Special Contribution

AGMR
Annals of Geriatric Medicine and Research
2018;22(3):117-120

https://doi.org/10.4235/agmr.2018.22.3.117
Print ISSN 2508-4798 On-line ISSN 2508-4909
www.e-agmr.org

Optimal Management of Chronic Medical Conditions Through Digital Medicine

Kwang-Il Kim

Department of Internal Medicine, Seoul National University Bundang Hospital, Seoul National University College of Medicine, Seongnam, Korea

Corresponding Author:
Kwang-il Kim, MD, PhD
https://orcid.org/0000-0002-6658-047X
Department of Internal Medicine, Seoul National University Bundang Hospital, Seoul National University College of Medicine, 82 Gumi-ro 173beon-gil, Bundang-gu, Seongnam 13620, Korea
Tel: +82-31-787-7032
Fax: +82-31-787-4052
E-mail: kikim907@snu.ac.kr

Received: September 6, 2018
Accepted: September 14, 2018

With the population aging in Korea, an optimal healthcare model for older adults should be developed. Older adults often have multiple chronic medical conditions, which need continuous monitoring for the best care and early detection of acute deterioration. Digital technology can be a solution to the unmet need of management of common chronic medical conditions such as hypertension, diabetes, and heart failure in older adults. Through this strategy, ideal care can be delivered without increased healthcare costs. This review describes the current status of common chronic medical conditions in Korean older adults and discusses the opportunities and challenges associated with digital technology-based chronic disease management. **(Ann Geriatr Med Res 2018;22:117-120)**

Key Words: Digital medicine, Elderly, Hypertension, Diabetes mellitus, Heart failure

BACKGROUND

The current healthcare system is appropriate for acute disease management but it is not cost-effective for the care of older adults with chronic diseases, multimorbidity, functional impairment, and, often, institutionalization. Accordingly, the health care costs for older adults with chronic medical conditions are higher than those of younger people. It is expected that health care cost for the management of chronic medical conditions will rise with the increasing proportion of older populations.

In addition, the socioeconomic gaps in several health outcomes have reportedly increased in recent years. This observation is associated with health status disparities and variation in the prevalence of diseases, disabilities, and mortality. In particular, socioeconomic inequalities are associated with health and wellbeing in later life.[1] Health disparities have great impacts on the health status of older people in Korea; thus, we need to understand the underlying causes and find an appropriate solution to decrease of health disparities.

Digital medicine can be a solution for better control of chronic medical conditions in older adults. Studies have shown promising results, which support the beneficial effect of monitoring, patient's engagement, early detection, and compliance by adopting digital technologies for the management of chronic medical conditions. All of these benefits can impact the improvement of chronic disease management and subsequently result in better clinical outcomes.

The purpose of this review was to briefly describe the current status of common chronic medical conditions in Korean older adults and to review the opportunities and challenges associated with digital technology-based chronic disease management of older people in Korea.

CURRENT HEALTH STATUS AMONG KOREAN OLDER ADULTS

In Korea, older people have a higher prevalence of chronic medical conditions along with higher rates of mortality and poorer health outcomes. For example, 62% of Korean older adults have hypertension, but only 64% of the hypertensive patients have controlled their blood pressure <150/90 mmHg.[2] In addition, 29.3% of Korean older women and 14.5% of Korean older men rated their health as poor or very poor, and chronic medical conditions were associated with a 2-fold increased risk of self-rated poor health status.[3]

Several factors are associated with an unfavorable health status, including poor access to healthcare, poverty, longer exposure to environmental hazards, and behavioral factors. A previous study showed a diminished relationship between old age and poor health; however, the relation-

ship remained after adjusting for socioeconomic factors.[4] These findings suggested that the gap in health status may be accounted for, in large part, by the low socioeconomic status of elderly people. Our government has tried to reduce social and economic inequalities in later life by introducing a basic age pension system, which is helpful to lower the poverty rate among older adults, thus ensuring that everyone is able to live long, enjoyable, and meaningful lives. Nonetheless, there remain health disparities among older adults, with different levels of chronic disease prevalence and management. Accordingly, additional strategies are required to improve management of chronic diseases in older adults.

