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Review Article

Comparison of Medication Adherence Assessment Tools in Patients: A Review

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ABSTRACT

Medication adherence is an essential component of therapeutic success, and interest in this issue is growing among patients with long-term treatment for chronic diseases. Because no universally accepted gold standard exists, adherence may be assessed using direct or indirect, objective or subjective approaches. Self-report measures are most widely used because they are convenient, affordable, and often capture behavior, barriers, and beliefs. However, various tools measure various constructs and therefore they should not be treated as interchangeable. This article aims to compare on the commonly used medication adherence assessment tools, including the Medication Adherence Questionnaire (MAQ), Morisky Medication Adherence Scale (MMAS-4 and MMAS-8), Brief Medication Questionnaire (Brief BMQ), Hill-Bone Compliance Scale, Medication Adherence Rating Scale (MARS-5), Adherence to Refills and Medications Scale (ARMS), Self-Efficacy for Appropriate Medication Use Scale (SEAMS), and Beliefs about Medicines Questionnaire (BMQ-Specific). Findings from the provided study and additional systematic reviews indicate substantial variation in domains, scoring, disease applicability, psychometric evidence and practical utility. The central implication is that tool selection should be driven by the research question, population, literacy, required domains, validation evidence and available resources rather than by popularity alone.

INTRODUCTION

Medication adherence is the degree to which a person's actual behavior of taking medication matches the recommendations agreed upon with a healthcare provider [2]. It is a multidimensional process. A patient might fail to start treatment,

might not carry out the prescribed regimen properly, or might stop the treatment before the intended time. As a result, assessing adherence is more complicated than just finding out whether or not a patient takes their medicines [4,5].

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Non-adherence to medication is common and can lead to poor control of the disease, to complications that are preventable and to greater use of healthcare services. It is therefore important to carry out accurate assessments in order to identify those patients who need counselling, having their regimen simplified, receiving adherence–support interventions or requiring further clinical assessment ^[1,2].

A key difficulty is that there is no single adherence measure that works well in all situations. Although objective methods can offer better evidence of actual medication-taking behavior, subjective methods

can give information on the purpose of the assessment and, where possible, complementary methods should be combined ^[1,3].

The systematic review by Nguyen et al. identified 43 self-report adherence scales across 60 articles and showed that these instruments do not all measure the same construct. Some primarily measure medication-taking behavior, whereas others assess barriers, beliefs, self-efficacy, or combinations of these domains ^[2]. This distinction is central to interpreting adherence scores and is the main focus of the present review.

2. WHY COMPARISON OF ADHERENCE TOOLS IS IMPORTANT

For the same patient, different adherence tools may lead to different classifications since these tools examine different aspect of adherence, employ different response formats, and have been validated on different groups of people. A brief

behavioral scale might be appropriate for use in screening, whereas a more multidimensional instrument would be more useful if the aim is to find out why a patient is non-adherent. Also, a belief instrument should not be automatically regarded as a direct measure of medication-taking behavior ^[2,4].

Measure the following:

- Medication-taking behavior, barriers, beliefs, self-efficacy, refill behavior or any combination thereof.
- The length of the study and the time it takes to administer it are important in busy clinical settings and in large studies.
- Some of the tools are broad in scope while others have had their effectiveness validated specifically for diseases.
- The way in which literacy and language are expressed and administered affects usability.
- With regard to scoring and interpretation, certain instruments include categories or cut-off points, whereas others are mainly used for describing levels or domains.
- The evidence from psychometrics indicates that reliability, validity, and responsiveness should be taken into account rather than assuming that a tool which is widely used is necessarily the best one ^[3,4,5].

