

Received 2023-09-01  
Revised 2023-09-09  
Accepted 2023-10-17

# Self-Care Management, Patient Education, and Nursing Support in Patients with Diabetes and Hypertension

Amirabbas Rostami <sup>1</sup>, Hamid Reza Sabet <sup>2</sup>, Eftekhar Azarm <sup>3</sup>, Haleh Kangari <sup>4</sup>, Zahra Elihaei <sup>5</sup>,  
Babak Khodadoustan Shahraki <sup>6</sup>, Parisa Hosseini Koukamari <sup>7</sup> ✉

<sup>1</sup> Department of Internal Medicine, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran

<sup>2</sup> Medical Journalism Department, School of Paramedical Sciences, Shiraz University of Medical Sciences, Shiraz, Iran

<sup>3</sup> School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran

<sup>4</sup> Department of optometry, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>5</sup> Department of Nursing, School of Nursing and Midwifery, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

<sup>6</sup> Isfahan university of medical sciences, Isfahan, Iran

<sup>7</sup> Department of Public Health, Student Research Committee, Saveh University of Medical Sciences, Saveh, Iran

## Abstract

Diabetes and related complications such as hypertension are considered major public health issues throughout the world as they are the most important causes of death and disability and cause huge economic implications for both patients and the public health system. Sufficient management of these complications along with novel patient education and self-care strategies are documented as ideal approaches able to postpone the onset of morbidity and disability and thereby delay the onset of preventable costs. However, contradictions regarding the efficacy of the studied self-care strategies are mentioned, thereby the current study aimed to review self-care strategies as a preventive approach to disease management and improving clinical outcomes in patients with diabetes and hypertension. The findings revealed that self-care through patient education with nursing support can improve medication adherence and lifestyle. However, clinical outcomes have revealed relative inconsistencies that require further studies. [GMJ.2024;13:e3166] DOI:[10.31661/gmj.v12i.3166](https://doi.org/10.31661/gmj.v12i.3166)

**Keywords:** Self-Care; Diabetes; Hypertension; Education; Lifestyle

## Introduction

Chronic non-communicable diseases are considered a major public health issue throughout the world, among which diabetes and cardiovascular disorders (CVDs) are described as the most notable diseases [1, 2]. Although it was previously estimated that the number of patients with diabetes around the

world will increase by approximately 60 percent from 382 million to 592 million between 2013 and 2035 [3], the International Diabetes Federation (IDF) has recently estimated that the number of diabetic patients projected to rise to 643 million by 2030 and 783 million by 2045 [4]. Also, IDF in 2023 estimated that 537 million individuals had diabetes worldwide, and 75 percent of them live in low- and

GMJ

Copyright© 2024, Galen Medical Journal.  
This is an open-access article distributed  
under the terms of the Creative Commons  
Attribution 4.0 International License  
(<http://creativecommons.org/licenses/by/4.0/>)  
Email:gmj@salviapub.com



✉ **Correspondence to:**

Parisa Hosseini Koukamari, Assistant Professor, Department of Public Health, Student Research Committee, Saveh University of Medical Sciences, Saveh, Iran.  
Telephone Number: 08648503202  
Email Address: P.hosseini@gmail.com

middle-income countries [4]. Moreover, the study of the global burden of disease, risk factors, and disabilities has confirmed that CVDs are the leading cause of mortality while hypertension, a major cause of premature death worldwide, is described as the globally major risk factor [5]. In fact, the World Health Organisation estimated that 1.28 billion people suffer from hypertension worldwide, and two-thirds of these individuals live in low and middle-income regions [5].

Hence, the rising burden of the mentioned diseases is challenging public health globally. It is widely documented that diabetes and related complications such as CVDs and hypertension cause huge economic implications for both patients and the public health system. The listed economic implications include direct huge costs incurred by both individuals and their families as well as by governmental agencies responsible for the management of the disease. Moreover, indirect costs result from a loss of wages and/or decreased productivity at work because of a person's disability. Notably, chronic diseases such as diabetes and hypertension are able to impose a vast amount of direct and indirect costs in both high-income nations (e.g. the United States of America) and middle- and low-income nations (e.g. India and a number of African countries) [6-8]. Moreover, the admission and subsequent complications of diabetes could remarkably increase the mentioned costs [9, 10]. There is a plethora of evidence demonstrating that the appropriate management of diabetes and risk factors such as hypertension could significantly postpone the onset of morbidity and disability and thereby delay the onset of preventable costs [11, 12].

