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REVIEW

Medication adherence: measurement methods and approaches

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ABSTRACT
Medication adherence is crucial for optimal treatment outcomes, yet many patients struggle to follow their prescribed regimens, impacting patients, families, and healthcare systems. Measurement of adherence is vital for effective care planning and intervention. This review explores medication adherence challenges and measurement methods, including therapeutic drug monitoring (TDM), medication event monitoring system (MEMS), analysis of adherence in insurance/pharmacy database, pill counts, and self-reports, each with its advantages and limitations.
This review advocates a partnership-based approach to adherence, stressing standardized reporting and team-based care. Adherence is influenced by many factors such as complex regimens, packaging, patient perspectives, side effects. Effectively addressing these factors is crucial for improving patient outcomes. In summary, medication adherence is vital but complex. The article covers various adherence measurement methods to promote medication adherence as an important matter *(Tab. 5, Fig. 2, Ref. 91)*. Text in PDF *www.elis.sk*
KEY WORDS: medication adherence, adherence barriers, primary non-adherence, medication event monitoring system, pill count, self-report.

Introduction

Distinguishing between "compliance" and "adherence" transcends mere semantics; it embodies a fundamental perspective shift essential for fostering a collaborative patient-provider relationship (1, 2). Medication adherence, the extent to which patients follow their prescribed medication regimens, plays a crucial role in achieving optimal therapeutic outcomes and improving overall patient health. However, studies consistently show that a significant proportion of patients fail to adhere to their medication plans (3–5).

The impact of medication non-adherence goes beyond just the patient, affecting healthcare providers, physicians, community pharmacists, caregivers, and families (6, 7). Based on a retrospective analysis by Arbuckle et al, nearly half of individuals using chronic prescription medications exhibit some form of non-adherence. This non-adherence leads to poor health-related outcomes, increased disease progression, greater healthcare service utilization, escalated care costs, and elevated mortality rates (8, 9) According to a review by Ingerski et al 50–55% of pediatric population and their families do not adhere to prescribed treatment plans, leading to many serious consequences such as a heightened risk of relapse of the disease, changes of the treatment regimen and drug resistance development (10). The underlying causes of nonadherence are not fully understood, but research suggests that individual perceptions and attitudes toward pharmaceutical interventions and the healthcare industry contribute significantly to this issue (8). Accurate assessment of adherence behavior is valuable for creating effective and optimized treatment plans. It enables the accurate attribution of changes in health outcomes to the prescribed regimen. The usefulness of medication adherence measurements depends on the validity and reliability of these measurements when making decisions about potential changes to recommendations, medications, or communication strategies to enhance patient engagement (11–13). One of the key challenges in promoting adherence is to obtain accurate insights into adherence rates and the factors that contribute to non-adherence. Numerous measures are available to effectively assess patient medication adherence (14, 15). The growing use of medication adherence monitoring technologies shows promise in enhancing patient adherence and ultimately improving long-term health outcomes. The selection of the adherence measurement method holds significance, as it can unintentionally impact results. For instance, patient self-reports might lead to under-reporting or over-reporting, while electronic

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medication monitors could register container openings without confirming actual consumption (16–18).

This article aims to provide a review of medication adherence and its measurements, highlighting their benefits, limitations, and its significance for clinical practice.

Methods

The review does not serve as an official evidence-based guideline but rather offers guidance for future research and clinical practice to researchers and healthcare professionals. Relevant literature on medication adherence and its measurement was identified on 6.7.2023 through a PubMed database search conducted from January 2003 to July 2023. The search was done using these keywords: (adherence OR medication adherence) AND (medication adherence assessment methods) AND (medication adherence treatment). The enclosed articles consisted of both original research studies and literature reviews reporting the use of specific adherence assessment tools. These tools encompassed self-report methods, pill counts, medication event monitoring systems (MEMS), electronic monitoring devices, therapeutic drug monitoring (TDM), as well as pharmacy records and insurance databases. Inclusion criteria consisted of articles in English, clear study design and methodology descriptions, available abstracts, reports of the adopted tools in the study with reliability and validity descriptions, and review papers focusing on medication adherence and its measurement. Duplicate articles were excluded.