3. CLASSIFICATION OF MEDICATION ADHERENCE MEASUREMENT METHODS

TABLE 1: CLASSIFICATION OF MEDICATION ADHERENCE MEASUREMENT METHODS

Category	Examples	Main strength	Main limitation
Direct/objective	Drug/metabolite concentrations; biological markers; directly observed therapy	Provides relatively direct evidence of exposure or observed administration	Cost, invasiveness, timing and pharmacokinetic variation



Electronic monitoring	Medication event monitoring systems/electronic packaging	Detailed record of opening/dosing events	Expensive; opening container does not prove ingestion
Pharmacy/claims records	MPR, PDC, refill data	Useful for large populations and longitudinal assessment	Medication obtained does not prove medication taken
Pill count	Count of remaining tablets	Simple objective approach	Can be manipulated; requires follow-up and does not establish ingestion
Self-report	MAQ, MMAS, Brief BMQ, ARMS, MARS	Low cost; practical; can explore barriers	Recall and social-desirability bias
Clinical outcomes	Disease control or biochemical/clinical indicators	Clinically meaningful	Outcomes are influenced by factors other than adherence

Lam and Fresco categorised adherence measurement into subjective and objective approaches and pointed out that each has advantages and disadvantages. They concluded that there is no perfect measure and a multi-measure approach is often preferable ^[1].

4. CENTRAL COMPARISON OF MAJOR MEDICATION ADHERENCE TOOLS

The following comparison is the heart of this review. The tools differ not only in number of items but, more importantly, in what they actually attempt to measure. When choosing and interpreting an instrument, the distinction between direct adherence behaviour and explanatory constructs such as beliefs or self-efficacy should be maintained ^[2,3].

TABLE 2: COMPARISON OF MAJOR MEDICATION ADHERENCE TOOLS

Tool	Items/structure	Primary construct	Typical application	Major strengths	Important limitations
MAQ / 4-item Morisky	4 items	Medication-taking behavior; common non-adherence behaviors	Broad chronic disease populations	Very short; easy to administer and score; broad applicability	Limited information about reasons/ barriers; self-report bias
MMAS-4	4 items	Medication-taking behavior	Chronic disease screening	Brief screening instrument	Does not comprehensively explain barriers or beliefs
MMAS-8	8 items; first 7 yes/no and final item 5-point response	Medication-taking behavior and circumstances contributing to underuse	Common chronic disease settings	More detailed than MMAS-4; widely used; explores issues such as forgetfulness	Self-report bias; interpretation depends on validated use; licensing/ copyright considerations
Brief BMQ	5-item Regimen + 2-item Belief + 2-item Recall screens in the original core instrument	Medication-taking behavior and barriers	Patients with multidrug regimens; chronic disease	Reviews each medication; identifies regimen, belief and recall problems	More time-consuming; scoring/ administration can be more complex
Hill-Bone	14-item version; 3 domains	Medication-taking,	Primarily hypertension	Multidimensional; disease-specific	Limited generalizability



		appointment keeping and sodium intake		domains; low-literacy development considerations	outside hypertension; versions differ
MARS-5	5 items	Medication-taking behavior and attitudes/ barriers depending on version/ context	Originally prominent in psychiatric populations; wider use exists	Short; useful behavioral/ attitudinal screening	Validation/ generalizability varies by population
ARMS	14 items	Taking medications and refilling medications	Chronic disease/primary care	Includes refill behavior; useful for populations with chronic therapy	Longer than MAQ/MMAS; criterion validity varies across studies
SEAMS	13 items	Self-efficacy for appropriate medication use	Chronic disease populations	Assesses confidence in managing medication use; useful for intervention planning	Not a direct adherence measure alone
BMQ-Specific	Beliefs/necessity and concerns domains	Beliefs about medicines	Chronic illness and treatment-specific belief assessment	Explains beliefs that may influence adherence	Not a stand-alone comprehensive adherence measure

5. DETAILED REVIEW OF INDIVIDUAL TOOLS

5.1 MEDICATION ADHERENCE QUESTIONNAIRE (MAQ)

The Medication Adherence Questionnaire (Morisky-Green Version) is one of the shortest and most popular self-report measures. The comparison studies found that it was quick to administer and score and had good applicability to a variety of diseases ^[3,6]. Its major advantage was the ability to quickly screen patients for adherence behavior, but it was found to provide limited insight into the spectrum of adherence issues ^[3]. As a brief screening tool, the MAQ is convenient in an outpatient setting, but a low score should not be the sole guide to patient management. Further assessment of adherence determinants, such as access to drugs, adverse effects, beliefs about

medication, regimen complexity, and self-confidence in regimen management, is needed to fully understand the reason for non-adherence ^[2,3].