Therefore, it is imperative that health systems are geared towards controlling patients with diabetes and other risk factors appropriately in order to detect the disease early, delay complications, and prevent hospital admissions [13]. Primary health care provides tremendous opportunities regarding the care of chronic non-communicable complications resulting in cost-saving [13]. Self-care, for example, is described as a fundamental element of treatment for patients with a chronic condition. Indeed, the self-care of diabetic patients is a major focus of many interventions and a plethora

of research exists describing different types of self-care interventions [14]. It should be stated that numerous sources have noted that proper disease management and novel patient education and self-care strategies may prevent the consequences of these complications and significantly reduce the huge public costs, disability, and mortality. Nevertheless, there are some kind of contradictions regarding the efficacy of the studied self-care methods. As a result, the current study aimed to review self-care strategies as a preventive /confrontational approach to managing the disease and improving clinical outcomes in patients with diabetes and hypertension.

#### *The Standard for Organization of Health Care, Patient Support, and Self-care*

The chronic care model (CCM) is described as a comprehensive standard of care for the organization of healthcare services for chronic diseases that emerged in the 1990s. The concept of CCM has been refined over the past years and is made on evidence that multicomponent structured care could be followed by improved outcomes for chronic non-communicable diseases [15]. Regarding the standard of medical care for diabetes, CCM is recommended by the American Diabetes Association for the organization of care by healthcare networks [16]. CCM defines and restructures care to cause partnerships between communities and health systems. Chronic care occurs within three major areas including the entire community, the health care system, and the provider organization that could be an integrated big delivery system or just a small clinic/primary care practice [13]. It is documented that the CCM recognizes the following six essential elements:

1. Health system for the organization of health care by providing leadership for securing resources and reducing, and removing barriers to care;
2. Self-management support by facilitating skill-based learning and patient empowerment;
3. Decision support by guiding for implementing evidence-based care;
4. Delivery system design contributing to coordinating care processes;
5. Clinical information systems track progress

through reporting outcomes to patients and providers;

6. Community resources and policies sustaining care by the application of community-based resources and public health policy.

The ultimate aim of CCM is to envision an informed and activated patient interacting with a prepared and proactive practice team that results in high-quality, satisfying encounters, and finally improved clinical outcomes [17, 18]. Since the burden of chronic diseases is increasing, the majority of chronic care is delivered in the primary care setting, thereby a considerable amount of time primary care physicians spend on confronting chronic diseases and supporting patients; as a result, global primary care practices require to be organized in order to provide high-quality care and educate patients.

Patient support groups are considered a component of CCM and a high-potential self-management strategy that is able to improve the care for chronic diseases such as diabetes and hypertension. It is evidenced that patient-led support teams may represent an ideological shift away from the perception of uninformed patients as 'passive' recipients of treatment to educated empowered individuals who are partners in the active effective management of their own condition [19, 20]. Peer support has been demonstrated to improve healthy behaviors in diabetic patients in undeveloped countries [21].

Support groups are responsible for a wide range of roles from improving treatment adherence, self-monitoring, reporting of disease, and providing emotional support to induce behavioral and lifestyle adjustments [21, 22]. As a result, support groups have produced considerable interest as a strategy for reaching low-income patients. Due to the scarcity of public and human resources in low- and middle-income countries for the management of patients with diabetes and hypertension, innovative and self-sustaining/self-care approaches are pivotally required for the improvement of the care of chronic disease patients [23]. Self-care, as mentioned earlier, is considered a principal and integral component of treatment in chronic disease and patients who engage in self-care represent a significant improvement in their clinical outcomes which is accompa-

nied by a higher quality of life, lower rate of hospital admission, and longer survival [24]. In fact, self-care has exponentially grown over the past decade mainly because of the availability of self-report instruments and applicable theories [25-28]. Although multiple studies have described a variety of self-care interventions specific to different pathological conditions [24, 29], healthcare is compartmentalized into specialties and subspecialties that usually prevent the delivery of information between different disciplines [14]. Self-care for chronic diseases has been theoretically described as the process of maintaining health through health-promoting practices and managing disease [30], thus self-care encompasses a variety of behaviors including both general and disease-specific, in which individuals suffering from a chronic disease engage to maintain their physical and emotional stability.

