*Arh. farm. 2025; 75: 181 – 201* *Review article/Pregledni rad*

# An overview of medication adherence: measurement methods and interventions

**Dijana Miceva[1]*, Katarina Smilkov[1], Darinka Gjorgieva Ackova[1], Zorica Naumovska[2], Biljana Lazarova[1, 3], Bistra Angelovska[1], Elena Drakalska Sersemova[1]**

[1]Faculty of Medical Sciences, Goce Delcev University, Stip, Krste Misirkov 10-A, 2000 Stip, North Macedonia

[2]Faculty of Pharmacy, Ss. Cyril and Methodius University in Skopje, Mother Tereza 47, 1000 Skopje, North Macedonia

[3]Clinical Hospital, Ljuben Ivanov bb, 2000 Štip, North Macedonia

*Corresponding author: Dijana Miceva, e-mail: dijana.miceva@ugd.edu.mk

Received: 30 April 2025; Revised in revised forme: 4 June 2025; Accepted: 4 June 2025

## Abstract

Medication adherence is essential for achieving therapeutic outcomes. However, many patients do not follow their prescribed medication regimens. About 50% of patients do not adhere to their pharmacotherapy, making medication adherence a widespread issue. Accurately measuring adherence is essential for effective care planning and intervention. This paper reviews various methods for measuring medication adherence, highlighting the advantages and disadvantages of each approach. Many factors can affect medication adherence. This review focuses on practical ways to measure adherence and strategies to enhance it, underscoring its importance in achieving better healthcare results. Healthcare providers must prioritize medication adherence, as it directly impacts the effectiveness of treatment and overall public health outcomes.

**Key words:** medication adherence, methods, interventions, factors

https://doi.org/10.5937/arhfarm75-58555

## Introduction

Medication adherence, the extent to which patients follow their prescribed medication regimens, is essential for achieving optimal therapeutic outcomes and improving overall health (1, 2, 3). Medication nonadherence affects not just individual patients but also healthcare providers, caregivers, and the entire healthcare system (1). It has been shown that more than 50% of patients do not adhere to their prescribed treatment regimens (4). Given the global rising prevalence of chronic conditions requiring long-term treatments, this represents an increasingly major healthcare problem. Chronic illnesses are often linked to even lower adherence rates, contributing to adverse health outcomes, increased hospital admissions, and healthcare costs (4, 5). Good medication adherence has been consistently linked to better disease control, prevention of complications, improved quality of life, and reduced mortality. Research shows that a range of complex factors can contribute to medication nonadherence (6). An accurate evaluation of medication adherence is crucial for developing effective treatment strategies and interventions (7, 8). Several methods are available to assess medication adherence, each with advantages and limitations (9). The selection of an appropriate assessment method is essential, as it directly influences the accuracy and dependability of the adherence data collected. This review explores medication adherence, focusing on factors contributing to nonadherence, methods to measure adherence, and potential solutions for improving patient outcomes. Taking medications as prescribed is essential for achieving optimal health outcomes. To improve adherence, a well-rounded approach is necessary to better understand the behaviors affecting it.

## Methods

A comprehensive review of the literature on medication adherence and its assessment was conducted by searching the PubMed database. The search was done using these key words: “medication adherence” AND “medication adherence assessment methods” AND “factors affecting medication adherence” AND “intervention”. The inclusion criteria consisted of articles in English and clear study design and methodology descriptions. The articles that included original research and literature reviews, highlighting factors influencing medication adherence, evaluating specific adherence assessment tools, and examining related interventions, were selected.

## Results and discussion

### Understanding Medication Adherence: Definition and Importance

Hippocrates, with his words, “keep watch also on the faults of the patients, which often make them lie about the taking of things prescribed”, was the first who addressed the problem of not taking medications as prescribed (10). However, it took many centuries for the importance of these observations to be fully recognized. The starting point for many medication adherence research studies is the well-known statement by C. Everett Koop, which is frequently referenced in literature focused on medication adherence – “Drugs don't work in patients who don't take them” (11). Various definitions of adherence

exist throughout medical literature and within different organizations. In 2003, the World Health Organization (WHO) defined adherence to long-term treatment as “the degree to which an individual's behavior – including taking medication, following a diet, and making lifestyle changes – matches the agreed-upon recommendations from a healthcare provider” (12). One of the main obstacles in measuring adherence is the need for standardization, which results in varied methods that are often difficult to compare accurately (13). To address the variability in adherence definitions and the complexity of adherence data, Vrijens et al. proposed a new taxonomy in 2012, the Ascertaining Barriers for Compliance (ABC) taxonomy on medication adherence (14). The ABC taxonomy outlines medication adherence as patients taking their medication according to prescription. It is divided into three fundamental phases: (A) initiation, (B) implementation, and (C) persistence (14). The first phase, initiation, is when patients begin their medication regimen by taking the first prescribed dose. Initiation can be classified as a binary variable: patients either begin their medication regimen or do not. The second step, implementation, refers to how closely a patient's actual medication dosing matches the prescribed regimen from the start of treatment through the final dose. The final step, defined as persistence, refers to the ongoing continuation of treatment, encompassing the duration and the occurrence of unscheduled breaks (prolonged periods of consecutively missed doses, with the minimum duration differing based on the specific treatment and condition) (13, 14).

**Exploring the Factors Contributing to Nonadherence**

Medication nonadherence is a widespread and persistent issue in the management of chronic diseases. Nonadherent patients are those who fail to follow their prescribed medication regimen, often taking lower doses less frequently than instructed or discontinuing the treatment on their initiative (15, 16). Medication nonadherence affects more than just the patient – it also impacts doctors, pharmacists, caregivers, families, and the healthcare system (17, 18). Studies indicate that nonadherence contributes to nearly 200,000 deaths each year and incurs costs of approximately €125 billion across Europe (19). This lack of adherence is linked to worsening health conditions, accelerated disease advancement, higher demand for medical services, rising healthcare expenses, and an increased risk of mortality (20, 21). Research has highlighted a wide range of factors influencing nonadherence. According to the comprehensive review by Kardas et al., nearly 800 distinct variables linked to medication-taking behavior were identified (22).

The WHO proposes a range of factors that interact and mutually reinforce each other within a multidimensional framework for understanding and addressing medication adherence. These factors include those related to the patient, the specific condition, the treatment, social and economic aspects, and the healthcare team and system (23). Patient-related factors involve individual characteristics such as forgetfulness, lack of understanding of illness or treatment, low health literacy, psychological resistance, and poor motivation. Factors such as age, beliefs about medication, and involvement in treatment decisions also significantly influence adherence. Condition-related factors refer

to the nature and severity of the illness. Chronic and asymptomatic diseases often lead to lower adherence, particularly when patients do not perceive immediate benefits from therapy. Comorbidities and disease duration can further complicate adherence behaviors. Therapy-related factors include the complexity of medication regimens, dosing frequency, side effects, and the route of administration. Adherence tends to decrease with more frequent dosing schedules and increases when treatments are well-tolerated and simple to follow. Social and economic factors such as low income, limited education, unemployment, and unstable living environments can hinder access to medications and health services. Cultural beliefs, stigma, and distrust in the healthcare system may also discourage patients from adhering to prescribed treatments. Healthcare team and system-related factors involve the quality of communication between healthcare providers and patients, the availability of educational support, coordination of care, and continuity of services. A poor patient-provider relationship and inadequate explanations about medication use are common contributors to nonadherence (24).