Uncovering the medication adherence: Factors and challenges

Achieving consistent medication adherence poses a multifaceted challenge for patients. Dosage regimens and the number of prescribed medicines can impact adherence, with complex regimens often leading to difficulties in following prescribed schedules. Packaging and visual aids play a crucial role in patient comprehension and organization. Functional abilities and cognitive functions can affect patients' ability to manage their medications effectively. Lifestyle choices, asymptomatic illness, and lack of knowledge about the importance of adherence can also contribute to non-adherence. Patients' perceptions of their illnesses and beliefs about medications influence their motivation to adhere to treatment. Additionally, concerns about medication adverse effects may lead to premature discontinuation of therapy in some individuals. The societal stigma linked to certain illnesses has been recognized as a potential driver of non-adherence in numerous cases (e.g., patient's social environment holding a pessimistic view of psychiatric treatment, concerns about revealing and a desire to avoid taking medication in public) (19, 20). Economic factors, such as unemployment, poverty, inadequate medical or prescription coverage, and high medication costs, are substantial contributors to non-adherence. On the other hand, in the review of systematic reviews Kardas et al, have also emphasized the positive influence of family and social support on adherence, contrasting it with the detrimental effects of its absence. Gender, in many cases, was considered irrelevant for adherence. Understanding and address-

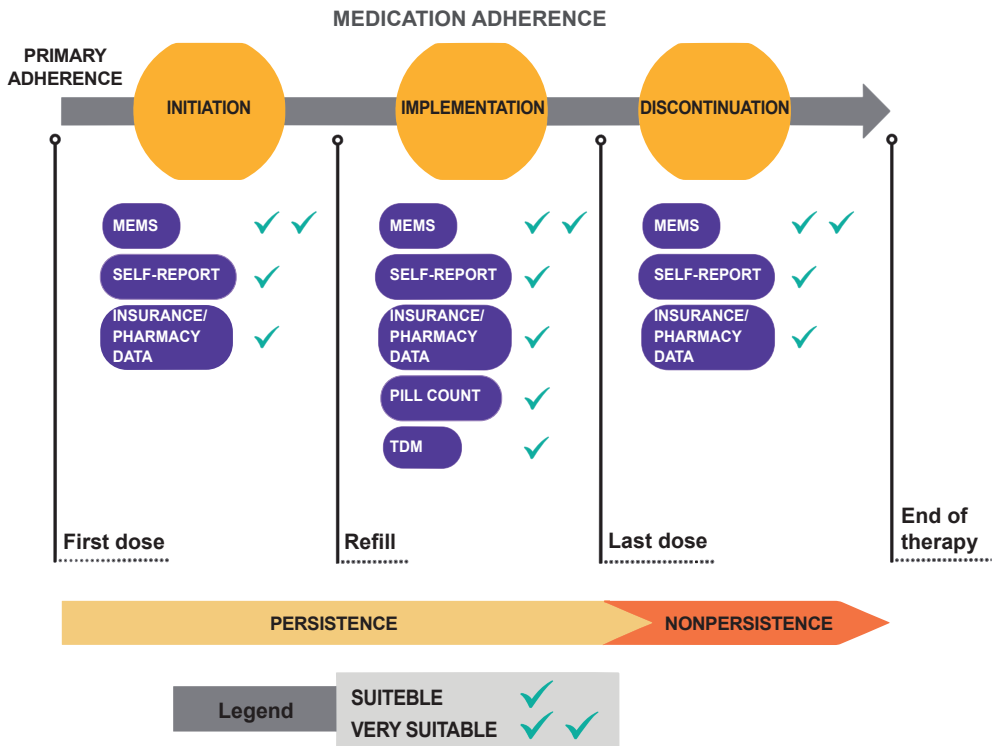

Fig. 1. Illustration of the process of medication adherence with suitable measurement methods to each phase modified according to Schulz et al (29) and Eliasson et al (28).

ing these multifaceted factors are essential in developing tailored measures and interventions to improve medication adherence and ultimately enhance patient outcomes (19, 21–23). As per the 2003 World Health Organization (WHO) report, adherence is a multidimensional phenomenon influenced by five sets of factors, termed "dimensions": Health system/ healthcare team factors, social/economic factors, condition-related factors, therapy-related factors, and patient-related factors. The mistaken belief that patients bear sole responsibility for treatment adherence overlooks how other factors impact behavior and capacity to adhere to treatment. The misconception traditionally attributes adherence to being solely driven by patients (11, 24, 25).