The mentioned behaviors such as adherence to medications, managing stress, ensuring appropriate and sufficient sleep, and physical activity are considered self-care maintenance, while self-care monitoring is referred to as the process of behavior monitoring for alterations in disease symptoms [31]. It is documented that self-care interventions are heterogeneous for specific patient groups in targeted self-care behaviors such as lifestyle and medication adherence, the intensity of intervention, and the obtained outcomes which in turn has made it difficult to reach evidenced recommendations for clinical practices. Hence, self-care interventions for each specific disease and patient group must be reviewed and interventions and outcomes must be assessed to understand the efficacy of studied approaches [32, 33]. In the following, the current study will review and discuss self-care interventions for patients with diabetes and hypertension.

#### *Self-care Approaches Could Improve Adherence to Medications*

It is widely established that medication non-adherence is a common, costly, and underdiagnosed occurrence in patients with chronic disease. It is accepted that adherence to medications is pivotally necessary for the improvement of outcomes and decrement of healthcare costs in chronic diseases such as

diabetes [34], and medication nonadherence results in poor health outcomes, increased risk of hospital admission, and higher rates of mortality [35, 36]. As the treatment regimen for diabetic patients is complex, it is difficult to adhere to diabetic medication and it has been demonstrated that medication adherence in patients with diabetes is worse than in patients with other chronic diseases [37].

The improvement of medication adherence is believed to be a high efficient strategy than altering the treatment regimen [38] since self-care protocols seek to provide an efficient approach to improve medication adherence. A recent study by Valdenor *et al.* has revealed that in patients with at least one chronic cardiometabolic disease including diabetes, hypertension, atrial fibrillation, or heart failure who were taking medications for their own disease, primary care physicians were not able to confront medication nonadherence [39], hence self-care strategies such as educating patients about the importance of medication adherence and behavioral interventions should be emphasized.

Raj *et al.* in a pilot randomized controlled trial, involving 50 elderly inpatients of general medicine wards diagnosed with select non-communicable chronic diseases, such as diabetes and hypertension, investigated the impact of behavioral intervention on medication adherence [40]. The results of this open-label, single-center, parallel-arm controlled trial revealed that behavioral interventions including receiving the usual standard of care or the intervention comprising of patient diary to mark daily prescribed medication intake, systematic education, and periodic telephone reminders for both 3 (91.88% compared to 78.20% in controls) and 6 months (83.08% compared to 68.64% in controls) could be followed by a significant improvement in medication adherence [40].

In addition, a four-year, parallel, randomized controlled clinical trial involved 50 individuals to assess the impact of participating in self-management education in comparison with individual education on clinical and psychological variables in patients with diabetes and hypertension [41]. The outcomes revealed that an educational approach based on the multidisciplinary structured group is

able to improve medication adherence and blood pressure in diabetic patients [41]. Concordantly, Parra *et al.* in a parallel randomized two-arm clinical trial involving 200 patients with hypertension and/or diabetes demonstrated that nursing intervention involving individual teaching in comparison with usual care is able to improve medication adherence significantly [42]. Due to the ubiquity of smartphones in individuals' daily lives, several studies have considered a high potential for mobile health (mHealth) tools in order to facilitate and improve medication adherence in patients with chronic diseases [43]. In this regard, Sartori *et al.* conducted a controlled randomized clinical trial to investigate the efficacy of WhatsApp-based education intervention in the adherence to antidiabetic and antihypertensive medication in patients with hypertension and diabetes, which showed that education of patients by WhatsApp probably could function as a reinforcement to improve medication adherence, however, clinical outcomes were not discussed [44].

Similarly, a pilot randomized feasibility trial on black patients with diabetes and hypertension revealed that a tailored mHealth intervention is able to significantly improve medication adherence and clinical outcomes. Nevertheless, the results showed no remarkable difference when compared to an attention control intervention for medication adherence [45]. Therefore, one can conclude that self-care strategies based on educational interventions, whether using mHealth tools or other methods, can lead to adherence to prescribed medication regimens and, as a result, desired therapeutic outcomes.