Adherence can be either supported or hindered by these factors, generally categorized as perceptual or practical, following the framework outlined in the National Institutes of Clinical Excellence (NICE) adherence guideline (25). Perceptual factors refer to factors which arise primarily from internal cognitive processes, including motivation, emotions, and personal views on illness and treatment. Practical factors refer primarily to external environmental factors relating to the environment, treatment details, or societal influences, and they can also impact behavior. These perceptual and practical factors may result in either intentional or unintentional nonadherence. However, a widely accepted method for categorizing adherence factors needs to be developed. Categorizing medication-taking behaviors as intentional or unintentional is a commonly applied approach to better understanding patient adherence actions and decision-making patterns (26, 27, 28). Intentional nonadherence is considered a process in which the patient actively decides not to take medication or follow treatment recommendations. This type of nonadherence often occurs after weighing the treatment's potential benefits and risks. Unintentional nonadherence refers to unplanned behavior; it is passive and is sometimes due to factors beyond the patient’s control. This classification is essential for healthcare professionals because it helps them understand medication-taking behaviors, which in turn influences the choice of strategies to improve adherence (29). Nonadherence to medication therapy leads to poor disease control and increased healthcare utilization (30). Nonadherence can be categorized into eight types based on the framework given by Arnet et al. (31). These include primary nonadherence, sporadic medication breaks (often called “drug holidays”), the “toothbrush effect” (inconsistent adherence due to routines), perfect adherence to the wrong medication, dosage mistakes (such as overdosing, underdosing, or inconsistent dosing), incorrect timing of doses, premature discontinuation of treatment, and challenges related to polypharmacy (31). Primary medication nonadherence (PMN) occurs when a new medication is prescribed for a patient. However, the patient does not obtain the medication or an appropriate alternative within an acceptable period after it was prescribed. This includes prescriptions

that patients present (or are electronically prescribed) and those that never reach the pharmacy. Secondary nonadherence measures prescription refills among patients who previously filled their first prescriptions (32).

In addition to these multifactorial influences, it is also important to recognize the specific challenges and barriers that hinder effective medication adherence. While factors describe broad areas of influence, barriers refer to concrete, often day-to-day obstacles experienced by patients. These include a lack of understanding or misinformation about medications, low motivation, psychological distress, or practical difficulties such as complex regimens and fear of side effects. Systemic challenges – like long wait times, poor communication with healthcare providers, fragmented care, and limited follow-up can further exacerbate adherence issues. Cultural stigma, religious beliefs, logistical burdens, and financial hardship also frequently interfere with consistent medication use. Addressing these barriers through patient-centered and context-sensitive strategies is essential for developing effective adherence interventions (33).

### Measuring medication adherence

Medication adherence is usually measured over a set period and given as a percentage, showing how well patients follow their prescribed medication. Adherence among patients can be divided into two groups: those who adhere and those who don't (34). Precise measurements of adherence are also vital for researchers and healthcare providers. Adherence can be measured using (a) direct and (b) indirect methods (Figure 1). Each of these methods has its own set of advantages and disadvantages, which will be explored further (35).

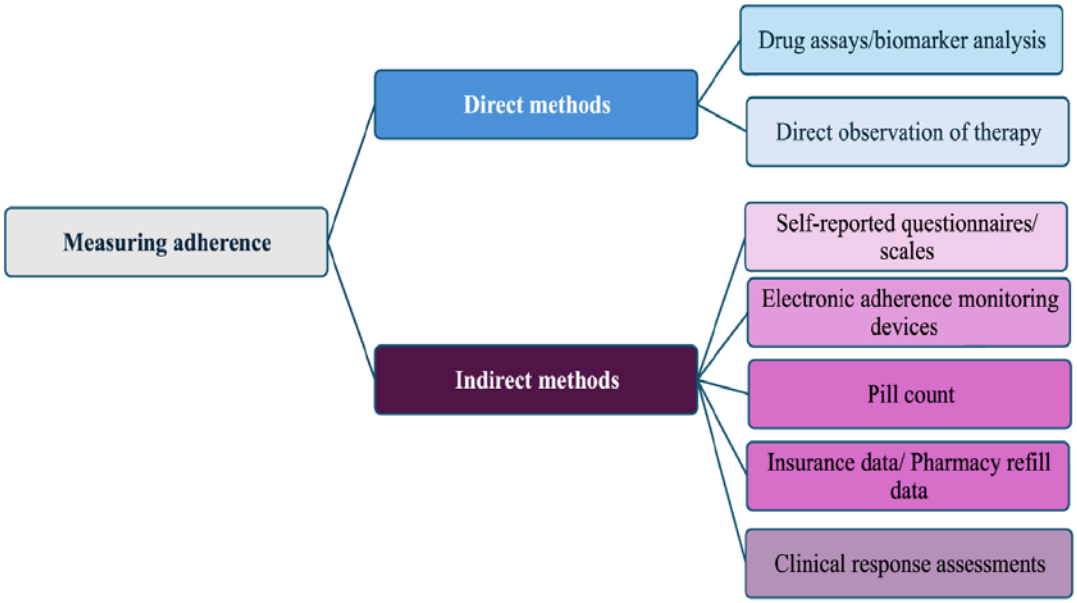


**Figure 1. Methods for measuring medication adherence**
**Slika 1. Metode za merenje pridržavanja terapije**

***Direct methods***

These methods can validate subjective assessments and provide the most accurate measurement of medication adherence. However, while they offer high precision, they are not practical for large-scale research or community settings due to the considerable resources they require, especially when compared to indirect methods. Direct methods for assessing adherence include: therapeutic drug monitoring (TDM), detection of a biological marker present in the medication, and direct observation of medication intake. While these methods provide objective adherence data, they can be costly, time-consuming, and influenced by patient behavior.