The International Society for Medication Adherence (ESPACOMP) adopts in Medication Adherence Reporting Guideline (EMERGE) a three-phase classification (The ABC taxonomy) of medication adherence, dividing it into (a) initiation, (b) implementation, and (c) discontinuation. Non-adherence to medication can manifest in various ways within these phases, including late or incomplete initiation, noninitiation, suboptimal implementation of the dosing regimen (e.g., late, skipped, extra, or reduced doses or drug holidays), or early discontinuation (non-persistence). In each phase, distinct methodological challenges arise concerning how medication use is defined, measured, and analyzed (26, 27). In clinical trials adherence measures serve as critical tools for the assessment of medication adherence and the identification of causative factors for non-adherence. Figure 1 provides an overview of the phases of medication adherence, with each phase accompanied by appropriate measurement methods (28–30).

Additionally, Vrijens et al, introduced a transparent taxonomy upon three key components that distinguish routine-based processes ('Adherence to medications' and 'Management of adherence') and the discipline that investigates these processes ('Adherence-related sciences') (31).

Arnet and Haefeli introduced the concept of eight forms of non-adherence, providing comprehensive insights into non-adherence behavior by describing situations where a patient's deviates from the considered optimal adherence (Fig. 2) (32).

One significant insight into medication adherence arises from the work of Blaschke et al, who analyzed a cohort of 16,907 participants from 95 clinical studies covering 30-1,400 days of follow-up. The persistence line shows how participants progressively adhere less to the prescribed dosing schedule as time progresses. Within a year, nearly 40% of trial participants had discontinued medication regardless of the ongoing regimen. The initial small drop signifies those never starting the regimen (4%). Following the curve, the decline gradually occurs, with, for instance, only 80% persisting at day 100, while 20% discontinue treatment (33).

Fig. 2. Illustrates in the word 'non-adherence,' eight forms of non-adherence, modified and adapted from Arnet et al.'s classification. The 'NON' type represents primary non-adherence, where the prescribed medication is unused or not picked up from the pharmacy. Type 'A' refers to 'drug holidays,' where the patient occasionally interrupts long-term medication recommendations. 'D' signifies the 'toothbrush effect,' resembles the common behavior before a dentist appointment: shortly before the appointment, the patient starts following the doctor's recommendation, which they otherwise largely ignore. 'H' represents perfect adherence but with the wrong medication. 'E,' 'R,' and 'E' denote dosage errors: overdose, underdose, and erratic dosing, respectively. 'N' involves incorrect dosing frequency, such as taking medication twice a day instead of the prescribed three times. 'C' signifies early therapy discontinuation. Lastly, 'E' represents a medication cocktail or polypharmacy pattern." (32).

Primary medication non-adherence (PMN)

PMN refers to the scenario in which the first prescription for a new medication is not fulfilled. This PMN is a significant yet underexplored contributor to reduced pharmacotherapy effectiveness. Many studies in medication adherence research concentrate on uncovering factors and consequences linked to what's known as "secondary" adherence. This applies to whether patients refill their prescriptions after the initial fill and adhere to the prescribed medication regimen. These studies examine the quality of execution and instances of discontinuation that do not align with the prescriber's intent. Existing research indicates a significant occurrence of PMN. The comprehensive review by Schulz and Laufs addresses the gap of various factors that contribute to the individual risk of primary non-adherence, with for example lipid-lowering drugs showing a higher rate of primary medication non-adherence compared to antihypertensive medications. One possible reason is that statins are frequently prescribed for primary prevention. However, the overall prevalence of primary non-adherence exceeds 10%. As e-prescribing gains prominence in prescription transmission, it is important to have standardized tracking methods for PMN to be able to evaluate the effectiveness of interventions aimed at reducing PMN (29, 34, 35).

Is there the "best" adherence measure?