#### *Self-care Approaches to Improve the Lifestyle of Patients with Diabetes and Hypertension*

It is widely suggested that patients with diabetes and hypertension must change their lifestyle including the reduction of weight, increment of physical activity, and development of behavior skills [45, 46, 39]. In fact, diabetic patients are referred to a structured intensive lifestyle intervention program to pursue 7% weight loss and a long-term goal of 150 minutes weekly of moderate-intensity physical activity. It has been demonstrated that intensive lifestyle intervention is able to postpone

the onset of diabetes by approximately 4 years and decrease the overall incidence of diabetes by about 34% over ten years [47]. In addition, skill development and self-monitoring such as the careful tracking of weight and food quantity along with measurement of heart rate and blood pressure are listed as self-care skills required for lifestyle change [48]. Interestingly, Trento and colleagues have determined that self-care education is able to improve blood pressure in diabetic patients by improving medication adherence and lifestyle changes [41]. Along with that, a 6-month hospital-initiated and discharge/community nurses-coordinated transitional care intervention could cause a remarkable decrease in both systolic and diastolic blood pressures as well as a nonsignificant improvement in the levels of HbA1c, knowledge of hypertension and diabetes, medication adherence, quality of life, hospital readmission in elder patients with hypertension and diabetes [46].

Previous studies have investigated several lifestyle-based self-care approaches in patients with diabetes and hypertension. Wilkinson *et al.* have shown that a lifestyle intervention consisting of 10-hour time-restricted eating can significantly reduce weight, blood pressure, and atherogenic lipids in patients [49]. Meanwhile, home blood pressure monitoring along with lifestyle intervention on weight, blood pressure, and self-efficacy failed to improve blood pressure one year after delivery [50].

The evaluation of a package of risk-based medication and lifestyle interventions in a pragmatic cluster randomized controlled trial by Wei *et al.* has determined that they have no significant effect on CVD-related complications such as diabetes and blood pressure [51]. Furthermore, it is demonstrated that the addition of web-based behavioral support in order to improve exercise referral schemes in 450 people aged 16–74 years, with chronic complications such as obesity, hypertension, type 2 diabetes, etc., had only a weak nonsignificant indicative impact on long-term moderate and vigorous physical activity [52]. Therefore, it appears that self-care strategies and care support approaches to improve lifestyle have less impressive outcomes compared to medication adherence findings.

### *Self-care May Improve Clinical Outcomes in Patients with Hypertension and Diabetes*

As mentioned earlier, several conducted studies did not investigate the clinical outcomes of self-care in diabetes and hypertension patients and also clarified contradictions regarding the effectiveness, especially in the case of lifestyle interventions. Therefore, in this part, the present study deals with the clinical findings and existing contradictions regarding the effectiveness of self-care strategies in the treatment of patients with diabetes and hypertension. It was previously described that 36 months of risk-based drug and lifestyle interventions in 13,385 patients with diabetes and hypertension significantly increased medication adherence and had a small effect on systolic blood pressure reduction. However, the mentioned intervention could not have any significant effect on the incidence rate of CVDs [51].

This is despite the fact that individual education of the patient by the nurse, increasing their awareness of the disease, and informing patients about how to do self-care represented desired outcomes. In fact, Li *et al.* conducted a study to investigate the nursing effect of self-care on 34 patients with diabetes and hypertension in comparison with patients who received routine nursing. The results demonstrated that the levels of fasting blood glucose, 2-hour postprandial glucose, and systolic and diastolic blood pressure in patients who received self-care nursing decreased significantly more than in the other group, suggesting that individualized self-care nursing and health education could effectively improve the psychological cognition and strengthen the control of blood pressure and blood sugar of patients with diabetes and hypertension [53]. Concordantly, Trento *et al.* revealed that self-care education is able to desirably improve blood pressure in patients with diabetes, presumably through improvement of medication adherence and lifestyle changes [41]. Although studies that emphasized nurse-led education have resulted in favorable findings, the investigation of other approaches in order to improve self-care has revealed contradictory and in some cases unpleasant results. The study of McManus *et al.*, who investigated the effect of home and online digital intervention

for the management of hypertension in primary care by the combination of self-monitoring of blood pressure with guided self-management, could be referred to as an example of the few studies that obtained positive results [54].

