

REVIEW ARTICLE

The Role of Digital Technology and New Strategies in Engagement and Adherence Among Patients With Cardiometabolic Disease

Márcio Krakauer,¹ Marcella Flores,² Renata Vital do Nascimento Lima,² Lara Abrão Sachetti³

Sociedade Brasileira de Diabetes, Coordenador Departamento de Tecnologia, Saúde Digital e Inovação,¹ São Paulo, SP – Brazil

Servier Médical,² São Paulo, SP – Brazil

Centro de Diabetes Curitiba,³ Curitiba, PR – Brazil

Abstract

This article explores challenges and barriers to managing cardiometabolic conditions, highlighting strategies and technologies for improving patient adherence. Approaches such as simplifying prescriptions, patient empowerment, health education, setting short-term goals, understanding social context, self-monitoring, and gamification have been effective in promoting adherence. The use of health apps for chronic diseases has also been increasing, facilitating medication adherence and self-monitoring. Integrating these approaches into clinical practice can lead to consistent outcomes and reduce care-associated costs.

Introduction

Chronic non-communicable diseases, whose rates have increased with the aging of the population, are a significant threat to health and quality of life. It has been estimated that the population over 60 years of age in Latin America and the Caribbean will increase at least 100% between 1980 and 2025, while in some of these countries it is projected to triple.¹

Patient engagement plays a crucial role in the management of cardiometabolic diseases. Actively engaged patients tend to have better treatment adherence, make lifestyle changes, and have better health outcomes. In this context, technological advances, changes in the health care delivery model, new tools,

Keywords

Reminder Systems; Patient Adherence; Digital Technology.

and strategies have emerged to promote patient engagement.

Among adults with chronic diseases, such as diabetes or hypertension, 30% to 50% fail to take the prescribed drugs.² These failures and low adherence are associated with increased morbidity and mortality and may contribute to between 33% and 69% of hospital admissions in the United States.³ The costs of poor adherence reach USD 100 billion each year in the US.⁴

In this review, we aim to show how technology can facilitate treatment adherence and engagement among patients with cardiometabolic diseases through tools that provide practical examples of daily decision making.

Adherence and engagement

Medication adherence refers to proper medication use according to the prescribed dosage, including treatment duration and frequency of use. It can be defined as the extent to which a patient acts according to a therapeutic regimen's prescribed interval and dose.⁵

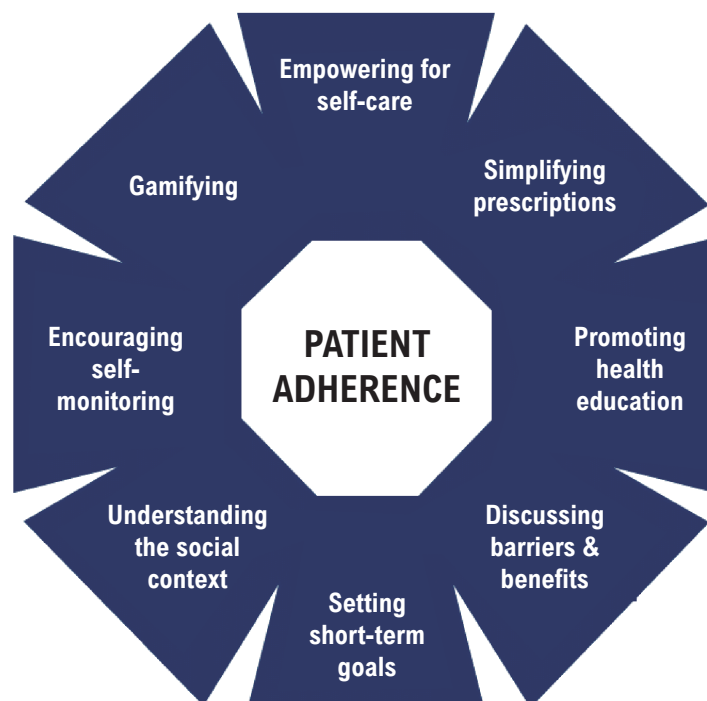
Patient engagement is generally low and declines over time, especially in chronic and often silent diseases such as hypertension, diabetes, dyslipidemia, and heart failure. In a study evaluating medication for secondary prevention in coronary artery disease, the rate of adequate usage did not exceed 50%.⁶