In the context of evaluating medication adherence, the selection of assessment methods significantly influences the quality of obtained data. Accurate assessment of adherence is crucial for both researchers and clinicians. Medication adherence can be assessed through both (a)direct and (b)indirect methods. Direct measures of adherence include therapeutic drug monitoring (TDM) – medication analyses of blood or urine, use of medication markers with the target medication, and direct observation of the patient receiv-

ing the medication. Indirect measures represent the predominant means of evaluating medication adherence. It indicates that the medication has been used by the patient. These measures include various forms of subjective self-reporting by the patient such as questionnaires and interviews. They also cover objective measures like pill counts, use of electronic monitoring devices, and retrospective analyses of prescription records and claims databases or health insurance databases. Assessing adherence can be challenging in resource-limited healthcare settings, such as small rural clinics or marginalized communities, that lack electronic databases, unless data digitization becomes more commonly used. Nevertheless, refining self-report measures through effective interview techniques and questionnaire validation can enhance the evaluation of medication adherence and comprehension of causal factors (36–40). Highlighted by Vrijens, several distinct approaches have been employed, each resulting in differing degrees of reliability and comprehensiveness. Among the reliable methods characterized by sparse sampling are therapeutic drug monitoring and pharmacy refill data, which provide valuable insights into adherence patterns. Alternatively, the utilization of a "Smart package" offers a reliable approach with rich sampling, automatically compiling detailed dosing history data. However, it is essential to acknowledge the potential biases introduced by certain methods. Biased approaches with sparse sampling, including retrospective questionnaires and pill counts, may not capture the complete adherence landscape. On the other hand, biased approaches with extensive data collection, such as patient diaries, questionnaires, and surveys, provide a better understanding of adherence behaviors (41,42).

Key characteristics of adherence measures include the origin of medication adherence data, the name of the instrument, the time frame it refers to, the scale used, validity assessments, statistical methodologies (including intention-to-treat analysis, specific statistical tests used, handling of missing data, total participant count, and statistical power examination), and medication adherence findings (pre-intervention and post-intervention measurements). In the systematic review and meta-analysis Zomahoun et al, pointed out that medication adherence is typically treated as a continuous variable in other cases in some studies individuals were dichotomized as adherent or non-adherent determined by whether they met or surpassed a specified threshold in terms of the proportion of medication intake (43,44).

Therapeutic drug monitoring (TDM)

TDM is a systematic approach that measures the concentration of specific medications in the blood or urine at prescribed intervals, providing valuable insights into the actual intake of medication by the patient. This evaluation, when appropriately interpreted in the context of the medicine's pharmacokinetic/pharmacodynamic (PK/PD) characteristics, is designed to optimize personalized dosage regimens. Yet, finding the optimal dosing for therapeutic exposure remains complex due to factors like age, genetics, and health conditions influencing outcomes (45, 46).

Usage of TDM is primarily focused on the surveillance of medications characterized by a narrow therapeutic range, those exhibiting pronounced pharmacokinetic variability, and those associated with an elevated frequency of adverse reactions. The advantages of TDM include its ability to confirm drug utilization, potentially detecting or preventing drug toxicity that could otherwise result in non-adherence. This approach is particularly suitable for patient populations experiencing alterations in pharmacokinetics (e.g., patients with kidney and liver disease). However, TDM does come with its drawbacks. It is a costly and invasive method, applicable to only a limited selection of drugs. Additionally, it provides insights only into momentary adherence patterns, lacking a comprehensive view of long-term behavior (Tab. 1) (38, 45).

Medication event monitoring system (MEMS)

MEMS technology consists of medication packaging containing a microprocessor that records and timestamps each instance the package is opened. Subsequently, this data is transferred to a computer for further analysis (47, 48). The continuous tracking of patient dosing histories through electronic monitoring has consistently highlighted the prevalence of irregular intake behaviors. These irregularities include spectrum of deviations from the prescribed regimen, challenging the simplistic 'good' vs. 'poor' adherer classification. Notably, under-dosing, when compared to the prescribed regimen, emerges as a considerably more frequent occurrence than over-dosing. Additionally, the issue of under-dosing becomes progressively more pronounced in terms of both prevalence and severity within drug regimens designed for extended or lifelong use. Various methods have been employed to

Tab. 1. TDM and its advantages and limitations.

METHOD	ADVANTAGES	LIMITATIONS
Therapeutic drug monitoring (TDM)	Confirms drug utilization	Costly and invasive
	Detects/prevents drug toxicity	Applicable to a limited selection of drugs
	Suitable for patients with altered pharmacokinetics	Provides momentary adherence data only
		Lacks a comprehensive view of long-term behavior

Tab. 2. MEMS and its advantages and limitations.