The mentioned unmasked randomized controlled trial conducted on 622 patients with poorly controlled and who had access to the internet showed that digital intervention, which provided feedback on blood pressure outcomes to patients and professionals along with optional lifestyle advice and motivational support, was able to remarkably reduce both systolic and diastolic blood pressure compared to patients who received routine care consisted of routine hypertension care and appointments and medication changes made at the discretion of the general physician [54]. Although these findings suggested a cost-effective and efficient approach to improving blood pressure in diabetic and elderly patients [54], other studies have reported negative results. A controlled randomized crossover study on 37 diabetic and hypertensive patients revealed that although integrative mobile health intervention (consisting of self-measurement of blood pressure and blood glucose levels, health education, lifestyle change, and medication monitoring and adherence) was able to elevate the input rate of taking medicine, no significant alteration in body weight, blood pressure, and HbA1c was achieved [55]. Accordingly, two other studies that sought to improve the clinical outcomes of patients through the use of mobile phones, one with nurse support and quality of life assessment [56] and the other to improve self-care health management [57], have reported the ineffectiveness of the interventions.

These contradictions regarding the effectiveness of self-care approaches in improving clinical outcomes of patients with diabetes and hypertension may be dependent on the type of approach. For example, in the evaluation of facilitators and barriers for improving self-management and patient support, it has been determined that voice messages are preferred over texts by both patients and primary health care providers to communicate trust and increase accessibility for patients with low levels of literacy, limited vision, and smartphone unavailability [58]. In addition, the lack of significant clinical outcomes can be attributed to the racial differences of the patients participating in the study, as Kobe *et al.* showed that a pharmacist-delivered telehealth intervention could be more effective in African-American patients than non-African Americans [47].

## Conclusion

The reviewed studies determined that self-care approaches along with health education and nursing support can effectively improve medication adherence in patients with diabetes and hypertension and to some extent change lifestyle for the benefit of health. However, there are inconsistencies regarding the improvement of clinical outcomes, which may be related to differences in approaches and racial diversity of participants. Therefore, determining the clinical effectiveness of these approaches and suggesting more ideal strategies requires further studies.

## Conflict of Interest

none declared.

## References

1. de-Graft Aikins A, Kushitor M, Koram K, Gyamfi S, Ogedegbe G. Chronic non-communicable diseases and the challenge of universal health coverage: insights from community-based cardiovascular disease research in urban poor communities in Accra, Ghana. *BMC public health*. 2014;14(2):1-9.
2. Heine M, Lategan F, Erasmus M, Lombaard CM, Mc Carthy N, Olivier J *et al.* Health education interventions to promote health literacy in adults with selected non-communicable diseases living in low-to-middle income countries: A systematic review and meta-analysis. *Journal of evaluation in clinical practice*. 2021;27(6):1417-28.
3. Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE. Global