Several factors are involved in this finding, including patient-related factors (such as sex, age, and socioeconomic status), disease-related factors (such as a lack of symptoms), health beliefs, lifestyle, and cultural habits (such as perceived severity of the problem), treatment (such as cost, side effects, and complex therapeutic regimens), institutional issues (such as health care policy and access to care), and the

Mailing Address: Márcio Krakauer

Universidade de São Paulo, Medicine. Av. Dr. Eneas de Carvalho Aguiar. Postal code: 05508-900. São Paulo, SP – Brazil.

E-mail: marcio@nidomater.com.br

Central Illustration: The Role of Digital Technology and New Strategies in Engagement and Adherence Among Patients With Cardiometabolic Disease

Int J Cardiovasc Sci. 2023; 36:e20230126

Patient-focused strategies to increase adherence.

relationship with the health team (such as the availability of a multi-professional team).⁷

Regarding treatment-related factors, Thom et al.⁸ and Castellano et al.⁹ respectively randomized 2,004 and 2,118 patients at risk of cardiovascular events to receive a single-pill fixed-dose combination of aspirin, statin, and 2 antihypertensives) vs receiving these four drugs in separate pills. Among patients who received a single pill, adherence increased 41-51%, systolic blood pressure decreased, and low density lipoprotein cholesterol decreased over the 15 months of the studies.^{8,9}

The results of the SECURE study, published in the *New England Journal of Medicine*, support these findings, highlighting the greater efficacy of a “polypill” approach compared to usual care, mainly for vital cardiovascular outcomes. In this study, among older adults with a recent myocardial infarction, a secondary prevention treatment strategy of a polypill containing aspirin, angiotensin converting enzyme inhibitors, and statins resulted in a lower risk of major adverse cardiovascular events than usual care according to current European

Society of Cardiology guidelines. These results were consistent regardless of country, age, sex, or the presence of diabetes.¹⁰

A patient-centered approach, recognizing individual limitations and giving chronic disease sufferers control and responsibility over their condition has also been an important strategy.¹¹

Examples of patient-focused strategies include (Central Illustration):

1. Stimulating self-care through empowerment: monitoring devices can reveal behavior and decision-making patterns. American and European guidelines on hypertension emphasize patient empowerment as one of the cornerstones of antihypertensive treatment.¹²

2. Simplifying prescriptions in description and dosage to best conform to the patient's schedule and lifestyle.

3. Promoting health education: it is essential to explain to patients, in a transparent, adequate, and informative way, what their disease is, its complications, warning signs, and symptoms, and the risks of non-adherence to therapy.

4. Discussing benefits and barriers, including possible stigmas, beliefs, and prejudices.

5. Setting short-term goals: tangible objectives with frequent feedback and recognition of goal achievement at each stage.

6. Understanding the social context is important for clear communication, setting goals, and using technological tools as treatment allies.¹³

7. Encouraging self-monitoring: self-monitoring in patients with chronic diseases is essential for condition management and making appropriate and assertive decisions.¹⁴

8. Gamifying: this relatively new concept refers to using game techniques as a learning strategy in real-life contexts. In health care and health education, it may improve outcomes, empower professionals, and facilitate therapy for patients. Gamification can transform how people interact with their immediate surroundings, generating results by creating innovative meanings, individualizing learning, and updating knowledge in an effort to change behavior.^{15,16}

