interventions. The most promising intervention strategies are those that increase patient medication participation and medication management skills, and their application in clinical practice (Pouls et al., 2021). As for example in the study of Young et al., (2012), interventions can promote improved asthma self-management by increasing patient engagement in medication management. As another example, patients and health care professionals, such as doctors, pharmacists, and nurses, were actively involved in the telepharmacy intervention process in many studies that resulted in a positive increase in medication adherence, thus demonstrating the importance of patient health care professional interactions on the success of eHealth interventions in form of telepharmacy (Emadi et al., 2022).

The results showed that some eHealth interventions were implemented for various patients, such as those with asthma, diabetes, and cancer. These data indicate that eHealth can be used as a method to increase patient compliance, especially for patients with chronic diseases. Internet-

based interventions specifically designed to improve medication adherence among chronically ill patients (Linn et al., 2011). eHealth includes SMS or audiovisual reminders (Chan et al., 2015; Johnson et al., 2015; Yap et al., 2013), phone-based and web-based health education (Gustafson, Wise, Bhattacharya, & Pulvermacher, 2012), computerized intervention authoring software (Macdonell et al., 2016), telehealth (Mcfarland et al., 2012), telephone-based (Bender et al., 2015; Eldeib et al., 2019), and telepharmacy (Young et al., 2012). The use of telehealth monitoring can enable accurate data transmission to providers, timely feedback to patients from care coordinators, and automated disease status education carried out by telehealth devices, all with a focus on improving diabetes control (Mcfarland et al., 2012). The use of electronic monitoring devices with audiovisual reminders led to a significant increase in adherence to inhaled corticosteroids in school-age children with asthma. This intervention could be useful for improving asthma control in patients whose poor asthma control is associated with poor adherence (Chan et al., 2015).

Based on a review of nine articles obtained, there are four articles that show results that the eHealth intervention did not increase medication adherence, so these results indicate that the eHealth given as an intervention to improve adherence did not always show positive results towards increasing adherence. However, even though it did not have an overall impact on increasing adherence, eHealth had another positive impact. Technology can facilitate customized and interactive solutions, such as special education, consistent support, and skill acquisition (Pouls et al., 2021). Interventions in eHealth have the potential to reduce healthcare costs while improving quality.

However, there are some limitations in the implementation of eHealth, so resources are needed for the successful implementation of eHealth (Cremers et al., 2021). One study in the form of an integrative review found that there are several factors that influence the success of eHealth implementation. These factors include low technological literacy of users or patients, lack of adaptation of strategies or methods developed to meet user demands, depersonalization of care, lack of privacy, and connectivity problems during use, which are the main obstacles to implementing eHealth. In addition, the absence of tangible benefits felt by patients and difficult access to the eHealth platform are also two additional barriers that are often experienced. Another obstacle in terms of health care facilities is the lack of funds to implement this health policy (Herrera et al., 2022).

The various results obtained related to increasing medication adherence are also suspected to be from the method of measuring adherence itself. Each method for assessing adherence has its own advantages and disadvantages, and there is no gold standard that can be used to assess medication adherence. Therefore, it is not only the problem of obstacles in the implementation of eHealth but will also be influenced by the measuring tools used in assessing patient compliance, so that the results obtained are also varied, some showing improved results and some not having an effect on treatment adherence (Jimmy & Jose, 2011). The use of e-health in the long term should be a concern because the prolonged monitoring may result in increased patient fatigue

and lowered compliance. In the long-term evaluation of telemedicine services, a suitable period of monitoring must be considered (Yap et al., 2013).

4. Conclusion

Based on the results of a review of nine articles, it was concluded that the various implementations of eHealth showed positive impact on medication adherence, but there are still many challenges in the implementation of eHealth, which are factors that will affect the results obtained. More efforts are needed to increase the effectiveness of eHealth interventions in improving medication adherence.

Conflict of Interest

The All authors report stated that they have no conflicts of interest in this work.

References

Bender, B. G., Cvietusa, P. J., Goodrich, G. K., Lowe, R., Nuanes, H. A., Rand, C., Shetterly, S., Tacinas, C., Vollmer, W. M., Wagner, N., Wamboldt, F. S., Xu, S., & Magid, D. J. (2015). Pragmatic Trial of Health Care Technologies to Improve Adherence to Pediatric Asthma Treatment A Randomized Clinical Trial. *JAMA Pediatrics*, *169*(4), 317–323. https://doi.org/10.1001/jamapediatrics.2014.3280

Car, J., Tan, W. S., Huang, Z., Sloot, P., & Franklin, B. D. (2017). eHealth in the future of medications management : personalisation, monitoring and adherence. *Medicine and the Future of Health*, *15*(73), 1–9. https://doi.org/10.1186/s12916-017-0838-0

Chan, A. H. Y., Stewart, A. W., Harrison, J., Jr, C. A. C., Black, P. N., & Mitchell, E. A. (2015). The effect of an electronic monitoring device with audiovisual reminder function on adherence to inhaled corticosteroids and school attendance in children with asthma : a randomised controlled trial. *The Lancet Respiratory Medicine*, *2600*(15), 00008–00009. https://doi.org/10.1016/S2213-2600(15)00008-9

Eldeib, H. K., Abbassi, M. M., Hussein, M. M., Salem, S. E., & Sabry, N. A. (2019). The Effect of Telephone-Based Follow-Up on Adherence, Efficacy, and Toxicity of Oral Capecitabine-Based Chemotherapy. *Telemedicine and E-Health*, *25*(6), 462–470. https://doi.org/10.1089/tmj.2018.0077