- estimates of diabetes prevalence for 2013 and projections for 2035. *Diabetes research and clinical practice*. 2014;103(2):137-49.
4. Federation ID. About diabetes. Facts & Figures: International Diabetes Federation; Available from: <https://idf.org/about-diabetes/diabetes-facts-figures/>. 2023.
  5. WHO. Hypertension. World Health Organisation: World Health Organisation; Available from: <https://www.who.int/news-room/fact-sheets/detail/hypertension>. 2023.
  6. Kansra P, Oberoi S. Cost of diabetes and its complications: results from a STEPS survey in Punjab, India. *Global Health Research and Policy*. 2023;8(1):1-11.
  7. Liu J, Liu M, Chai Z, Li C, Wang Y, Shen M et al. Projected rapid growth in diabetes disease burden and economic burden in China: a spatio-temporal study from 2020 to 2030. *The Lancet Regional Health–Western Pacific*. 2023;33:100700.
  8. Okafor CN, Obikeze E, Young E, Onwujekwe O. Economic Burden of Diabetes and Hypertension: A Study of Direct and Indirect Cost of Treatment in Southeast Nigeria. *International Journal of Social Determinants of Health and Health Services*. 2023;53(2):168-75.
  9. Lopes M, Ramsey S, Pantalone K, Li Q, Singh R, Du Y et al. CO84 Real-World Assessment of All-Cause and Cardiovascular-Related Inpatient Readmissions, Healthcare Resource Utilization, and Costs Among Type 2 Diabetes Patients with and without Chronic Kidney Disease. *Value in Health*. 2023;26(6):S30.
  10. Morton JI, Marquina C, Shaw JE, Liew D, Polkinghorne KR, Ademi Z, Magliano DJ. Projecting the incidence and costs of major cardiovascular and kidney complications of type 2 diabetes with widespread SGLT2i and GLP-1 RA use: a cost-effectiveness analysis. *Diabetologia*. 2023;66(4):642-56.
  11. Bellary S, Kyrou I, Brown JE, Bailey CJ. Type 2 diabetes mellitus in older adults: clinical considerations and management. *Nature Reviews Endocrinology*. 2021;17(9):534-48.
  12. Priyadi A, Muhtadi A, Suwantika AA, Sumiwi SA. An economic evaluation of diabetes mellitus management in South East Asia. *Journal of Advanced Pharmacy Education & Research* | Apr-Jun. 2019;9(2):53-74.
  13. Lall D, Prabhakaran D. Organization of primary health care for diabetes and hypertension in high, low and middle income countries. *Expert Review of Cardiovascular Therapy*. 2014;12(8):987-95.
  14. Riegel B, Westland H, Iovino P, Barelds I, Slot JB, Stawnychy MA et al. Characteristics of self-care interventions for patients with a chronic condition: A scoping review. *International journal of nursing studies*. 2021;116:103713.
  15. Coleman K, Austin BT, Brach C, Wagner EH. Evidence on the chronic care model in the new millennium. *Health affairs*. 2009;28(1):75-85.
  16. Care D. Standards of medical care in diabetes 2019. *Diabetes Care*. 2019;42(Suppl 1):S124-38.
  17. Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness. *Jama*. 2002;288(14):1775-9.
  18. Lall D, Engel N, Srinivasan PN, Devadasan N, Horstman K, Criel B. Improving primary care for diabetes and hypertension: findings from implementation research in rural South India. *BMJ open*. 2020;10(12):e040271.
  19. de Silva D. Evidence. helping people help themselves: the health foundation inspiring improvement; 2011.
  20. Jones F, Poestges H, Brimicombe L. Building Bridges between healthcare professionals, patients and families: A coproduced and integrated approach to self-management support in stroke. *NeuroRehabilitation*. 2016;39(4):471-80.
  21. Werfalli M, Raubenheimer PJ, Engel M, Musekiwa A, Bobrow K, Peer N et al. The effectiveness of peer and community health worker-led self-management support programs for improving diabetes health-related outcomes in adults in low-and-middle-income countries: a systematic review. *Systematic Reviews*. 2020;9(1):1-19.
  22. Shahin W, Kennedy GA, Stupans I. The association between social support and medication adherence in patients with hypertension: A systematic review. *Pharmacy Practice (Granada)*. 2021;19(2): 2300.
  23. Sanya RE, Johnston ES, Kibe P, Werfalli M, Mahone S, Levitt NS et al. Effectiveness of self-financing patient-led support groups in the management of hypertension and diabetes in low-and middle-income countries: Systematic review. *Tropical Medicine & International Health*. 2023;28(2):80-9.
  24. Jonkman NH, Westland H, Groenwold RH, Ågren S, Atienza F, Blue L et al. Do self-management interventions work in