METHOD	ADVANTAGES	LIMITATIONS
Medication event monitoring system (MEMS)	Records precise date and time of medication intake	No ability to characterize adherence patterns or causes
	Highlights irregular intake behaviors	Under-dosing more frequentthan over-dosing
	Provides unbiased data on intervals between doses over prolonged periods	Issue of under-dosing in extended/lifelong regimens

assess a patient's drug exposure, but electronic monitoring remains the only approach providing reliable, unbiased data regarding the intervals between successive doses over extended periods, earning it recognition as the gold standard (Tab. 2) (41).

Insurance data, pharmacy refill data

Data extraction from pharmacy or insurance databases is utilized to analyze medication-taking behavior, enabling retrospective analysis. This approach finds application in chronic diseases and cases involving polypharmacy. The benefits include the ability to scrutinize adherence and persistence, analyze clinical and sociodemographic factors impacting adherence, and facilitate easier data access for population differentiation (38, 49, 50).

Insurance databases enable the examination of implementation through metrics such as the Proportion of Days Covered (PDC) or the Medication Possession Ratio (MPR). The conventional PDC approach calculates the number of days between the first prescription fill date and a defined end date as the denominator, with the numerator representing the number of days covered by prescription fills during that period. Adherence rates are often assessed using specific thresholds to distinguish between adherent and non-adherent patients. The commonly used threshold is 0.8, with 0.95 frequently applied, particularly for medications requiring strict adherence (e.g., direct oral anticoagulants) (51–53). This measure is considered more precise than the MPR because it excludes overlapping supplies of medications and may overstate true adherence. Due to its accuracy and reliability, the PDC is endorsed by various organizations and authors as the preferred method for measuring adherence using administrative drug data (49, 54–56).

However, it's important to note that there is currently no universally agreed-upon or standardized method for calculating and reporting the PDC. This includes addressing complex medication-related issues such as existing medication supplies, early refills (stockpiling), and switching medications within the same pharmacological class (49, 57). Wawruch et al, conducted a study focused on analyzing and comparing non-adherence rates in older patients with peripheral arterial disease, who were either persistent or non-persistent with their statin treatment during a 5-year follow-up. The study shows the factors associated with non-adherence in both groups. The findings revealed a significantly higher proportion of non-adherent patients within the non-persistent group compared to the persistent group (43.6% vs 29.6%). The outcome of this database analysis enables us to indicate inadequate medication adherence behavior among non-persistent patients even during the persistent phase prior to discontinuation. However, limitations arise, as this method can only be employed within a closed database system, lacks assurance of actual medication intake by patients, and may potentially overstate adherence levels (Tab. 3) (49).

Pill count

Pill count, an indirect and objective approach, counts taken dosage units between appointments, later compared to the total received to calculate an adherence ratio. Its cost-effectiveness and simplicity contribute to its popularity, yet it has limitations. Not feasible for non-discrete dosages, this method often underestimates adherence due to its reliance on dispensed date without accounting for potential extra medication use. Especially for chronic patients, refilling before running out is common. The arbitrary adherence/non-adherence cutoff leads to a discrepancy (58). A pill count can take place either in a healthcare professional's office or during a home visit. An issue with conducting office-based pill counts is that individuals may not bring all their various prescriptions to the appointment. This limitation is less likely to occur during home visit pill counts; however, home visits pose challenges due to logistical inefficiencies, travel time, and associated expenses. An alternative approach is a telephone-based pill count, where the patient self-reports their medication count while receiving guidance from a healthcare professional or researcher over the phone. Multiple studies have demonstrated that a telephone pill count can serve as a valid alternative to traditional home visit pill counts (59–62). Pill count shares an assumption with MEMS – removal of a dosage unit equals medication intake. Nevertheless, unlike MEMS, pill counting lacks the capability to generate patterns. Correct dosage removal does not guarantee consistent dosing, and it cannot characterize adherence patterns or identify root causes (Tab. 4) (58).

Tab. 3. Insurance data, pharmacy refill data – advantages and limitations.