Gustafson, D., Wise, M., Bhattacharya, A., & Pulvermacher, A. (2012). The Effects of Combining Web-Based eHealth With Telephone Nurse Case Management for Pediatric Asthma Control : A Randomized Controlled Trial. *Journal of Medical Internet Research*, *14*(4), 1–19. https://doi.org/10.2196/jmir.1964

Gustafson, D., Wise, M., Bhattacharya, A., Pulvermacher, A., Shanovich, K., Phillips, B., Lehman, E., Chinchilli, V., Hawkins, R., & Kim, J.-S. (2012). The effects of combining Web-based eHealth with telephone nurse case management for pediatric asthma control: a randomized controlled trial. *Journal of Medical Internet Research*, *14*(4), e101. https://doi.org/10.2196/jmir.1964

Herrera, S., Salazar, A., & Nazar, gabriela. (2022). Barriers and Supports in eHealth Implementation among People with Chronic Cardiovascular Ailments : Integrative Review. *International Journal of Environmental Research and Public Health*, *19*, 1–13.

Jeminiwa, R., Hohmann, L., Qian, J., Garza, K., Hansen, R., & Fox, B. I. (2019). Impact of eHealth on medication adherence among patients with asthma : A systematic review and

meta-analysis. *Respiratory Medicine*, *149*, 59–68. https://doi.org/10.1016/j.rmed.2019.02.011

Jimmy, B., & Jose, J. (2011). Patient medication adherence: Measures in daily practice. *Oman Medical Journal*, *26*(3), 155–159. https://doi.org/10.5001/omj.2011.38

Johnson, K. B., Patterson, B. L., Ho, Y., Chen, Q., Nian, H., Davison, C. L., Slagle, J., & Mulvaney, S. A. (2015). The feasibility of text reminders to improve medication adherence in adolescents with asthma. *Journal of the American Medical Informatics*, *0*, 1–8. https://doi.org/10.1093/jamia/ocv158

Macdonell, K. K., Naar, S., Gibson-scipio, W., Lam, P., & Secord, E. (2016). The Detroit Young Adult Asthma Project : Pilot of a Technology-Based Medication Adherence Intervention for African-American Emerging Adults. *Journal of Adolescent Health*, 1–7. https://doi.org/10.1016/j.jadohealth.2016.05.016

Marcelo, A. B., Pascual, K. C., Udayasankaran, J. G., Allaudin, F. S., & Kijsanayotin, B. (2022). A framework for regional health information systems interoperability: The Asia eHealth Information Network (AeHIN) experience. *Roadmap to Successful Digital Health Ecosystems: A Global Perspective*, 399–414. https://doi.org/10.1016/B978-0-12-823413-6.00005-7

Mcfarland, M., Davis, K., Wallace, J., Wan, J., Cassidy, R., Morgan, T., & Venugopal, D. (2012). Use of home telehealth monitoring with active medication therapy management by clinical pharmacists in veterans with poorly controlled type 2 diabetes mellitus. *Pharmacotherapy*, *32*(5), 420–426. https://doi.org/10.1002/j.1875-9114.2011.01038.x

Miller, L., Psych, M., Schuz, B., Walters, J., & Walters, E. H. (2017). Mobile Technology Interventions for Asthma Self-Management : Systematic Review and Meta-Analysis. *JMIR MHealth Anf UHealth*, *5*(5), 1–22. https://doi.org/10.2196/mhealth.7168

Renzi, E., Baccolini, V., Migliara, G., & De Vito, C. (2022). The Impact of eHealth Interventions on the Improvementof Self-Care in Chronic Patients: An Overview ofSystematic Reviews. *Life*, *12*(1253), 1–16. https://doi.org/10.21037/mhealth.2017.07.03

Toney, B., Goff, D. A., & Weber, R. J. (2015). Social Media as a Leadership Tool for Pharmacists. *Hospital Pharmacy*, *50*(7), 644–648. https://doi.org/10.1016/j.rmed.2019.02.011

WHO. (2003). Adherence to Long -Term Therapies Evidence for action. In *Applied Mechanics and Materials*. https://doi.org/10.4028/www.scientific.net/AMM.321-324.1779

Xu BS, A., Wang BS, Y., & Wu, X. (2019). Effectiveness of e - health based self - management to improve cancer - related fatigue , self - efficacy and quality of life in cancer patients : Systematic review and meta - analysis. *J Adv Nurs*, *00*, 1–14. https://doi.org/10.1111/jan.14197

Yap, K. Y. L., Low, H. X., Koh, K. S., Un, M., Shih, V., & Chan, A. (2013). Feasibility and acceptance of a pharmacist-run Tele-oncology service for chemotherapy-induced nausea and vomiting in ambulatory cancer patients. *Telemedicine and E-Health*, *19*(5), 387–395. https://doi.org/10.1089/tmj.2012.0136

Young, H. N., Havican, S. N., Griesbach, S., Thorpe, J. M., Chewning, B. A., & Sorkness, C. A. (2012). Patient And phaRmacist Telephonic Encounters (PARTE) in an Underserved Rural Patient Population with Asthma: Results of a Pilot Study. *Telemedicine and E-Health*, *18*(6), 427–433. https://doi.org/10.1089/tmj.2011.0194