- patients with heart failure An individual patient data meta-analysis. *Circulation*. 2016;133(12):1189-98.
25. Ausili D, Barbaranelli C, Rossi E, Reborà P, Fabrizi D, Coghi C et al. Development and psychometric testing of a theory-based tool to measure self-care in diabetes patients: the Self-Care of Diabetes Inventory. *BMC Endocrine Disorders*. 2017;17(1):1-12.
  26. Riegel B, Barbaranelli C, Carlson B, Sethares KA, Daus M, Moser DK et al. Psychometric testing of the revised self-care of heart failure index. *The Journal of cardiovascular nursing*. 2019;34(2):183.
  27. Baydoun M, Barton DL, Arslanian-Engoren C. A cancer specific middle-range theory of symptom self-care management: A theory synthesis. *Journal of Advanced Nursing*. 2018;74(12):2935-46.
  28. Vellone E, Riegel B, Alvaro R. The situation-specific theory of caregiver contributions to heart failure self-care. Situation specific theories: Development, utilization, and evaluation in nursing. 2021:193-206.
  29. Jonkman NH, Westland H, Trappenburg JC, Groenwold RH, Bischoff EW, Bourbeau J et al. Do self-management interventions in COPD patients work and which patients benefit most An individual patient data meta-analysis. *International journal of chronic obstructive pulmonary disease*. 2016:2063-74.
  30. Riegel B, Jaarsma T, Stromberg A. Theory of Self-Care of Chronic Illness. In: Smith MJ, Liehr PR, editors. New York: Springer Publishing Company. p. 341-54.
  31. Riegel B, Jaarsma T, Lee CS, Strömberg A. Integrating Symptoms Into the Middle-Range Theory of Self-Care of Chronic Illness. *ANS Advances in nursing science*. 2019;42(3):206-15.
  32. Jaarsma T, Strömberg A, Dunbar SB, Fitzsimons D, Lee C, Middleton S et al. Self-care research: How to grow the evidence base? *Int J Nurs Stud*. 2020;105:103555.
  33. Jonkman NH, Groenwold RHH, Trappenburg JCA, Hoes AW, Schuurmans MJ. Complex self-management interventions in chronic disease unravelled: a review of lessons learned from an individual patient data meta-analysis. *Journal of clinical epidemiology*. 2017;83:48-56.
  34. Balkrishnan R. The importance of medication adherence in improving chronic-disease related outcomes: what we know and what we need to further know. *LWW*. 2005: 517-20.
  35. Ho PM, Rumsfeld JS, Masoudi FA, McClure DL, Plomondon ME, Steiner JF, Magid DJ. Effect of medication nonadherence on hospitalization and mortality among patients with diabetes mellitus. *Archives of internal medicine*. 2006;166(17):1836-41.
  36. Teo V, Toh MR, Kwan YH, Raaj S, Tan S-YD, Tan JZY. Association between Total Daily Doses with duration of hospitalization among readmitted patients in a multi-ethnic Asian population. *Saudi Pharmaceutical Journal*. 2015;23(4):388-96.
  37. Robin AL, Muir KW. Medication adherence in patients with ocular hypertension or glaucoma. *Expert Review of Ophthalmology*. 2019;14(4-5):199-210.
  38. Liao YW, Cheow C, Leung KTY, Tan H, Low SF, Cheen HHM et al. A cultural adaptation and validation study of a self-report measure of the extent of and reasons for medication nonadherence among patients with diabetes in Singapore. *Patient preference and adherence*. 2019:1241-52.
  39. Valdenor C, Ganesan D, Paculdo D, Schrecker J, Heltsley R, Westerfield C, et al. Clinical Variation in the Treatment Practices for Medication Nonadherence, Drug-Drug Interactions, and Recognition of Disease Progression in Patients with Chronic Cardiometabolic Diseases: A Cross-Sectional Patient Simulation Study among Primary Care Physicians. *International Journal of Clinical Practice*. 2022;2022: 6450641.
  40. Raj JP, Mathews B. Effect of behavioral intervention on medication adherence among elderly with select non-communicable diseases (ENDORSE): Pilot randomized controlled trial. *Geriatrics & Gerontology International*. 2020;20(11):1079-84.
  41. Trento M, Fornengo P, Amione C, Salassa M, Barutta F, Gruden G, et al. Self-management education may improve blood pressure in people with type 2 diabetes A randomized controlled clinical trial. *Nutrition, Metabolism and Cardiovascular Diseases*. 2020;30(11):1973-9.
  42. Parra DI, Guevara SLR, Rojas LZ. 'Teaching: individual'to improve adherence in hypertension and type 2 diabetes. *British Journal of Community Nursing*. 2021;26(2):84-91.
  43. Organization WH. mHealth new horizons for health through mobile technologies. mHealth: new horizons for health through mobile technologies; 2011.