METHOD	ADVANTAGES	LIMITATIONS
Insurance data, pharmacy refill data	Enables retrospective analysis of medication-taking behavior	No universally agreed-upon method for calculating adherence metrics (e.g., PDC)
	Analyzes adherence and persistence	Doesn't ensure actual medication intake by patients
	Facilitates data access for population differentiation	May overstate adherence levels

Tab. 4. Pill count and its advantages and limitations.

METHOD	ADVANTAGES	LIMITATIONS
Pill count	Low cost and simple	Not suitable for non-discrete dosages
	Objective counting of dosage units	Underestimates adherence when patients refill before running out
	Calculates adherence ratio	Relies on arbitrary adherence cutoff
		Doesn't identify adherence patterns or cause

Self-report questionnaires, Self-report adherence scales

Self-report is the most frequently used indirect, subjective method of adherence measurement. The assessment of medication adherence often relies on diaries and structured questionnaires, which share both advantages and limitations. Self-reported questionnaires are commonly used in medication adherence research due to their cost-effectiveness and efficiency. These methods are convenient to administer through various channels, making them practical for clinical settings and large-scale epidemiological studies. However, its accuracy depends on various factors, including the patient's relationship with the healthcare professional, the communication skills of the healthcare professional conducting the interview, and the potential influence of "social desirability" bias on patient responses. The accuracy of self-report data collection relies on factors such as the quality of the assessment instrument, social desirability bias, the patient's memory or cognitive status. Self-report methods offer insights into patient adherence behavior and potential barriers, making them a valuable choice for researchers and relatively well-accepted by patients. However, researchers should be cautious about issues concerning the importance of rigorously evaluating existing self-report measurement instruments used in adherence research (38, 63–66).

Recent questionnaires assessing adherence barriers, including the "Adherence Barriers Questionnaire (ABQ)," and "The Identification of Medication Adherence Barriers Questionnaire (IMAB-Q)," have been introduced (67, 68). For adherence barriers of acute treatment of oral antibacterial therapy has the team of Haag et al developed a self-report questionnaire (BIOTICA) which provides hints about patients at risk for non-adherence at the point of medication dispense (67). Questionnaires are suitable for evaluating beliefs and concerns, such as barriers to medication adherence. After identifying these adherence barriers, healthcare providers can assist in addressing them and offer tailored interventions, particularly for at-risk patients (Tab. 5) (68–70).

Self-report adherence scales can serve the dual purpose of measuring medication-taking behavior and identifying barriers and beliefs linked to adherence. The choice of an adherence scale should be made after considering what aspects of adherence it evaluates and the extent of its validation. Research on self-report adherence scales for medication-taking behavior is extensive. However, there has been limited attention given to the role of scales that identify patient-specific barriers and beliefs in promoting informed medication use. This area presents a significant and promising path for further research (71, 72).

In the field of medication adherence research, researchers have conducted multiple questionnaires and validation efforts. Recent systematic reviews, such as the study by Kwan et al emphasize the diversity in questionnaires and validation methods, highlighting an unaddressed gap in fulfilling recommended measurement properties. This gap relates to psychometric properties for patient-reported outcome measures (PROM) (73). The diversity of available measures for medication adherence, each at varying stages of development and validation, limits researchers to few straightforward options for assessing medication adherence (73, 74).

Multi-approach setting

Dietrich et al, conducted a feasibility study on newly developed adherence monitoring package (AMoPac) to identify non-adherent patients with polypharmacy in primary care, highlighting the strengths and limitations of a multi-assessment approach to adherence with a potential to look deeper into the non-adherent patients (75). AMoPac was developed based on peer-reviewed literature, encompasses three essential elements: (1) electronically tracking patients' medication intake over a four-week period, (2) providing intake behavior feedback via pharmacists, and (3) generating an adherence report intended for communication with general practitioners (GPs). In the cases where no clinical explanation is evident, the typical response is to either increase the dosage or introduce a new medication to the treatment plan. With the utilization of AMoPac, GPs have the option to incorporate an adherence monitoring period prior to making adjustments to the therapy. This enables them to gain insights into non-response and non-adherence issues (75, 76). In a multi-approach setting, where non-adherence to medication can be attributed to a diverse range of factors, encompassing both unintentional and intentional aspects,

Tab. 5. Self-report adherence measurements and their advantages and limitations.