Gauging adherence and engagement is a challenge. Questionnaires validated in Brazil¹⁷ have often been used in clinical research but are seldom applied in clinical practice. Open, detailed anamnesis and the doctor-patient relationship are fundamental in this process. The concept of patient empowerment is reflected in recent guidelines from the European Society of Cardiology and the European Society of Hypertension, which emphasize patient participation and cooperation.¹² Considering this context, health technologies can be used to increase patient engagement.¹⁸

Chronic disease health apps

More and more mobile phone apps for health management are being released, which is associated with the increasing use of smartphones and increased access to the Internet. Some of these tools include alarms reminding users to take their medication or health coaching from an artificially intelligent chatbot in patient support programs. This union of technology and health care can significantly benefit patient engagement.

Some tools can integrate healthy eating guidelines, exercise, psychosocial care, help with alcohol and tobacco cessation, monitoring vital data and recording periodic laboratory tests. The Elfie® app (Figure 1) combines all these functions in an user-friendly software with an intuitive interface. This platform is intended for health

professionals and patients, generating health data for subsequent therapeutic decision making by the health team. The app uses behavioral science, engagement, and gamification techniques, and has been validated by the Brazilian Society of Cardiology and the Brazilian Society of Diabetes. Recent guidelines and scientific evidence are its data source. Elfie® gamifies the patient's journey, ie, each time users monitor their blood pressure, cholesterol, glycemia, take their medications, or exercise, they receive points that can be exchanged for health-related products or benefits. This app is part of a patient support program based on the COACH trial.¹⁹ Other studies using this model have shown that hypertension self-management programs based on mobile technology can support long-term blood pressure control and detect very high blood pressure, improving real-world blood pressure monitoring.²⁰