*Therapeutic drug monitoring* (TDM) remains a reliable approach (36, 37). However, detecting a drug in an assay does not confirm adherence, just as its absence does not necessarily indicate nonadherence. TDM is an invasive and costly procedure that requires blood or urine samples and is applicable to a limited number of medications, with results influenced by individual metabolic differences. This makes it challenging to accurately quantify drug levels, particularly for drugs that are metabolized either very quickly or very slowly, as their concentrations may be minimal in the bloodstream even after taking the medication. Additionally, patients may demonstrate improved adherence right before a scheduled appointment (white coat adherence) while continuing to be nonadherent during other periods (36, 38). It also offers information on short-term adherence, but it fails to capture a complete picture of long-term adherence behaviors (39). TDM helps clinicians tailor optimal treatment regimens for patients and is routinely applied in select clinical scenarios. It plays a crucial role in adjusting individual dosages by considering biological variations. TDM is primarily used for drugs with narrow therapeutic windows, significant pharmacokinetic variability, challenging target concentration monitoring, or a high risk of both therapeutic and toxic effects (39, 40). An increasing number of studies highlight the reliability of TDM in detecting medication nonadherence across various clinical conditions. Variability in drug levels can serve as a valuable indicator of nonadherence, particularly when combined with other methods such as clinician assessments or self-reporting (41). Implementing TDM requires teamwork from different healthcare professionals, including scientists, doctors, nurses, and pharmacists. Clear communication is key to ensuring the best use of TDM in patient care. Effective communication among these professionals is essential to uphold best practices and optimize the clinical utility of TDM (42, 43).

*Biological markers*, or *biomarkers*, refer to specific substances in blood, urine, saliva, or other bodily fluids that can confirm the intake of a medication. Some medications include unique molecular tags, excipients, or isotope-labeled compounds that can serve as identifiable markers. For example, in psychiatry or infectious disease management, the detection of specific drug-related metabolites (e.g., in antipsychotics or tuberculosis therapy) can act as adherence biomarkers. These markers help provide direct evidence that a drug has been ingested and metabolized, supporting the assessment of recent medication intake. However, biomarker testing is limited to certain drugs, may

require specialized equipment, and does not always provide information about long-term adherence patterns (38).

*Direct observation of therapy* means that the patient's use of prescribed treatments is monitored directly by a healthcare provider or family member. This method is regarded as one of the most reliable ways to assess adherence. Observing a patient's medication-taking behavior can confirm the patient's self-reports or provide essential support when the patient is unable to do so, as in the case of young children or those with dementia. When family members help remind patients to take their medication or assist with treatments like injections, direct observation becomes an effective strategy to ensure adherence (44). On the other hand, in direct observation, patients may conceal medication under their tongue and discard it later, making routine monitoring unreliable. As a result, this method is primarily used for patients receiving single dose therapy, intermittent treatment, or those in hospital settings, making it difficult to implement in larger population groups. This approach is also susceptible to bias, as patients may only take their medication when they know they are being observed, leading to inaccurate adherence reports (45).

***Indirect methods***

Indirect methods are the most widely used approach for evaluating medication adherence, as they are generally non-invasive, cost-effective, and feasible for use in both clinical practice and research settings. These methods do not directly measure the presence of a drug in the body but instead infer adherence through related behaviors and records. Common examples include patient self-report questionnaires, pill counts, electronic monitoring devices such as smart pill bottles or medication event monitoring systems (MEMS) and pharmacy refill data.

*Self-reported questionnaires and scales* – Self-reporting remains the most simple, subjective and indirect method for measuring medication adherence. These methods usually involve using scales or questionnaires where patients report their adherence based on specific questions. Whether administered online, through structured interviews, or as written questionnaires, these tools are widely used in adherence research and can be easily adapted to different patient populations (46, 47). Self-report measures are useful for assessing medication adherence as they are cost-effective, noninvasive, easy to administer, and cause little burden on patients. They also allow for flexibility in timing and method of collection. In clinical practice, self-reporting is one of the simplest ways to identify nonadherence. It gives healthcare providers valuable information that can help address issues before they lead to serious health problems (36, 48). However, they have limitations that may impact the accuracy of patient-reported adherence. A common challenge is that patients often overreport their adherence, especially if they worry that admitting to nonadherence might disappoint their healthcare provider. The article by Stirratt et al. highlights the advantages of self-reporting in clinical settings, particularly its speed and efficiency. The importance of using validated, easy-to-use self-report tools that meet high standards for accurate adherence reporting was also highlighted (49).

Several self-reported questionnaires are commonly used to measure medication adherence, across different patient populations. The Morisky scales are extensively utilized, with more than 110 versions available and translations in over 80 languages. The Medication Adherence Questionnaire (MAQ), developed by Morisky et al., is a 4-item tool assessing forgetfulness, carelessness, and medication used based on symptoms. It is publicly available for research and clinical use (50)**.** The 4-item Morisky Medication Adherence Scale (MMAS-4) includes the same questions but is copyrighted (51), while the MMAS-8 expands on it with situational and emotional factors (52). Both MMAS-4 and MMAS-8 require licensing and fees, making it essential to consider alternative validated self-report tools for research and clinical practice. These include the Medication Adherence Rating Scale (MARS), available in 10- and 5-item versions, the Adherence to Refills and Medications Scale (ARMS), the Simplified Medication Adherence Questionnaire (SMAQ), the Hill-Bone Scale, and the ProMAS questionnaire (27, 53). Some of these questionnaires address the issue of general adherence, others also contain items that offer information to address specific conditions. The tools vary in terms of what they measure, including whether they capture barriers to nonadherence, self-efficacy and perceptions or beliefs about medications, which can be considered as consequences of medication adherence itself (54). Recently, new tools have been created to assess barriers to medication adherence, meeting the need for instruments that capture patients' challenges. Recent questionnaires assessing adherence barriers are the Adherence Barriers Questionnaire (ABQ) and the Identification of Medication Adherence Barriers Questionnaire (IMAB-Q). These questionnaires are suitable for assessing beliefs and concerns that may serve as barriers to medication adherence (55, 56). Research on medication adherence has expanded to include various questionnaires and validation techniques, aiming to enhance the accuracy and reliability of adherence assessments.

Systematic reviews, like those by Kwan et al., have highlighted the wide variety of tools available and the different methods used to validate them. However, despite the wealth of instruments at researchers' disposal, a significant challenge persists the need to meet the psychometric standards outlined for patient-reported outcome measures (PROMs). Many tools used to assess adherence don't always show key qualities like reliability, validity, and sensitivity. Filling these gaps is important for moving the field forward. It will help researchers use better, more consistent tools, which can make medication adherence assessments more reliable and accurate, ultimately improving patient care and outcomes (57, 58).

*Pill count* is an indirect and objective method that counts the number of taken dosage units between appointments and then compares it to the total received dosage from the patient. After that, the adherence ratio can be calculated. Although this method is inexpensive and easy to use, it also has certain limitations (38). Removing the correct dose from its container does not ensure that the medication is taken. This approach does not show a clear pattern of medication use and does not explain why a patient might not be following their prescribed treatment. This method often underestimates adherence because it calculates based only on the date of medication refill, ignoring any leftover

supply patients might have. Many patients with chronic illnesses refill their prescriptions early, leading to extra doses. Also, the standard for defining adherence is often chosen randomly, which could be more consistent in measuring and comparing adherence between studies (34).