5.2 MMAS-4

The four-item Morisky Medication Adherence Scale is a brief measure intended for screening purposes that asks the patients about behaviors indicative of non-adherence such as forgetting to take the medication, being careless and stopping the drugs under specified conditions ^[6]. The tool's primary advantage is its brevity which makes it convenient to use in practice and research.

The main shortcoming is the amount of explanation that is required for each item which might be tiring for some patients. In addition, a patient who positively screens for this tool might need further assessment to identify the reason for



medication non-adherence. This reason can be various ranging from forgetfulness, intentional non-use of drugs, adverse effects, lack of access to drugs, concern about medications or other reasons.

5.3 MMAS-8

The eight-item Morisky scale was constructed from the former MAQ. The current review points out that the first seven items are to be answered yes/no, while the last item uses a five-point Likert response. Those additional items give more insight into medication-taking behaviors, and why patients may not take their medicines ^[1].

The MMAS-8 gives more information than the brief four-item version but is still relatively quick to complete. It has seen its widespread use in research on patients with chronic disease. However, systematic reviews of medication adherence measures suggest that self-report tools should not be presumed to be equivalent to more objective measures of adherence. In the light of the validation evidence present for the MMAS-8 itself, and the legal and practical context in which it is applied, the use of the MMAS-8 should be carefully considered. ^[1,4,7]

5.4 BRIEF MEDICATION QUESTIONNAIRE (BRIEF BMQ)

The Brief Medication Questionnaire is most appropriate when the researcher's aim is to evaluate medication-taking behavior in combination with barriers to adherence. The provided literature revealed that the questionnaire comprises 3 primary screens: a 5-item Regimen Screen, a 2-item Belief Screen, and a 2-item Recall Screen ^[1,8]. The Regimen Screen assess the manner in which the participant took each drug during the past week; the Belief Screen was created to identify troublesome or challenging

aspects; and the Recall Screen discovers whether it was difficult to remember the regimen.

The Access screen, which refers to the inability to obtain or refill the medication, is also available in few sources. Notably, the structure of the Brief Medication Questionnaire may vary depending on the author's preferences, which means that it is essential to specify the exact version of the instrument rather than referring to generic versions ^[8].

The key advantage of the Brief BMQ is that it is appropriate for assessing multidrug regimens, allowing the researcher to identify adherence issues on an individual drug basis. This ability is particularly valuable in cases when the objective is to differentiate between various forms of non-adherence, thus providing more information than a simple measure of behavior would. However, a limitation of the questionnaire is that a detailed review of the regimen and the completion of multiple screens can take more time than a very brief assessment ^[1,8].

It is also important to note that the Brief Medication Questionnaire should not be confused with another patient-reported outcome measure, that is the Beliefs about Medicines Questionnaire (BMQ-Specific). Although the two questionnaires share some similarities and may be mentioned in the same literature pieces, they are clearly different, and the researcher's goal will determine the choice of the instrument.

5.5 HILL-BONE COMPLIANCE SCALE

The Hill-Bone Compliance Scale was developed mainly for hypertensive patients. The 14-item form assesses three behavioral domains: medication-taking behavior, appointment keeping and sodium intake, with items rated on a four-point response scale ^[1,8].



Its multidimensional structure is useful when adherence to antihypertensive therapy is being considered together with appointment attendance and dietary behavior. The main limitation is generalizability: because the instrument is strongly linked to hypertension care, it is less appropriate as a universal adherence tool for unrelated conditions [1,3].

5.6 MEDICATION ADHERENCE RATING SCALE (MARS-5)

The 5-item version of the Medication Adherence Report Scale (MARS-5) is useful for evaluating medication-taking behaviors and attitudes toward medicines and has been evaluated among patient-reported outcome measures used to measure medication adherence [4]. In previous comparative work, strong associations were found between MARS-5 responses and psychiatric populations, although recent work has also examined applications for other disease groups [3,4].

MARS-5 is useful when a short behavioral measure is required, but investigators should confirm that the version has been validated for their population and condition. It should not be assumed that psychometric performance in one disease group will automatically transfer to another.

5.7 ADHERENCE TO REFILLS AND MEDICATIONS SCALE (ARMS)

ARMS was designed to evaluate both taking medications as directed and obtaining/refilling medications. This is an important distinction because patients can be adherent when they possess medicines but fail to refill them on time, or can obtain medicines without taking them correctly. The supplied Nguyen review reports validation evidence including association with

clinical outcomes, pharmacy records and other adherence measures [2].