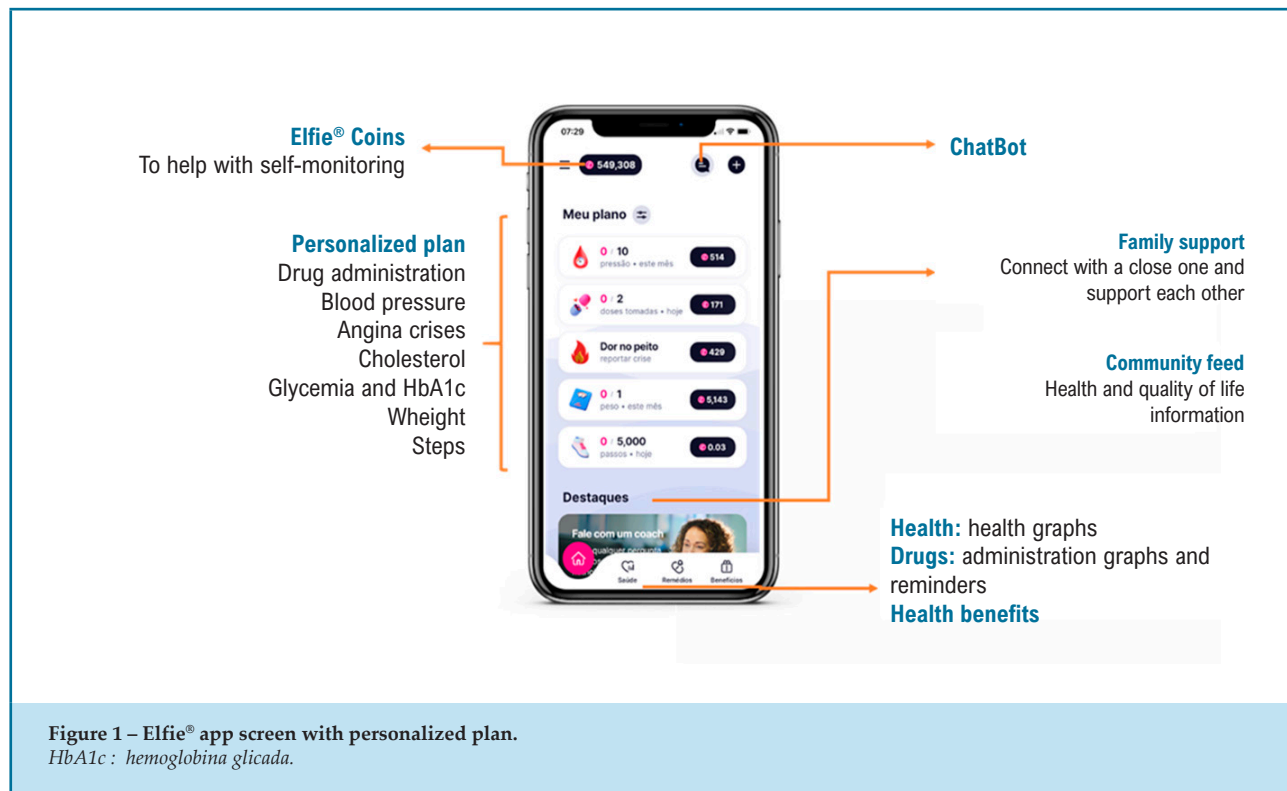
Health education strategies

There is also good evidence for the efficacy of a combination of educational interventions (eg, cognitive, motivational, and behavioral). National non-governmental organizations have begun initiatives of this type, especially for people with diabetes, family members, health professionals, and individuals interested in learning about diabetes and cardiovascular complications. Thus, everyone can, in their own way, help improve treatment adherence and engagement.

Non-profit agencies can play a fundamental role in educating people with chronic non-communicable diseases through online or in-person programs to address issues related to the disease, the patient, and society. Using these tools, patients can adapt and modify their lifestyle habits to reduce risks and improve control of chronic diseases. Examples include the National Association for Diabetic Assistance (ANAD); ADJ Diabetes Brasil, São Paulo; Diabetes Association of Greater São Paulo (ADIABC); Institute for People with Diabetes (IPD), Paraná; Diabetic Association of Lagoa (ADILA), Rio de Janeiro; and the Voices of Advocacy coalition.²¹

Simplifying polypharmacy: portioning medications for home use

Polypharmacy is another common complaint in doctors' offices, and patients and doctors should be aware of how medications are being taken: the time, the frequency, and whether they are being taken before or during meals.²² In light of this problem, some



startups have sought to streamline the purchasing and organization of medication regimens for patients. Pioneers in this effort include SafePill and FAR.ME; these companies send a personalized box each month to users with the pills portioned into individual packets. Each packet is sequentially labeled with the day and time each dose should be taken. These companies also have smartphone apps that remind users to take their medications and record confirmation that it has been taken.

Another advantage of these companies is that they guarantee the best price for medications and have a team of pharmacists to answer questions and modify the regimen when the patient's medical team makes any prescription changes.

Continuous glucose monitoring

The health belief model has had excellent results in clinical practice. According to this model, greater patient engagement in a given behavior results from the interaction between self-perception of one's health condition (or the risk of developing some disease) and the self-perceived benefits of adopting a healthy attitude.²³

Using a device to continuously monitor glucose, for example, could directly improve clinical outcomes through greater engagement, since it would allow the patient to see impact of glycemia and their daily progress regarding food, exercise, and emotional aspects, thus leading to positive behavioral change.

A study found that glycated hemoglobin was reduced in patients with type 1 and type 2 diabetes who used a Freestyle Libre monitor (Abbott Laboratories, Abbott Park, IL, USA), even without modifying their therapeutic regimen.¹

Limitations and barriers

There are several barriers to managing chronic diseases, such as insufficient knowledge about the condition, financial difficulties, and the side effects of medications. Technological innovations can be used to meet needs on an individual level and facilitate daily life.

On the other hand, attention should also be paid to patient inexperience with health apps, since they may give a false impression of poor performance. It is up to health professionals to assist and instruct each patient, answering questions and encouraging their use.