*Electronic Medication Packaging (EMP) Devices* – Electronic adherence monitoring devices (EMDs) offer a more accurate way to track medication adherence by recording when a medication container is opened. The use of EMDs helps prevent overestimating medication adherence, which is common with self-reported measures. These devices can also detect intentional medication disposal, where patients may discard pills before doctor visits, a behavior that can often go unnoticed with other adherence measurement methods (27). EMDs are designed to track adherence directly through the medication's packaging. These devices have several key features: (a) they log each instance a dose is taken and store adherence records, (b) they provide audiovisual alerts to remind patients of upcoming doses, (c) they may have digital screens for easy monitoring, (d) support real-time tracking, and (e) deliver feedback on adherence patterns to patients and healthcare providers (56). Alder et al. categorized primary electronic adherence monitoring technologies into four main types: sensor-based systems, proximity sensors, vision-based technology, and fusion systems that integrate multiple sensing approaches to improve accuracy and reliability in tracking medication use (59). Smart pills, or digital ingestion monitoring systems, consist of a microsensor, an adhesive external monitor worn on the abdomen, and a mobile application (61). These ingestible devices, resembling small capsules, are swallowed like regular pills and travel through the digestive system, collecting data on physiological parameters (62). Encased within the medication, the micro-ingestible sensor is activated upon contact with stomach fluids after the capsule dissolves. It then transmits a unique signal to the external monitor, which records the ingestion event and sends the data, along with other physiological measurements like heart rate, to a mobile application. The app uploads this information to a central server, allowing real-time adherence monitoring. This technology provides a direct and objective method for tracking medication intake, improving adherence assessment, and potentially enhancing treatment outcomes (63–65). Researchers at Proteus Digital Health, Inc. (Redwood City, CA, USA) have developed a micro biosensor designed to be integrated into oral medications, such as pills or capsules, to monitor medication ingestion. Similarly, MyTMed is another adherence monitoring system that utilizes ingestible biosensors (60). Its core component is a digital capsule capable of encapsulating oral medications, allowing for real-time tracking of drug intake and improving adherence assessment. Biosensor-based techniques offer the advantage of accurately detecting medication ingestion in real time. However, their use raises concerns about patient privacy and autonomy, as these devices require direct ingestion, making them inherently intrusive (66, 67). One common EMD used in adherence research is the Medication Events Monitoring System (MEMS), which accurately tracks dosing activities for detailed analysis. The MEMS accurately tracks medication use by recording how often and consistently patients take their medication. It logs the date and time each

time a medication is used, helping to identify adherence patterns, including irregular or consistent nonadherence. Research has shown that the MEMS provides more useful information than self-reports or biochemical tests, as it uncovers patterns of missed doses or deviations from the prescribed schedule, especially in long-term treatments. This information helps identify areas where interventions may be needed (38). Despite its precision, the MEMS's high cost and logistical demands make it less appealing for extensive studies or routine applications. MEMS devices are expensive, and potential equipment loss or damage by patients adds to the costs (38, 59). Studies also incur equipment rental, data retrieval, and supporting patient compliance expenses. A 2001 study found that six months of MEMS usage cost $274 per patient to track adherence in schizophrenia treatment. Practical challenges include coordinating refills and ensuring patients use the device correctly to avoid inaccurate adherence classification (68).

*Insurance data, pharmacy refill data* – Data from pharmacy or insurance records, which include information on treatments, diagnoses, and medical history, can be used to study medication adherence patterns. This approach is especially useful for chronic diseases and polypharmacy, as it analyzes prescription refill patterns to estimate medication adherence. While this method helps in large studies and provides insights into adherence, it only estimates medication possession, not actual intake, which can lead to overestimations. It is useful, but adherence barriers must be addressed beyond demographics and treatment factors (69). Nonadherence metrics are commonly evaluated using the Proportion of Days Covered (PDC) and Medication Possession Ratio (MPR). The MPR generally reflects the percentage of days for which medication supply was obtained within a set timeframe. Different calculation methods for the MPR can affect results, so understanding these variations is essential. The PDC is the number of days the drug was available divided by the number of days in the study period. An 80% adherence threshold is typically used to classify patients as adherent or nonadherent, though some studies treat it as a continuous variable (35). To improve the consistency and accuracy of PDC reporting, Dalli et al. developed the TEN-SPIDERS framework. This tool outlines specific criteria for standardized reporting, with each letter representing essential components: Threshold, Eligibility, Numerator/denominator, Survival, Pre-supply, In-hospital supplies, Dosing information, Early refills, and Switching. By clarifying these aspects, the TEN-SPIDERS tool provides a structured approach to enable more accurate cross-study and cross-system comparisons of adherence data (70). Digital databases are also helpful in researching primary medication nonadherence (PMN) and secondary medication nonadherence.

### Improving adherence – Interventions

A better understanding and monitoring of medication adherence allow the development of more effective strategies to improve and maintain it. Some argue that improving adherence may substantially impact public health more than advances in specific medical treatments. As highlighted by a WHO report from 2003, “Enhancing the effectiveness of adherence interventions could have a far greater effect on population

health than any improvement in specific medical treatments" (34). Interventions to improve adherence are usually designed for different levels. Each level focuses on different adherence factors, creating a well-rounded approach to help patients stick to their medication plans.

*Regimen-based interventions* focus on optimizing the medication regimen itself to promote adherence. Reducing the number of daily doses or combining multiple medications into one, can significantly improve adherence (71). These strategies focus on making the treatment plan easier for patients to follow by reducing the complexity of dosing schedules or the number of medications. Several tools and formulations support this goal. Fixed-dose drug combinations (FDCs) reduce pill burden and dosing complexity by combining two or more active ingredients into a single pill. This strategy is particularly effective in managing chronic diseases such as hypertension, diabetes, and HIV, where long-term therapy is required (72). Pill boxes and medication organizers are simple, low-cost aids that help patients manage their medication schedules by separating doses by day and time. These tools are especially helpful for older adults and those taking multiple medications, reducing the risk of missed or double doses (73). Once-daily dosing regimens improve convenience and are consistently associated with better adherence compared to regimens requiring multiple daily doses. Reducing dosing frequency minimizes treatment burden and supports routine integration into patients' daily lives (74). Research by Boeni et al. showed that multidrug punch cards are a helpful intervention for supporting adherence, especially in primary care (75). They streamline complex regimens by organizing medications into a single card for easy daily use. These cards help patients stick to their medication schedules and feel more satisfied with their care, especially older adults managing multiple prescriptions. Healthcare providers should recommend them to patients with complex medication routines. Medication charts list patient medications, help with adherence, support care transitions, improve provider teamwork, and ensure accurate records (75, 76).

*Patient-level interventions* usually include reminders, personalized counseling, behavioral support, and education about the disease and treatment. These strategies have been shown to greatly improve adherence. It helps them to better understand their health and treatment. Research shows that counseling directly for patients can significantly improve adherence. Programs that combine medication management, patient education, and behavioral support have been proven to help people stick to their medication plans for chronic conditions. These approaches focus on personalized patient engagement, addressing both practical and behavioral factors that impact medication adherence, and are among the few interventions proven to enhance long-term medication management (77). Technological tools such as mobile apps, SMS reminders, and smart pillboxes have also been used to support adherence by sending prompts or tracking medication intake in real time. Gibson et al. reviewed asthma-related adherence studies, focusing on interventions grounded in self-management (78). Programs that successfully incorporated self-monitoring of peak expiratory flow rates or symptoms, routine medical reviews, and detailed action plans demonstrated significant health improvements.