ARMS is consequently attractive for chronic disease and primary-care research when refill behavior is relevant. Its longer format, compared with MAQ or MMAS-4, increases the information obtained but also increases respondent burden.

5.8 SELF-EFFICACY FOR APPROPRIATE MEDICATION USE SCALE (SEAMS)

SEAMS comprises 13 questions that explore self-efficacy which is the patient's confidence in his or her ability to take medicines appropriately in spite of challenges. Comparative studies established SEAMS as a clinically significant adherence-related patient-reported outcome measure [3,4].

The critical interpretive issue is that SEAMS evaluates self-efficacy rather than the medication-taking behavior. Thus, a patient may report high self-efficacy but be nonadherent or have low self-efficacy but currently adhere to the therapy. For this reason, SEAMS is particularly informative as an adjunct tool when the research question addresses potential barriers to adherence that may be surmounted by educational, counselling or behavioral interventions.

5.9 BELIEFS ABOUT MEDICINES QUESTIONNAIRE (BMQ-SPECIFIC)

BMQ-Specific is primarily a beliefs measure, rather than a stand-alone adherence scale. The authors of the BMQ-Specific state its focus on "whether the patient regarded their medicines as necessary and whether they had any concerns about the medicines" [2]. Patients' beliefs about the necessity and concerns related to the medicines they take can affect their adherence to treatment and provide clinicians with insight into patients' intentional non-adherence to treatment.



Thus, the BMQ-Specific adherence scale is intended to work in combination with a direct measurement of adherence. The authors of the BMQ-Specific note that “a high concern score is not sufficient evidence of intentional non-adherence to treatment; however, it does provide an important therapeutic communication

opportunity” [2]. In fact, Nguyen et al. insist that belief-focused measures should not be used as standalone adherence indicators [2].

6. COMPARISON ACCORDING TO WHAT THE TOOL MEASURES

TABLE 3: COMPARISON ACCORDING TO WHAT THE TOOL MEASURES

Dimension	Tools particularly relevant	Interpretation
Medication-taking behavior	MAQ/MMAS-4, MMAS-8, MARS-5, Brief BMQ	Best suited for estimating or screening whether doses are taken as prescribed
Barriers/reasons	Brief BMQ, ARMS, some MARS/related tools	Useful for identifying practical or behavioral reasons for missed doses
Refill behavior	ARMS; pharmacy refill measures	Important when access and timely medication acquisition are concerns
Beliefs	BMQ-Specific	Explores necessity beliefs and concerns; complements, rather than replaces, adherence assessment
Self-efficacy	SEAMS	Measures confidence in managing medication use; useful for intervention planning
Hypertension-specific behaviors	Hill-Bone	Adds appointment keeping and sodium-related behavior to medication-taking assessment

7. PSYCHOMETRIC CONSIDERATIONS: RELIABILITY AND VALIDITY

Reliability is a property of an instrument that determines its consistency, and validity is a property that determines if the instrument measures what it is supposed to measure. The provided literature review allows identifying that different instruments can demonstrate different

psychometric properties and that different instruments can work differently with different populations. The conducted review by Culig and Leppée provides an example of such differences, which are demonstrated by different Cronbach’s alpha values for different scales and studies, which can inform decisions about the reliability of an instrument for different populations [9].

TABLE 4: RELIABILITY & VALIDITY OF TOOLS

Tool	Evidence/ observations from reviewed literature	Interpretive point
MAQ	Short and widely validated across diseases; psychometric results vary by study	Practical and adaptable, but brevity limits explanatory scope
MMAS-4/MMAS-8	Included among PROMs with at least moderate evidence for multiple measurement properties in a systematic review	Strong research use does not eliminate need for population-specific validation
Brief BMQ	Reported criterion/validity evidence and useful identification of non-adherence types	More informative but more complex than short screens
Hill-Bone	High internal consistency reported in several studies; disease-specific	Best interpreted in hypertension-focused contexts
MARS-5	Included among PROMs with moderate evidence across multiple measurement properties	Performance varies by population and version
ARMS	Reported internal consistency and criterion associations in validation studies	Useful when refill behavior matters