Conclusions

Population aging and the increased prevalence of chronic non-communicable diseases represent significant challenges to health and quality of life. Patient adherence and engagement are fundamental pillars of cardiometabolic disease management.

Challenges and barriers lead to inadequate follow-up and management, which are associated with worse health outcomes and high medical costs. This review surveyed health strategies and technologies to improve patient adherence and engagement, which may even be effective apart from drug regimen adjustments. Approaches such as simplifying prescriptions, patient empowerment, health education, setting short-term goals, and understanding the social context have effectively promoted adherence. Self-monitoring and gamification have also shown promise.

The use of health apps is increasing among chronic disease patients, facilitating medication adherence and self-monitoring. These tools offer patients support, information, and reminders about medications and health care. Integrating these approaches into clinical practice can lead to gratifying and consistent outcomes, increasing treatment adherence and reducing treatment costs.

Although these technologies have advantages, there are obstacles to their implementation, such as insufficient publicity and security issues, such as data protection and privacy. However, their continued development and improvement, in conjunction with patient-centered approaches, could revolutionize care for people with cardiometabolic conditions and significantly improve their

quality of life. Health care professionals must encourage and guide the appropriate use of these technologies.

Author Contributions

Conception and design of the research: Krakauer M; acquisition of data, analysis and interpretation of the data and writing of the manuscript: Krakauer M, Sachetti LA; obtaining financing and critical revision of the manuscript for intellectual content: Krakauer M, Flores M, Lima RVN, Sachetti LA.

Potential Conflict of Interest

Márcio Krakauer was Speaker at Servier do Brasil and received a grant from Servier do Brasil to prepare the article. Marcella Flores is Medical Manager at Servier do Brasil Laboratories. Renata Lima is Medical Manager at Servier do Brasil Laboratories.

Sources of Funding

This study was partially funded by Servier do Brasil.

Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

References

- Lebrão ML, Laurenti R. Saúde, Bem-Estar e Envelhecimento: O Estudo SABE no Município de São Paulo. *Rev Bras Epidemiol.* 2005;8(2):127-41. doi: 10.1590/S1415-790X2005000200005.
- Naderi SH, Bestwick JP, Wald DS. Adherence to Drugs that Prevent Cardiovascular Disease: Meta-Analysis on 376,162 Patients. *Am J Med.* 2012;125(9):882-7.e1. doi: 10.1016/j.amjmed.2011.12.013.
- Iuga AO, McGuire MJ. Adherence and Health Care Costs. *Risk Manag Healthc Policy.* 2014;7:35-44. doi: 10.2147/RMHP.S19801.
- Senst BL, Achusim LE, Genest RP, Cosentino LA, Ford CC, Little JA, et al. Practical Approach to Determining Costs and Frequency of Adverse Drug Events in a Health Care Network. *Am J Health Syst Pharm.* 2001;58(12):1126-32. doi: 10.1093/ajhp/58.12.1126.
- Cramer JA, Roy A, Burrell A, Fairchild CJ, Fuldeore MJ, Ollendorf DA, et al. Medication Compliance and Persistence: Terminology and Definitions. *Value Health.* 2008;11(1):44-7. doi: 10.1111/j.1524-4733.2007.00213.x.
- Yusuf S, Islam S, Chow CK, Rangarajan S, Dagenais G, Diaz R, et al. Countries (the PURE Study): a Prospective Epidemiological Survey. *Lancet.* 2011;378(9798):1231-43. doi: 10.1016/S0140-6736(11)61215-4.
- Gusmão JL, Mion D Jr. Adesão ao Tratamento – Conceitos. *Rev Bras Hipertens.* 2006;13(1):23-25.
- Thom S, Poulter N, Field J, Patel A, Prabhakaran D, Stanton A, et al. Effects of a Fixed-Dose Combination Strategy on Adherence and Risk Factors in Patients with or at High Risk of CVD: The UMPIRE Randomized Clinical Trial. *JAMA.* 2013;310(9):918-29. doi: 10.1001/jama.2013.277064.
- Castellano JM, Sanz G, Peñalvo JL, Bansilal S, Fernández-Ortiz A, Alvarez L, et al. A Polypill Strategy to Improve Adherence: Results from the FOCUS Project. *J Am Coll Cardiol.* 2014;64(20):2071-82. doi: 10.1016/j.jacc.2014.08.021.
- Castellano JM, Pocock SJ, Bhatt DL, Quesada AJ, Owen R, Fernandez-Ortiz A, et al. Polypill Strategy in Secondary Cardiovascular Prevention. *N Engl J Med.* 2022;387(11):967-77. doi: 10.1056/NEJMoa2208275.
- Funnell MM, Anderson RM. Empowerment and Self-Management of Diabetes. *Clin Diabetes.* 2004;22(3):123-7. doi: 10.2337/diaclin.22.3.123.