These benefits included fewer nighttime asthma symptoms, reduced hospital visits, less time missed from work or school, and fewer physician consultations, particularly for adults with asthma (78–80).

*Provider-level interventions* focus on improving communication and encouraging shared decision-making with patients. By listening carefully and offering personalized support, providers can address health concerns and build a strong, collaborative relationship that helps patients take control of their health. A review by Conn et al. shows that provider-level interventions significantly enhance medication adherence by equipping healthcare providers with skills and support to monitor and address adherence issues actively (81). Studies show that when providers take a more active role in guiding patients, adherence improves, especially when the focus is on better communication and coordinated care. These approaches help build trust between providers and patients, creating a supportive environment where patients feel encouraged to manage their health. Patient-centered strategies and system-level changes, like continuous care and quality improvements, can boost adherence. Proper training and support for providers, customized to their roles, are essential for making long-lasting improvements in adherence (81).

*System-level interventions* include synchronizing medication refill dates, extending prescription durations, and improving access to healthcare. These strategies are designed to simplify the process and encourage regular medication use. On this way it can help patients manage their treatment plans more easily (27). The healthcare system and the quality of the patient-provider relationship shape patient adherence to prescribed treatments. The trust a patient places in their healthcare provider and the feeling of being heard play a key role in their willingness to follow medical advice. Also, when patients understand their diagnosis and why they need their treatments, they're more likely to follow their prescribed plan. These aspects of care create a sense of partnership and reassurance, helping patients feel more confident and motivated to stick to their medication plans (69). A study on patients' roles in a public healthcare system found at least ten key responsibilities (82). Many of these stress the importance of following healthcare providers' advice on treatment or lifestyle changes. This highlights the expectation that patients should follow the advice given by their healthcare provider. Fragmented healthcare systems make it harder for patients to adhere to their medications because of the gaps in care coordination and limited access to care. Lack of health information technology also means that healthcare providers can't easily access full patient records, which affects continuous care. Additionally, when providers have too many patients, they have less time to evaluate medication adherence properly. Since adherence is crucial for patient outcomes, healthcare systems need to improve by focusing on better care coordination, easier access to patient information, and allowing enough time to support adherence (15). Community pharmacists play a key role in supporting patients' adherence to prescribed treatments, which leads to better health outcomes. Their role in healthcare helps them address medication-related issues like managing medications and making sure patients follow their treatment plans. Baumgartner et al.

created a useful framework to improve medication adherence during patient visits to community pharmacies. This approach outlines adherence interventions into three key components: identifying *who* should be targeted, determining *how* to engage and support the patient, and assessing *how many* interventions are needed. This structured model provides a clear and manageable pathway for pharmacists to address adherence more effectively in everyday practice (83). Interprofessional collaboration improves patient care by allowing pharmacists to identify and resolve adherence barriers. They serve as a crucial link between the patient and the other healthcare team, helping to achieve the best treatment outcomes (83). A review by Rajiah et al. showed that community pharmacists play an important role in improving medication adherence and the proper use of medicines by providing effective patient counseling. This helps patients stick to their treatments, leading to better health outcomes. On the other hand, poor adherence can lead to health problems and higher healthcare costs. By focusing on patient-centered care and clear communication, pharmacists help guide patients toward better health and reduce the impact of illness. However, pharmacists also need to understand that changes in a patient's social or financial situation can affect their ability to follow treatment and manage their health (84).

### Limitations and Future Directions

Despite the importance of medication adherence, several limitations affect both measurement methods and interventions. One significant limitation is the variability in adherence definitions and assessment tools used across different studies, making it challenging to compare results or generalize findings. Furthermore, the complex and multifactorial nature of medication nonadherence presents a challenge for developing tailored interventions. Many studies focus on specific populations or conditions, which may limit the applicability of findings to broader patient groups. Finally, healthcare provider attitudes and the lack of time during consultations can hinder effective communication about medication adherence, impacting patients' understanding and motivation. Integrating medication adherence into health policy discussions is essential for increasing awareness and driving the implementation of effective strategies. Moving forward, the efforts should concentrate on enhancing the accuracy of adherence measurement and screening through the use of validated tools. Such improvements are necessary to better capture the complexities of patient behavior and develop targeted interventions.

## Conclusion

Medication adherence has been a long-standing challenge, and despite years of effort, it remains an unresolved issue. Improving medication adherence is a team effort. Healthcare professionals like doctors, pharmacists, and nurses all play an important role in supporting patients. To promote better outcomes, it's crucial to use different assessment tools that match the patient's needs, available resources and clinical context. Healthcare providers need to focus on adherence because it directly affects treatment success and

public health. Better adherence helps achieve the best results, prevents complications, lowers healthcare costs, and improves patients' quality of life. Addressing adherence should be a top priority in healthcare. It ensures that patients get the best care and stick to their treatment plans for long-term health benefits. While there are many ways to measure adherence, using them effectively is key to seeing real results. These methods should be part of routine healthcare practice in order to identify adherence issues. It's also important to use proven interventions to improve adherence. Combining reliable tools with effective strategies helps providers support patients, improve treatment success, and boost overall health outcomes.


## Acknowledgements

The authors have no acknowledgments to declare.


## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Author contributions

DM: conceptualization, literature review, and manuscript preparation;
KS, DGA, ZN: methodology and critical revision of the manuscript;
DM and BL: data interpretation, writing - review, and editing;
EDS and BA: supervision and final approval of the version to be submitted.

## References


1. Vervloet M, Linn AJ, van Weert JC, de Bakker DH, Bouvy ML, van Dijk L. The effectiveness of interventions using electronic reminders to improve adherence to chronic medication: a systematic review of the literature. J Am Med Inform Assoc. 2012;19(5):696–704. doi: 10.1136/amiajnl-2011-000748.
2. Wawruch M, Petrova M, Tesar T, Murin J, Schnorrerova P, Paduchova M, et al. Factors associated with non-adherence to angiotensin-converting enzyme inhibitors and angiotensin receptor blockers in older patients with peripheral arterial disease. Front Pharmacol. 2023;14. doi: 10.3389/fphar.2023.1199669.
3. Baryakova TH, Pogostin BH, Langer R, McHugh KJ. Overcoming barriers to patient adherence: the case for developing innovative drug delivery systems. Nat Rev Drug Discov. 2023;22(5):387–409. doi: 10.1038/s41573-023-00670-0.
4. Kleinsinger F. The unmet challenge of medication nonadherence. Perm J. 2018;22:18–33. doi: 10.7812/TPP/18-033.