DIGITAL MEDICINE: A NEW OPTION FOR IMPROVED CHRONIC DISEASE MANAGEMENT

When people think of digital medicine, most of them consider it to have nothing to do with older adults, poor people, and people of low income or low socioeconomic status. In other words, it is believed that there is a "digital divide," a substantial gap in the use of digital technologies according to age, race/ethnicity, geographic location, and socioeconomic status. However, technologies enabling digital medicine can be accessed by these populations at a relatively low cost. For older adults, there is still a lag in smartphone use; however, increasing numbers are discovering the value of these technologies. In Korea, 77% of older people aged 60 years or older used smartphones.[5] This high prevalence of smartphone use increases the likelihood of successfully implementing health interventions for traditionally hard-to-reach populations. Mobile technologies can enhance communication between patients and healthcare providers. For example, mobile applications provide a simple, low-cost way to educate patients and an automatic response to patients' questions can be delivered directly using computerized clinical decision support systems. Accordingly, the benefit of digital medicine will be greater in the care of chronic diseases, which are common but poorly controlled among older adults. Digital platforms for the management of chronic diseases are generally well accepted by patients and also enhance patient engagement.

Among chronic medical conditions, previous studies showed promising results in the management of hypertension, heart failure (HF), and diabetes mellitus.

Hypertension

Hypertension is the most common chronic medical condition and a major risk factor for cardiovascular and cerebrovascular disease worldwide. It is also the leading contributor to the global disease burden. High blood pressure accounted for more than 20% of all health loss in adults aged 70 years and older.[6] Lowering blood pressure is effective in reducing the cardiovascular disease risk for the hypertensive patients. Unfortunately, the real-world overall treatment and control rates of hypertension are unsatisfactory despite effective pharmacologic and non-pharmacologic therapies. In particular, the hypertension control rate among treated older hypertensive patients is lower than that of younger patients. Several factors are associated with these unfavorable results, include the use of suboptimal doses of medications, lack of patient engagement, poor compliance, and ineffective lifestyle modification.

Hypertension can be safely and effectively managed using a digital health platform, achieving better blood pressure control than that of traditional office-based care. Home blood pressure monitoring has advantages over traditional office-based blood pressure measurement and care, through a larger sample of blood pressure data, reducing misclassification to white-coat or masked hypertension, and an ability to take more timely action and course-correct therapy. It also effective in activating patient's motivation and encouraging drug adherence. The current technology is accurate and easy to use, and home-based blood pressure measurements also better predict cardiovascular outcomes. A previous study showed that digital medicine-based management including blood pressure telemonitoring, medication management, and lifestyle recommendations via a clinical pharmacist and a health coach, was associated with better blood pressure control, with target goal achievement rates of 71% among the digital-medicine group and 31% among the usual-care group.[7] In addition, a meta-analysis investigated the effect of an interactive digital intervention for blood pressure management. They showed that the digital intervention group had lower blood pressures (-3.74/-2.37 mmHg, systolic and diastolic blood pressure, respectively) than those of the usual care group.[8] However, the sustainability and long-term clinical effectiveness of these interventions remain unclear.

Diabetes Mellitus

Diabetes is present in 29.8% of Korean older adults aged over 65 years.[9] Diabetic patients have a 2-fold increased risk of dying than that among those younger than 80 years without diabetes. Diabetic vascular complications such as cardiovascular disease and cerebrovascular disease are the most serious problems associated with poor clinical outcome and increased healthcare costs. In addition, hypoglycemia is a treatment-related complication associated with increased mortality, especially among older adults. Recent data showed that hospital admission rates for hypoglycemia exceed those for hyperglycemia among older adults.[10] These data suggested that optimal glucose control is required in older people. However, diabetes management is often suboptimal in older people, especially those living in long-term care facilities.[11]