METHOD	ADVANTAGES	LIMITATIONS
DIARIES AND STRUCTURED QUESTIONNAIRES	Cost-effective and efficient	Limited accuracy due to self-report
	Convenient administration	Affected by patient-provider relationship
	Practical for clinical settings and large-scale studies	Risk of overestimation or underestimation
	Provides insights into patient adherence behavior	Vulnerable to social desirability bias
	Identifies adherence barriers	Validity influenced by cognitive status
	Supports tailored interventions	Limited differentiation among diseases in the elderly
	Useful for research and clinical practice	Does not directly measure adherence
ADHERENCE BARRIER QUESTIONNAIRES	Assesses beliefs and concerns	Does not directly measure adherence
	Identifies specific reasons for nonadherence	Subjective and reliant on self-report
	Supports targeted interventions	
SELF-REPORT ADHERENCE SCALES	Measures medication behavior and barriers	Choice must align with assessment goal
	Identifies patient-specific barriers and beliefs	Limited focus on promoting informed use
	Strong validation for medication behavior	

(77, 78) it becomes apparent that a singular approach may not yield significant improvements. In this context, Demonceau et. al suggest the strategy which involves:

1. The identification of individuals exhibiting suboptimal adherence to their prescribed medication.
2. A comprehensive analysis of the underlying causes contributing to their non-adherence.
3. The development of tailored interventions designed to address the unique needs of these patients, considering the multifaceted nature of their non-adherence (77).

Aspects Linked to Health System/Team Building

The patient-physician dynamic, as well as the broader healthcare system, influence patient trust in healthcare advice and adherence to prescribed medications. The significance of trust and confidence in the physician, the experience of being heard and having worries addressed, along with the patients' convictions, and the assurance in the diagnosis and comprehension of the purpose behind a prescribed medication, all play a pivotal role in patient adherence (79–81).

Nevertheless, community pharmacists play a crucial role in motivating patients to consciously adhere to their prescribed treatment plans. The collaboration between professions itself can contribute to patient benefits and pharmacists are well-suited to address non-adherence due to resolving drug-related problems, including difficulties with medication management and intake (82). Baumgartner et al have developed feasible framework for defining a strategy to address medication adherence during patient's visit to the community pharmacy, simplifying the approach to medication adherence with three components: Who, How, and How many (83). Each pharmacy team can customize these components to match their unique patient, provider, and system characteristics (82, 83).

The role of pharmacists has evolved beyond medication dispensing to encompass direct patient care responsibilities in primary care, complementing physicians' skills. Pharmacists serve as valuable team members, contributing to cost reduction and improved healthcare quality (84, 85).

Fragmented healthcare systems pose obstacles to medication adherence, limiting both care coordination and patient access. Widespread health information technology deficiency prevents easy access to patient information across various care settings, negatively affecting care quality, medication refills, and communication. The strain on healthcare systems with a high patient load often results in insufficient time for healthcare professionals to comprehensively assess patient medication behavior. Consequently, discussions about adherence importance and strategies are compromised. Healthcare systems must prioritize medication adherence, allocating sufficient time for adherence discussions through the implementation of team-based care strategies. Empowering non-physician staff to handle certain tasks can afford physicians more time for crucial adherence discussions (86–89).

Patients' records, whether in paper-based or electronic health records, often lack critical information regarding medication adherence. This deficiency poses a significant challenge for physicians who find it exceedingly difficult to objectively assess their patients' medication intake behavior, resulting in uncertainty about the effectiveness of any interventions. As a result, the well-known saying, "you can't improve what you can't measure", retains its significant relevance. Currently, there are no established standards for reporting patient adherence data to healthcare professionals, with only sporadic examples mentioned in the literature (90, 91).

Conclusion and perspectives

Medication adherence is a critical factor for therapeutic success, yet many patients struggle with it, affecting healthcare providers, patients, their families, and healthcare systems. Accurate and validated adherence measurements are essential, and a multi-approach strategy can provide deeper insights. Collaboration among healthcare professionals, especially physicians, nurses, and pharmacists, is crucial for addressing non-adherence. Moreover, the implementation of standardized reporting forms can simplify the evaluation of adherence and strengthen care coordination, ultimately leading to improved patient outcomes.

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