SEAMS	Reported good internal consistency in reviewed literature	Measures self-efficacy, not adherence alone
BMQ-Specific	Construct and criterion-related evidence for beliefs	Should be used to explain beliefs rather than as a sole adherence score

A 2020 systematic review reported a total of 121 unique medication-adherence patient-reported outcome measures from 214 studies. Several of these instruments, including the MMAS-4, MMAS-8, MARS-5, Hill-Bone and SEAMS, had at least moderate evidence for five or more of the measurement properties, but there was no instrument that could be regarded as universally superior ^[4]. A later systematic review in cardiovascular disease and type 2 diabetes mellitus also noted substantial variability and did not classify any of the 27 assessed PROMs as having sufficiently strong evidence for any of the measurement properties to be placed in its highest category ^[7].

8. ADVANTAGES AND LIMITATIONS OF SELF-REPORT TOOLS

ADVANTAGES:

- Inexpensive, rapid, non-invasive and feasible for large studies.
- Are self-administered or interviewer administered depending on level of literacy and study design
- Are able to ascertain barriers, beliefs and behavioral patterns which are not revealed by objective measures
- Are a useful screening tool for patients who may benefit from a more intensive assessment of adherence

LIMITATIONS:

- Recall bias, social-desirability bias and intentional misreporting of non-adherence.
- Different wording, recall periods and scoring systems between instruments make direct comparison between them difficult.
- Performance may vary when the instrument is used in a different population than that in which it was validated ^[1,2,3,4].

9. OBJECTIVE AND INDIRECT MEASURES AS COMPLEMENTS

The potential objective and indirect measures of adherence can be used for self-reported adherence assessments. Firstly, pharmacy dispensing records can provide information on the number of dispensed doses surrendered by the patient whereas the pill count method determines the number of tablets or capsules by weight and electronic monitoring objectively measures the opening of the medication container. Secondly, the concentration of drugs or their metabolites in fluids is an objective measure of exposure, which typically requires significant resources to assess and can be invasive and variable due to inter-individual differences in pharmacokinetics ^[1,5].

However, most importantly, different medication adherence measures assess different constructs of adherence behavior. For example, pharmacy records determine the number of doses dispensed to the patient, electronic monitoring measures only register the number of times the medication container has been opened, self-administration evaluates individuals' behavior and attitudes towards medication use, whereas clinical



outcomes reflect the overall effect of adherence and other factors on health status. Therefore, the fact that different medication adherence measures yield different results is not surprising, as each evaluates a unique construct of medication adherence. Indeed, when measuring adherence, an individual behaves differently depending on which component of adherence is assessed by the selected method and therefore interacts with it differently.

10. MULTIMETHOD APPROACH

Because no single measure is a gold standard, a multimethod strategy can provide a more informative assessment ^[1,3]. For example, a study may combine a brief behavioral questionnaire with pharmacy refill data and a short barrier/belief assessment. This approach can answer both questions: 'Is the patient likely to be non-adherent?' and 'Why might the patient be non-adherent?'

11. SELECTION OF THE MOST APPROPRIATE TOOL

TABLE 5: SELECTION OF APPROPRIATE TOOLS

Research requirement	Preferred option(s)	Reason
Very brief screening across chronic diseases	MAQ/MMAS-4	Minimal respondent burden and rapid administration
More detailed behavioral screening	MMAS-8	Adds information beyond the four-item approach
Multidrug regimen and reasons for non-adherence	Brief BMQ	Reviews individual medicines and includes regimen, belief and recall domains
Hypertension-focused adherence research	Hill-Bone	Includes medication, appointment and sodium-related domains
Medication-taking behavior with psychiatric history/population	MARS-5	Short instrument with established psychiatric use; confirm population-specific validation
Taking + refilling behavior	ARMS	Explicitly includes medication and refill behavior
Confidence/self-efficacy	SEAMS	Measures ability/confidence to manage medication use
Necessity and concerns about medicines	BMQ-Specific	Explores beliefs that may influence adherence

12. ROLE OF PHARMACISTS IN ADHERENCE ASSESSMENT

Pharmacists are in a good position to assess adherence as medication histories, refill patterns, regimen complexity, adverse effects and patient beliefs can be reviewed during medication related encounters. An appropriate choice of questionnaire should be followed by patient-centered interpretation of the results rather than labelling a patient adherent or non-adherent.