5. Iuga AO, McGuire MJ. Adherence and health care costs. Risk Manag Healthc Policy. 2014;7:35–44. doi: 10.2147/RMHP.S19801.
6. Aljofan M, Oshibayeva A, Moldaliyev I, Saruarov Y, Maulenkul T, Gaipov A. The rate of medication nonadherence and influencing factors: A systematic review. Electron J Gen Med. 2023;20(3):em471.
7. Demonceau J, Ruppar T, Kristanto P, Hughes DA, Fargher E, Kardas P, et al. Identification and assessment of adherence-enhancing interventions in studies assessing medication adherence through electronically compiled drug dosing histories: A systematic literature review and meta-analysis. Drugs. 2013;73(6):545–62. doi: 10.1007/s40265-013-0041-3.
8. Gossec L, Tubach F, Dougados M, Ravaud P. Reporting of adherence to medication in recent randomized controlled trials of 6 chronic diseases: a systematic literature review. Am J Med Sci. 2007;334(4):248–54. doi: 10.1097/MAJ.0b013e318068dde8.
9. Lehmann A, Aslani P, Ahmed R, Celio J, Gauchet A, Bedouch P, et al. Assessing medication adherence: Options to consider. Int J Clin Pharm. 2014;36(1):55–69. doi: 10.1007/s11096-013-9865-x.
10. Kardas P. From non-adherence to adherence: Can innovative solutions resolve a longstanding problem? Eur J Intern Med. 2024;119:6–12. doi: 10.1016/j.ejim.2023.10.012.
11. Mechler K, Hage A. Drugs don't work in patients who don't take them. Z Kinder Jugendpsychiatr Psychother. 2019;47(6):528–34. doi: 10.1024/1422-4917/a000645.
12. Adherence to long-term therapies: evidence for action [Internet]. World Health Organization; 2003 [cited 2025 May 29]. Available from: https://iris.who.int/bitstream/handle/10665/42682/9241545992.pdf.
13. Tibble H, Flook M, Sheikh A, Tsanas A, Horne R, Vrijens B, et al. Measuring and reporting treatment adherence: What can we learn by comparing two respiratory conditions? Br J Clin Pharmacol. 2021;87:825–36. doi: 10.1111/bcp.14458.
14. Vrijens B, Dima AL, Van Ganse E, van Boven JFM, Eakin MN, Foster JM, et al. What We Mean When We Talk About Adherence in Respiratory Medicine. J Allergy Clin Immunol Pract. 2016;4(5):802–12. doi: 10.1016/j.jaip.2016.05.019.
15. Brown MT, Bussell JK. Medication adherence: WHO cares? Mayo Clin Proc. 2011;86(4):304–14. doi: 10.4065/mcp.2010.0575.
16. George M, Bender B. New insights to improve treatment adherence in asthma and COPD. Patient Prefer Adherence. 2019;13:1325–34. doi: 10.2147/PPA.S209532.
17. Jimmy B, Jose J. Patient medication adherence: measures in daily practice. Oman Med J. 2011;26(3):155–9. doi: 10.5001/omj.2011.38.
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):412–424. doi: 10.1016/j.ahj.2011.06.007.
19. van Boven JF, Tsiligianni I, Potočnjak I, Mihajlović J, Dima AL, Nabergoj Makovec U, et al. European Network to Advance Best Practices and Technology on Medication Adherence: Mission Statement. Front Pharmacol. 2021;12:748702. doi: 10.3389/fphar.2021.748702.
20. Arbuckle C, Tomaszewski D, Brown L, Schommer J, Morisky D, Parlett-Pelleriti C, Linstead E. Exploring the relationship of digital information sources and medication adherence. Comput Biol Med. 2019;109:303–310. doi: 10.1016/j.compbiomed.2019.04.023.

21. Partridge AH, Avorn J, Wang PS, Winer EP. Adherence to Therapy with Oral Antineoplastic Agents. J Natl Cancer Inst. 2002;94(9):652–61.
22. Kardas P, Lewek P, Matyjaszczyk M. Determinants of patient adherence: A review of systematic reviews. Front Pharmacol. 2013;4. doi: 10.3389/fphar.2013.00091.
23. Mondesir FL, Levitan EB, Malla G, Mukerji R, Carson AP, Safford MM, Turan JM. Patient perspectives on factors influencing medication adherence among people with coronary heart disease (CHD) and CHD risk factors. Patient Prefer Adherence. 2019;13:2017–27. doi: 10.2147/PPA.S222176.
24. Aljofan M, Oshibayeva A, Moldaliyev I, Saruarov Y, Maulenkul T, Gaipov A. The rate of medication nonadherence and influencing factors: A systematic Review. Electron J Gen Med. 2023;20(3):em471.
25. Chan AHY, Cooper V, Lycett H, Horne R. Practical barriers to medication adherence: What do current self- or observer-reported instruments assess? Front Pharmacol. 2020;11:572. doi: 10.3389/fphar.2020.00572.
26. Wroe AL. Intentional and unintentional nonadherence: a study of decision making. J Behav Med. 2002;25(4):355–72. doi: 10.1023/a:1015866415552.
27. Rusu RN, Ababei DC, Stanciu GD, Neamțu M, Macadan I, Anghel Lazăr CI, Bild V. Adherence to treatment – Reviewing methods of assessment and improvement. Farmacia. 2023;71(2):236–46.
28. Lehane E, McCarthy G. Intentional and unintentional medication non-adherence: a comprehensive framework for clinical research and practice? a discussion paper. Int J Nurs Stud. 2007;44(8):1468–77. doi: 10.1016/j.ijnurstu.2006.07.010.
29. Bae SG, Kam S, Park KS, Kim KY, Hong NS, Kim KS, et al. Factors related to intentional and unintentional medication nonadherence in elderly patients with hypertension in rural community. Patient Prefer Adherence. 2016;10:1979–89. doi: 10.2147/PPA.S114529.
30. Cutler RL, Fernandez-Llimos F, Frommer M, Benrimoj C, Garcia-Cardenas V. Economic impact of medication non-adherence by disease groups: a systematic review. BMJ Open. 2018;8:e016982. doi: 10.1136/bmjopen-2017-016982.
31. Arnet I, Haefeli WE. Compliance: Fakten Perspektiven. Manag Care. 1998;3:27–31.
32. Adams AJ, Stolpe SF. Defining and Measuring Primary Medication Nonadherence: Development of a Quality Measure. J Manag Care Spec Pharm. 2016;22(5):516–23. doi: 10.18553/jmcp .2016.22.5.516.
33. Kvarnström K, Westerholm A, Airaksinen M, Liira H. Factors Contributing to Medication Adherence in Patients with a Chronic Condition: A Scoping Review of Qualitative Research. Pharmaceutics. 2021;13(7). doi: 10.3390/pharmaceutics13071100.
34. Lam WY, Fresco P. Medication adherence measures: An overview. Biomed Res Int. 2015. doi: 10.1155/2015/217047.
35. Anghel LA, Farcas AM, Oprean RN. An overview of the common methods used to measure treatment adherence. Med Pharm Rep. 2019;92(2):117–22. doi: 10.15386/mpr-1201.
36. Osterberg L, Blaschke T. Adherence to medication. N Engl J Med. 2005;353:487–97. doi: 10.1056/NEJMra050100.