A digital approach can be an effective strategy for stable blood glucose control among elderly people. It can be useful for monitoring blood glucose level, providing suitable

diet and/or exercise recommendations, and enhancing drug compliance. An age-friendly clinical decision support system using a mobile phone-connected glucometer and individualized text messaging resulted in better glycemic control with less hypoglycemia compared to usual care in older diabetic patients.[12]

Heart Failure

HF is associated with prolonged and frequent hospitalizations; thus, HF is responsible for a tremendous burden on healthcare systems. The prevalence of this condition increases markedly with age. HF is the most common diagnosis for hospital admission in patients aged 65 years and older in high-income countries.[13] In addition, up to 25% of patients hospitalized with HF are readmitted within 30 days.[14,15] Despite advances in the quality of acute and chronic HF disease management, knowledge gaps remain regarding effective interventions to support the transition of care for HF patients. In addition, HF patients are frequently associated with multimorbidity. Accordingly, it is difficult to manage the accompanying pathologic conditions. Polypharmacy is another issue in managing older HF patients.

Digital medicine can be helpful in the monitoring, prevention and early detection of the aggravation of HF, as well as the management of drug compliance. Several studies have investigated the role of mobile devices in managing HF. The majority of these studies utilized mobile health technology as part of an HF monitoring system, which typically included a device to measure blood pressure, weighing scale, and an electrocardiogram recorder. However, the impacts of the mHealth interventions on all-cause mortality, cardiovascular mortality, HF-related hospitalizations, length of stay, New York Heart Association functional class, left ventricular ejection fraction, quality of life, and self-care were inconsistent at best.[16] Although several small pilot studies showed beneficial results using telemonitoring in HF patients, a large trial using telephone-based monitoring failed to show a significant benefit in reducing death or hospitalization.[17]

However, compliance, effective intervention, and monitoring are important factors in the management of HF patients. Furthermore, automatic, daily, implant-based, multiparameter telemonitoring can significantly improve clinical outcomes for patients with HF. Such telemonitoring is feasible and should be used in clinical practice.[18,19] Recently, a well-designed randomized controlled trial was published, which showed that structured remote patient management intervention could reduce the percentage of days lost due to unplanned cardiovascular hospital admissions and all-cause mortality.[20] The limitation of current studies includes insufficient data regarding the effectiveness of the monitoring devices, well-designed patient monitoring and feedback systems, and patient compliance using those devices. Accordingly, more precise monitoring devices should be developed to effectively evaluate and detect the aggravation of HF in these patients.

CHALLENGE FOR DIGITAL MEDICINE

To optimize its potential and make the greatest impact, digital medicine should be tailored to the needs of older populations. Complicated instructions for the use of mobile devices prevents their appropriate utilization among older people; thus, adherence and compliance will be low. Accordingly, we should provide non-language-based, user-friendly environments such as devices with simple designs that have only essential functions, relatively large size, and are inexpensive. Also, unobtrusive methods to gather data using the internet of things (IoT) may increase device usage among older people. Healthcare provider behaviors and practice patterns also contribute to the digital divide in care. Providers tend not to recommend mobile device for older, low income, or poor patients. While older people use digital health technologies less often, a substantial number (90% of younger people) use the internet or own cell phones. Accordingly, providing age-friendly environments for digital healthcare will lead to more older people using digital health technologies for disease prevention or management.[21] Finally, patient engagement is a key component of digital healthcare; thus, it is imperative to find ways to motivate and encourage participation, especially for the optimal care of chronic medical conditions.

CONCLUSIONS

Considering the current unmet need for healthcare support, the expanded use of digital technologies will provide opportunities to reduce health disparities. The new digital technologies can help to reduce health disparities worldwide and improve health outcomes for the aging population.

CONFLICTS OF INTEREST DISCLOSURES

The research claims no conflicts of interest.

ACKNOWLEDGMENTS

This research was supported by the grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number : H18C0037).