12. Bakris G, Ali W, Parati G. ACC/AHA versus ESC/ESH on Hypertension Guidelines: JACC Guideline Comparison. *J Am Coll Cardiol*. 2019;73(23):3018-26. doi: 10.1016/j.jacc.2019.03.507.
13. Katz M, Feitosa GF, Pinto IMF, Felix MM, Bortolotto LA. Uso da Tecnologia para Engajar Pacientes e Otimizar a Adesão Terapêutica. *Rev Soc Cardiol Estado São Paulo*. 2020;30(3):352-7. doi: 10.29381/0103-8559/20203003352-7.
14. Lacerda MCC. Impactos do Programa de Automonitoramento da Glicemia Capilar na Qualidade de Vida de Pacientes Diabéticos. *Res Soc Dev*. 2022;11(15):e310111537183. doi: 10.33448/rsd-v11i15.37183.
15. Possolli GE, Marchiorato AL, Nascimento GL. Gamificação como Recurso Educacional na Área da Saúde: Uma Revisão Integrativa. *Educ Tecnol*. 2020;23(3):1-17.
16. Ferreira SC. A Gamificação na Área da Saúde: Um Mapeamento Sistemático. *SJEEC*. 2019;13:48-56.
17. Morisky DE, Ang A, Krousel-Wood M, Ward HJ. Predictive Validity of a Medication Adherence Measure in an Outpatient Setting. *J Clin Hypertens*. 2008;10(5):348-54. doi: 10.1111/j.1751-7176.2008.07572.x.
18. Bosworth HB, Granger BB, Mendys P, Brindis R, Burkholder R, Czajkowski SM, et al. Medication Adherence: A Call for Action. *Am Heart J*. 2011;162(3):412-24. doi: 10.1016/j.ahj.2011.06.007.
19. Lee DS, Straus SE, Farkouh ME, Austin PC, Taljaard M, Chong A, et al. Trial of an Intervention to Improve Acute Heart Failure Outcomes. *N Engl J Med*. 2023;388(1):22-32. doi: 10.1056/NEJMoa2211680.
20. Gazit T, Gutman M, Beatty AL. Assessment of Hypertension Control Among Adults Participating in a Mobile Technology Blood Pressure Self-Management Program. *JAMA Netw Open*. 2021;4(10):e2127008. doi: 10.1001/jamanetworkopen.2021.27008.
21. Brasil. Ministério da Saúde. Síntese de Evidências para Políticas de Saúde: Adesão ao Tratamento Medicamentoso por Pacientes Portadores. Brasília: Ministério da Saúde; 2016.
22. Hajar ER, Cafiero AC, Hanlon JT. Polypharmacy in Elderly Patients. *Am J Geriatr Pharmacother*. 2007;5(4):345-51. doi: 10.1016/j.amjopharm.2007.12.002.
23. Janz NK, Becker MH. The Health Belief Model: A Decade Later. *Health Educ Q*. 1984;11(1):1-47. doi: 10.1177/109019818401100101.