37. Avataneo V, De Nicolò A, Rabbia F, Perlo E, Burrello J, Berra E, et al. Therapeutic drug monitoring-guided definition of adherence profiles in resistant hypertension and identification of predictors of poor adherence. Br J Clin Pharmacol. 2018;84(11):2535–43. doi: 10.1111/bcp.13706.
38. Farmer KC. Methods for measuring and monitoring medication regimen adherence in clinical trials and clinical practice. Clin Ther. 1999;21(6):1074–90. doi: 10.1016/s0149-2918(99)80026-5.
39. Kang JS, Lee MH. Overview of therapeutic drug monitoring. Korean J Intern Med. 2009;24(1):1–10. doi: 10.3904/kjim.2009.24.1.1.
40. Simeoli R, Dorlo TPC, Hanff LM, Huitema ADR, Dreesen E. Editorial:Therapeutic Drug Monitoring (TDM): AUseful Tool for Pediatric Pharmacology Applied to Routine Clinical Practice. Front Pharmacol. 2022;13. doi: 10.3389/fphar.2022.931843.
41. Jung O, Gechter JL, Wunder C, Paulke A, Bartel C, Geiger H, Toennes SW. Resistant hypertension? Assessment of adherence by toxicological urine analysis. J Hypertens. 2013;31(4):766–74. doi: 10.1097/HJH.0b013e32835e2286.
42. Gross AS. Best practice in therapeutic drug monitoring. Br J Clin Pharmacol. 2001;52. doi: 10.1046/j.1365-2125.2001.0520s1005.x.
43. DiPiro JT, Spruill WJ, Blouin RA, Wade WE, Pruemer JM. Introduction to pharmacokinetics and pharmacodynamics. In: DiPiro JT, Spruill WJ, Blouin RA, Wade WE, Pruemer JM, editors. Concepts in Clinical Pharmacokinetics. Bethesda: ASHP; 2002; pp. 1–11.
44. Basu S, Garg S, Sharma N, Singh MM. Improving the assessment of medication adherence: challenges and considerations with a focus on low-resource settings. Tzu Chi Med J. 2019;31(2):73–80. doi: 10.4103/tcmj.tcmj_177_18.
45. Vermeire E, Hearnshaw H, Van Royen P, Denekens J. Patient adherence to treatment: three decades of research. A comprehensive review. J Clin Pharm Ther. 2001;26(5):331–42. doi: 10.1046/j.1365-2710.2001.00363.x.
46. Forbes CA, Deshpande S, Sorio-Vilela F, Kutikova L, Duffy S, Gouni-Berthold I, et al. A systematic literature review comparing methods for the measurement of patient persistence and adherence. Curr Med Res Opin. 2018;34:1613–25. doi: 10.1080/03007995.2018.1477747.
47. de Achaval S, Suarez-Almazor ME. Treatment adherence to disease-modifying antirheumatic drugs in patients with rheumatoid arthritis and systemic lupus erythematosus. Int J Clin Rheumatol. 2010;5:313–26. doi: 10.2217/ijr.10.15.
48. Garfield S, Clifford S, Eliasson L, Barber N, Willson A. Suitability of measures of self-reported medication adherence for routine clinical use: a systematic review. BMC Med Res Methodol. 2011;11. doi: 10.1186/1471-2288-11-149.
49. Stirratt MJ, Dunbar-Jacob J, Crane HM, Simoni JM, Czajkowski S, Hilliard ME, et al. Self-report measures of medication adherence behavior: recommendations on optimal use. Transl Behav Med. 2015;5(4):470–82. doi: 10.1007/s13142-015-0315-2.
50. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. Med Care. 1986;24(1):67–74. doi: 10.1097/00005650-198601000-00007.
51. Park SP, Lee EYJ. How should medical researchers respond to false copyright infringement claims? Sci Ed. 2019;6(2):137–41.

52. 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.
53. Tesfaye W, Peterson G. Self-reported medication adherence measurement tools: Some options to avoid a legal minefield. J Clin Pharm Ther. 2022;47(3):363–8. doi: 10.1111/jcpt.13515.
54. Nguyen TM, La Caze A, Cottrell N. What are validated self-report adherence scales really measuring?: a systematic review. Br J Clin Pharmacol. 2014;77(3):427–45.
55. Bhattacharya D, Brown TJ, Clark AB, Dima AL, Easthall C, Taylor N, Li Z. Validation of the Identification of Medication Adherence Barriers Questionnaire (IMAB-Q); a Behavioural Science-Underpinned Tool for Identifying Non-Adherence and Diagnosing an Individual's Barriers to Adherence. Patient Prefer Adherence. 2023;17:2991–3000. doi: 10.2147/PPA.S427207.
56. Müller S, Kohlmann T, Wilke T. Validation of the Adherence Barriers Questionnaire – an instrument for identifying potential risk factors associated with medication-related non-adherence. BMC Health Serv Res. 2015;15. doi: 10.1186/s12913-015-0809-0.
57. Gagnier JJ, Lai J, Mokkink LB, Terwee CB. COSMIN reporting guideline for studies on measurement properties of patient-reported outcome measures. Qual Life Res. 2021;30(8):2197–218. doi: 10.1007/s11136-021-02822-4.
58. Kwan YH, Weng SD, Loh DHF, Phang JK, Oo LJY, Blalock DV, et al. Measurement properties of existing patient-reported outcome measures on medication adherence: Systematic review. J Med Internet Res. 2020;22(10). doi: 10.2196/19179.
59. Checchi KD, Huybrechts KF, Avorn J, Kesselheim AS. Electronic medication packaging devices and medication adherence: a systematic review. JAMA. 2014;312(12):1237–47. doi: 10.1001/jama.2014.10059.
60. Aldeer M, Javanmard M, Martin RP. A Review of Medication Adherence Monitoring Technologies. Appl Syst Innov. 2018;1(2). doi: 10.3390/asi1020014.
61. Al Shammari YH, Al Shammari HA, Barak TMB, Alharbi BS, Alshammari ST, Alnais SA, et al. Smart pills: the future of adherence monitoring. Int J Health Sci. 2019;3:1–15. doi: 10.53730/ijhs.v3nS1.14916.
62. Kiourti A, Nikita KS. A review of in-body biotelemetry devices: Implantables, ingestibles, and injectables. IEEE Trans Biomed Eng. 2017;64:1422–30. doi: 10.1109/TBME.2017.2668612.
63. Park LG, Howie-Esquivel J, Dracup K. Electronic measurement of medication adherence. West J Nurs Res. 2015;37(1):28–49. doi: 10.1177/0193945914524492.
64. Chai PR, Rosen RK, Boyer EW. Ingestible biosensors for real-time medicaladherence monitoring: MyTMed. Proc Annu Hawaii Int Conf Syst Sci. 2016;2016:3416–23. doi: 10.1109/HICSS.2016.426.
65. Eisenberger U, Wüthrich RP, Bock A, Ambühl P, Steiger J, Intondi A, et al. Medication adherence assessment: high accuracy of the new Ingestible Sensor System in kidney transplants. Transplantation. 2013;96(3):245–50. doi: 10.1097/TP.0b013e31829b7571.
66. Trappe W, Howard R, Moore RS. Low-energy security: Limits and opportunities in the Internet of things. IEEE Secur Priv. 2015;13:14–21. doi: 10.1109/MSP.2015.7.
67. Silva DS, Snyder J. The ethics of new technologies to track drug adherence. CMAJ. 2018;190(40):1209–10.