REFERENCES

1. Mackenbach JP, Stirbu I, Roskam AJ, Schaap MM, Menvielle G, Leinsalu M, et al. Socioeconomic inequalities in health in 22 European countries. N Engl J Med 2008;358:2468-81.
2. Kang MG, Kim SW, Yoon SJ, Choi JY, Kim KI, Kim CH. Association between frailty and hypertension prevalence, treatment, and

control in the elderly Korean population. Sci Rep 2017;7:7542.
3. Park JM. Health status and health services utilization in elderly Koreans. Int J Equity Health 2014;13:73.
4. Park EJ, Cho SI, Jang SN. Poor health in the Korean older population: age effect or adverse socioeconomic position. Arch Gerontol Geriatr 2012;55:599-604.
5. Gallup Korea. 2012-2018 Smartphone penetration rate [Internet]. Seoul (Korea): Gallup Korea; [cited 2018 Jul 26]. Available from: http://www.gallup.co.kr/gallupdb/reportContent.asp?seqNo=943.
6. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2224-60.
7. Milani RV, Lavie CJ, Bober RM, Milani AR, Ventura HO. Improving hypertension control and patient engagement using digital tools. Am J Med 2017;130:14-20.
8. McLean G, Band R, Saunderson K, Hanlon P, Murray E, Little P, et al. Digital interventions to promote self-management in adults with hypertension systematic review and meta-analysis. J Hypertens 2016;34:600-12.
9. Korean Diabetes Association. Diabetes fact sheet in Korea 2018. Seoul (Korea): Korean Diabetes Association; 2018.
10. Lipska KJ, Ross JS, Wang Y, Inzucchi SE, Minges K, Karter AJ, et al. National trends in US hospital admissions for hyperglycemia and hypoglycemia among Medicare beneficiaries, 1999 to 2011. JAMA Intern Med 2014;174:1116-24.
11. Sinclair A, Dunning T, Rodriguez-Mañas L. Diabetes in older people: new insights and remaining challenges. Lancet Diabetes Endocrinol 2015;3:275-85.
12. Lim S, Kang SM, Shin H, Lee HJ, Won Yoon J, Yu SH, et al. Improved glycemic control without hypoglycemia in elderly diabetic patients using the ubiquitous healthcare service, a new medical information system. Diabetes Care 2011;34:308-13.
13. Braunwald E. The war against heart failure: the Lancet lecture. Lancet 2015;385:812-24.
14. Bueno H, Ross JS, Wang Y, Chen J, Vidán MT, Normand SL, et al. Trends in length of stay and short-term outcomes among Medicare patients hospitalized for heart failure, 1993-2006. JAMA 2010;303:2141-7.
15. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. N Engl J Med 2009;360:1418-28.
16. Cajita MI, Gleason KT, Han HR. A systematic review of mHealth-based heart failure interventions. J Cardiovasc Nurs 2016;31(3):E10-22.
17. Chaudhry SI, Mattera JA, Curtis JP, Spertus JA, Herrin J, Lin Z, et al. Telemonitoring in patients with heart failure. N Engl J Med 2010;363:2301-9.
18. Hindricks G, Taborsky M, Glikson M, Heinrich U, Schumacher B, Katz A, et al. Implant-based multiparameter telemonitoring of patients with heart failure (IN-TIME): a randomised controlled trial. Lancet 2014;384:583-90.
19. Abraham WT, Stevenson LW, Bourge RC, Lindenfeld JA, Bauman JG, Adamson PB, et al. Sustained efficacy of pulmonary artery pressure to guide adjustment of chronic heart failure therapy: complete follow-up results from the CHAMPION randomised trial. Lancet 2016;387:453-61.
20. Koehler F, Koehler K, Deckwart O, Prescher S, Wegscheider K, Kirwan BA, et al. Efficacy of telemedical interventional management in patients with heart failure (TIM-HF2): a randomised, controlled, parallel-group, unmasked trial. Lancet 2018 Aug 24 [Epub]. pii: S0140-6736(18)31880-4. https://doi.org/10.1016/S0140-6736(18)31880-4.
21. Levine DM, Lipsitz SR, Linder JA. Trends in seniors' use of digital health technology in the United States, 2011-2014. JAMA 2016;316:538-40.