- Regimen complexity and opportunities for regimen simplification should be explored.
- Explore intentional medication non-adherence due to concerns about benefits and risks should be resolved.
- Unintentional non-adherence due to forgetfulness, cognitive impairment and regimens that are difficult to follow should be examined.
- Missed doses, delayed refill and patterns of discontinuation should be identified.
- Identification of affordability/refill access barriers is needed.



- Education, reminders, adherence aids and other follow-up measures should then be initiated based on the exploration and patient-specific needs.

13. RESEARCH GAPS

Current literature shows several important gaps. First, there is still no universally accepted gold-standard adherence scale. Second, many instruments have been validated in specific diseases or populations, limiting transferability. Third, systematic reviews continue to report heterogeneous psychometric evidence and inconsistent reporting of important characteristics such as administration time, copyright/licensing, language availability and comparator measures [4,5,7].

Another important gap is the distinction between measuring adherence and explaining adherence. Behavioral scales can identify possible non-adherence but may not reveal whether the cause is intentional or unintentional. Conversely, tools such as BMQ-Specific and SEAMS provide explanatory information but should not be interpreted as direct measures of dose-taking behavior [2]. Future studies should therefore emphasize construct clarity, culturally appropriate validation, and combined assessment of behavior with modifiable barriers.

14. DISCUSSION

Medication adherence is a complex multidimensional construct, which is not simple to measure correctly. Various instruments have been developed by researchers for its assessment, targeting on different areas or utilizing distinct methodologies. Therefore, there are multiple instruments for monitoring medication adherence, which target different populations or ailments, applying diverse resources. It is difficult to

determine which tool is the best, yet investigator suggest considering the aims of the study, populations of interest, disease status, and available resources while selecting a tool [1,2].

A comparative analysis of the instruments reveals that each of the tool has its own advantage and disadvantages and applicability, addressing various scopes and interests with diverse approaches. Firstly, MAQ/MMAS primarily evaluates adherence to taking medication and is effective for rapid screening; however, both questionnaires are deficient in providing rich information on regimen-related issues, beliefs, and recall. Secondly, BMQ consists of various items, making it extremely suitable to collect complete data on patient beliefs, barriers, and problems related to regimen recall. Thirdly, ARMS is mainly used in tracking medication-taking and refill behaviors, while Hill-Bone is mainly used for patients with hypertension. Finally, MARS is a shorter self-report questionnaire, which focuses on medication-taking behavior, whereas SEAMS questionnaires mainly assess self-efficacy in relation to medication. Hence, the length of the questionnaire is not always proportional to the data collected, and a researcher should always consider what information is needed while selecting an item [2,3].

Self-report questionnaires are the most prevalent category of medication adherence measurement tools, which are inexpensive, time-saving, non-invasive, and applicable to a wide range of populations. However, self-report tests may contain social-desirability response bias and memory biases, and they have the potential to generate underreporting of non-adherence. Pill counts, pharmacy refill records, electronic monitoring, and drug levels are additional methods for determining medication adherence, which may be resource-intensive [1].



15. CONCLUSION

Medication adherence assessment is essential but challenging because adherence is multidimensional and no single method is universally appropriate. The central comparison in this review demonstrates that the major self-report tools differ substantially in construct, length, population, domains and practical utility. MAQ/MMAS-4 are useful for rapid behavioral screening; MMAS-8 provides a somewhat broader behavioral assessment; the Brief BMQ provides more detailed information on regimen, belief and recall problems; Hill-Bone is particularly relevant to hypertension; MARS-5 provides a short behavioral/attitudinal assessment; ARMS incorporates refill behavior; SEAMS focuses on self-efficacy; and BMQ-Specific focuses on medication beliefs ^[1,2,3,4,8,9].

The most appropriate tool should therefore be selected according to the research question rather than popularity alone. When resources permit, combining a self-report tool with an objective or indirect measure can improve the overall assessment. For clinical pharmacy practice and research, the goal should not simply be to obtain an adherence score but to identify actionable causes of non-adherence and guide individualized interventions.

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