68. Diaz E, Levine HB, Sullivan MC, Sernyak MJ, Hawkins KA, Cramer JA, Woods SW. Use of the medication event monitoring system to estimate medication compliance in patients with schizophrenia. J Psychiatry Neurosci. 2001;26(4):325–9.
69. Schnorrerova P, Matalová P, Wawruch M. Medication adherence: Measurement methods and approaches. Bratisl Lek Listy. 2024;125(4). doi: 10.4149/BLL_2024_40.
70. Dalli LL, Kilkenny MF, Arnet I, Sanfilippo FM, Cummings DM, Kapral MK, et al. Towards better report-ing of the proportion of days covered method in cardiovas-cular medication adherence: A scoping review and new tool TEN-SPIDERS. Br J Clin Pharmacol. 2022;88(10):4427–42. doi: 10.1111/bcp.15391.
71. Stirratt MJ, Curtis JR, Danila MI, Hansen R, Miller MJ, Gakumo CA. Advancing the science and practice of medication adherence. J Gen Intern Med. 2018;33(2):216–22. doi: 10.1007/s11606-017-4198-4.
72. Claxton AJ, Cramer J, Pierce C. A systematic review of the associations between dose regimens and medication compliance. Clin Ther. 2001;23(8):1296–310. doi: 10.1016/s0149-2918(01)80109-0.
73. George J, Elliott RA, Stewart DC. A systematic review of interventions to improve medication taking in elderly patients prescribed multiple medications. Drugs Aging. 2008;25(4):307–24. doi: 10.2165/00002512-200825040-00004.
74. Ingersoll KS, Cohen J. The impact of medication regimen factors on adherence to chronic treatment: a review of literature. J Behav Med. 2008;31(3):213–24. doi: 10.1007/s10865-007-9147-y.
75. Boeni F, Hersberger KE, Arnet I. Multidrug punch cards in primary care: A mixed methods study on patients' preferences and impact on adherence. Front Pharmacol. 2014;5. doi: 10.3389/fphar.2014.00229.
76. Dietrich FM, Hersberger KE, Arnet I. Benefits of medication charts provided at transitions of care: A narrative systematic review. BMJ Open. 2020;10(10). doi: 10.1136/bmjopen-2020-038037.
77. Viswanathan M, Golin CE, Jones CD, Ashok M, Blalock SJ, Wines RC, et al. Interventions to improve adherence to self-administered medications for chronic diseases in the United States: a systematic review. Ann Intern Med. 2012;157(11):785–95. doi: 10.7326/0003-4819-157-11-201212040-00538.
78. Gibson PG, Powell H, Wilson A, Abramson M, Haywood P, Bauman A, et al. Self-management education and regular practitioner review for adults with asthma (review). Cochrane Database Syst Rev. 2003. doi: 10.1002/14651858.CD001117.
79. Kotses H, Bernstein IL, Bernstein DI, Reynolds RV, Korbee L, Wigal JK, et al. A self-management program for adult asthma. Part I: development and evaluation. J Allergy Clin Immunol. 1995;95(2):529–40. doi: 10.1016/S0091-6749(95)70081-6.
80. Taitel MS, Kotses H, Bernstein IL, Bernstein DI, Creer TL. A self-management program for adult asthma. Part II: cost-benefit analysis. J Allergy Clin Immunol. 1995;95(3):672–6. doi: 10.1016/S0091-6749(95)70297-0.
81. Conn VS, Ruppar TM, Enriquez M, Cooper PS, Chan KC. Healthcare provider targeted interventions to improve medication adherence: systematic review and meta-analysis. Int J Clin Pract. 2015;69(8):889–99. doi: 10.1111/ijcp.12632.
82. Evans HM. Do patients have duties? J Med Ethics. 2007;33(12):689–94. doi: 10.1136/jme.2007.021188.

83. Baumgartner PC, Comment N, Hersberger KE, Arnet I. Development and testing of a framework for defining a strategy to address medication adherence during patient encounters in community pharmacies. Explor Res Clin Soc Pharm. 2022;5:100123. doi: 10.1016/j.rcsop.2022.100123.
84. Rajiah K, Sivarasa S, Maharajan MK. Impact of Pharmacists' Interventions and Patients' Decision on Health Outcomes in Terms of Medication Adherence and Quality Use of Medicines among Patients Attending Community Pharmacies: A Systematic Review. Int J Environ Res Public Health. 2021;18(9):4392. doi: 10.3390/ijerph18094392.

# Pregled pridržavanja terapije: metode merenja i intervencije

**Dijana Miceva[1]*, Katarina Smilkov[1], Darinka Gjorgieva Ackova[1], Zorica Naumovska[2], Biljana Lazarova[1, 3], Bistra Angelovska[1], Elena Drakalska Sersemova[1]**

[1]Fakultet za medicinske nauke – Univerzitet „Goce Delčev", Štip, Krste Misirkov 10-A, 2000 Štip, Severna Makedonija

[2]Farmaceutski fakultet – Univerzitet „Sv. Kiril i Metodij" u Skoplju, Majka Tereza 47, 1000 Skoplje, Severna Makedonija

[3]Klinička bolnica, Ljuben Ivanov bb, 2000 Štip, Severna Makedonija

*Autor za korespondenciju: Dijana Miceva, e-mail: dijana.miceva@ugd.edu.mk

## Kratak sadržaj

Pridržavanje propisanoj terapiji (adherenca) je od ključne važnosti za postizanje njenih ciljeva. Međutim, mnogi pacijenti se ne pridržavaju propisanog režima uzimanja lekova. Oko 50% pacijenata ne prati propisani režim uzimanja terapije, što čini adherencu rasprostranjenim problemom. Precizno praćenje adherence je od suštinskog značaja za planiranje delotvorne nege i intervencije. Ovaj rad daje pregled različitih metoda za procenu adherence, ističući prednosti i nedostatke svakog pristupa. Brojni faktori mogu uticati na adherencu. Ovaj pregled je usmeren na praktične načine merenja adherence i strategije za njeno unapređenje, naglašavajući njen značaj u postizanju boljih zdravstvenih rezultata. Zdravstveni radnici moraju dati prioritet adherenci jer ona direktno utiče na ishode lečenja i ukupne rezultate u javnom zdravlju.

**Ključne reči:** pridržavanje terapije, metode, intervencije, faktori