44. Sartori AC, Rodrigues Lucena TF, Lopes CT, Picinin Bernuci M, Yamaguchi MU. Educational intervention using WhatsApp on medication adherence in hypertension and diabetes patients: a randomized clinical trial. *Telemedicine and e-Health*. 2020;26(12):1526-32.
45. Schoenthaler A, Leon M, Butler M, Steinhäuser K, Wardzinski W. Development and evaluation of a tailored mobile health intervention to improve medication adherence in black patients with uncontrolled hypertension and type 2 diabetes: pilot randomized feasibility trial. *JMIR mHealth and uHealth*. 2020;8(9):e17135.
46. Tu Q, Xiao LD, Ullah S, Fuller J, Du H. A transitional care intervention for hypertension control for older people with diabetes: A cluster randomized controlled trial. *Journal of advanced nursing*. 2020;76(10):2696-708.
47. Kobe EA, Diamantidis CJ, Bosworth HB, Davenport CA, Oakes M, Alexopoulos A-S et al. Racial differences in the effectiveness of a multifactorial telehealth intervention to slow diabetic kidney disease. *Medical care*. 2020;58(11):968.
48. Koenigsberg MR, Corliss J. Diabetes self-management: facilitating lifestyle change. *American Family Physician*. 2017;96(6):362-70.
49. Wilkinson MJ, Manoogian EN, Zadorian A, Lo H, Fakhouri S, Shoghi A et al. Ten-hour time-restricted eating reduces weight, blood pressure, and atherogenic lipids in patients with metabolic syndrome. *Cell metabolism*. 2020;31(1):92-104.
50. Hauspurg A, Seely EW, Rich-Edwards J, Hayduchok C, Bryan S, Roche AT et al. Postpartum home blood pressure monitoring and lifestyle intervention in overweight and obese individuals the first year after gestational hypertension or pre-eclampsia: A pilot feasibility trial. *BJOG: An International Journal of Obstetrics & Gynaecology*. 2023;130(7):715-26.
51. Wei X, Zhang Z, Chong MK, Hicks JP, Gong W, Zou G et al. Evaluation of a package of risk-based pharmaceutical and lifestyle interventions in patients with hypertension and/or diabetes in rural China: A pragmatic cluster randomised controlled trial. *PLoS Medicine*. 2021;18(7):e1003694.
52. Taylor AH, Taylor RS, Ingram WM, Anokye N, Dean S, Jolly K et al. Adding web-based behavioural support to exercise referral schemes for inactive adults with chronic health conditions: the e-coachER RCT. *Health Technology Assessment (Winchester, England)*. 2020;24(63):1.
53. Li R, Xu W, Yang P, Tan L, Ling Z, Gan X. The nursing effect of individualized management on patients with diabetes mellitus type 2 and hypertension. *Frontiers in Endocrinology*. 2022;13:846419.
54. McManus RJ, Little P, Stuart B, Morton K, Raftery J, Kelly J et al. Home and Online Management and Evaluation of Blood Pressure (HOME BP) using a digital intervention in poorly controlled hypertension: randomised controlled trial. *bmj*. 2021;372: m4858.
55. Oh SW, Kim K-K, Kim SS, Park SK, Park S. Effect of an integrative mobile health intervention in patients with hypertension and diabetes: crossover study. *JMIR mHealth and uHealth*. 2022;10(1):e27192.
56. Wong AKC, Wong FKY, Chow KKS, Wong SM, Bayuo J, Ho AKY. Effect of a Mobile Health Application With Nurse Support on Quality of Life Among Community-Dwelling Older Adults in Hong Kong: A Randomized Clinical Trial. *JAMA network open*. 2022;5(11):e2241137-e.
57. Wong AKC, Wong FKY, Chang KKP. A proactive mobile health application program for promoting self-care health management among older adults in the community: study protocol of a three-arm randomized controlled trial. *Gerontology*. 2020;66(5):506-13.
58. Steinman L, Heang H, van Pelt M, Ide N, Cui H, Rao M et al. Facilitators and barriers to chronic disease self-management and mobile health interventions for people living with diabetes and hypertension in Cambodia: qualitative study. *JMIR mHealth and uHealth*. 2020;8(4):e13536.