REVIEW

Exploring Validated Self-Reported Instruments to Assess Adherence to Medications Used: A Review Comparing Existing Instruments

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Objective: To provide an overview of instruments that measure adherence to medications to facilitate selection of an instrument and to provide a summary of some published adherence assessment tools tailored to be used by the healthcare team, especially the pharmacists.
Data Sources: Studies were identified via PubMed, Medline, Embase, and Google Scholar using the search terms medication adherence, compliance, persistence, combined with the terms questionnaire, scale, survey, self-report, and instrument.
Study Selection: Articles written in English, describing questionnaire instruments that were psychometrically evaluated (reporting a good coefficient of internal consistency, reliability assessed through Cronbach's alpha, and had been validated against a subjective or objective measure), and containing 30 or fewer items were included.
Data Synthesis: Twelve instruments were identified and included in this review. Instruments were reviewed by evaluating specific characteristics (number of items, sample size, reliability, sensitivity, specificity, questionnaire completion time, criterion validity, and component analysis).
Conclusion: Various instruments are used to assess patient adherence to medications; however, no single one performs well on all criteria. Every instrument has different advantages and unique properties. A particular instrument can be chosen after considering certain factors, such as the specific requirements, population, the needed time to complete the questionnaire, the sensitivity, and the specificity of the questionnaire. Moreover, there is a recognized need to provide primary care medication adherence services customized to patient's needs. A link for teamwork between healthcare providers such as pharmacists and patients is needed. This link can be a validated instrument to assess patient's adherence to medication.
Keywords: adherence to medications, compliance, questionnaire, self-report, scale, survey, instrument

Introduction

Adherence is commonly defined as the degree to which patients follow medical advice and take their medications according to the way prescribed by the healthcare team.[1,2] There is an increasing focus on medication adherence research, partly due to the evidence highlighting the extent and consequences of sub-optimal adherence. These issues are widespread, applicable not only to a specific disease but across the spectrum of chronic diseases, resulting in significant health and cost sequelae associated with non-adherence.[3]

Non-adherence is a phenomenon with different observable patterns, across patients, and even within the same patient for different treatments. The most commonly observed patterns are categorized into *intentional* non-adherence (deliberate non-adherence which is associated with patients' beliefs, where patients usually decide not to take their medications), and *unintentional* non-adherence (unplanned behavior which is associated with lack of resources).[4,5] Non-adherence research indicates an extensive range of potential determinants or factors, which may be categorized into patient-related factors, physician or healthcare system-related factors, medication-related factors, and external factors.[6–8] Among chronic illnesses, only half of the patients take their medications as prescribed by their doctors or by the healthcare team.[7]

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It is necessary to measure patients' adherence with valid and reliable instruments;[9] indeed several methods are used to assess adherence. These methods are delineated into *direct* and *indirect* methods. Each method has its own advantages and disadvantages.[10,11] Direct methods include observational measures and biological markers while indirect methods include self-reported questionnaires, pharmacy refill records, pill count, and electronic monitoring systems.[12] However, to date, no method has been nominated as a universal gold standard method;[13] but generally, self-reported adherence questionnaires are the most used method to assess patient adherence to medications for clinical use.[14] Self-report measures offer several advantages, including low cost, ability to differentiate between intentional and unintentional non-adherence, non-invasiveness, and ease of administration. Self-report measures if devised well can also provide some extra information such as reasons behind non-adherence, beliefs about medications, and patient understanding of medications regimens.[14–16]

As prescribers, physicians often have scarce time for exploring adherence, and thus would do well to emphasize the availability of other educational resources/health professionals, including but not limited to pharmacists.[7] Pharmacists are uniquely positioned to deliver customized patient-oriented services that would ensure that patients are taking their medications in adherence with the healthcare team instructions; due to the fact that they interact with almost every outpatient.[17] Moreover, in case of chronic diseases, the pharmacist dispenses repeat prescriptions, giving them the sole chance to reassess patient's adherence to medication and to re-educate the patients regarding any medication or regarding the importance of adhering to their medications.[7,17–21]

This review aims to present a data summary for healthcare providers generally, and pharmacists specifically, regarding utilizable adherence assessment instruments (self-reported questionnaire) that can be used at the point of care.

Literature Review

Studies reporting the development and validation of adherence instruments were identified through PubMed, Medline, Embase, and Google Scholar using the search terms medication adherence, compliance, persistence, combined with the terms questionnaire, scale, survey, self-report, and instrument. Our literature review identified some medication adherence instruments; however, we focused to provide a data summary for healthcare providers generally, and pharmacists specifically, regarding utilizable adherence assessment instruments that can be used at the point of care. As there are no existing criteria regarding instrument (questionnaire) selection; the research team developed a certain criterion to help pharmacists in the instrument selection process. Our criteria included instruments written in English, containing 30 or fewer items (practical to use at the point of care),[22] describing scales/instruments which were psychometrically evaluated (reported a good coefficient of internal consistency, reliability assessed through Cronbach's alpha, and had been validated against a subjective or objective measure).

Instruments meeting the inclusion criteria were collated and data such as the number of the items in the instrument, the sample size, reliability, sensitivity, specificity, questionnaire completion time, and criterion validity were extracted and summarized. The study selection process is illustrated in Figure 1. Twelve instruments were identified and included in this review.

Data Synthesis

The selected instruments (n=12) pertaining to usable adherence assessment instruments are listed in Table 1. The number of scale items varies widely from four to 30 items.[23–25] Some of the instruments were developed with a small sample size (43 patients), such as the Brief Medication Questionnaire (BMQ), in contrast, other instruments were developed and tested in a relatively large sample size (1,009 patients), such as the Test of the Adherence to Inhalers (TAI).[26,27]

The reliability of the instruments, measured using Cronbach's Alpha coefficient, ranged from 0.61 for the Morisky Medication Adherence Scale (MMAS-4) to 0.93 for the Drug Attitude Inventory scale (DAI).[23,28] Generally, scales with a coefficient higher than 0.7 are considered sufficient to indicate adequate internal consistency.[29]

The sensitivity of the instruments (the ability of the questionnaire to detect true non-adherence) ranged from 0.63 in the Pediatric Inhaler Adherence Questionnaire (PIAQ) to 0.848 in the TAI (when the cut-off score was 45).[27,30]

As for specificity (the ability of the questionnaire to correctly identify those patients who are not facing adherence problems) ranged from 0.226 in the TAI (when the cut-off score was 45) to 1.0 in the BMQ (for the regimen screen section) and 0.9 in the PIAQ.[26,27,30] Five instruments did not report the sensitivity nor the specificity.

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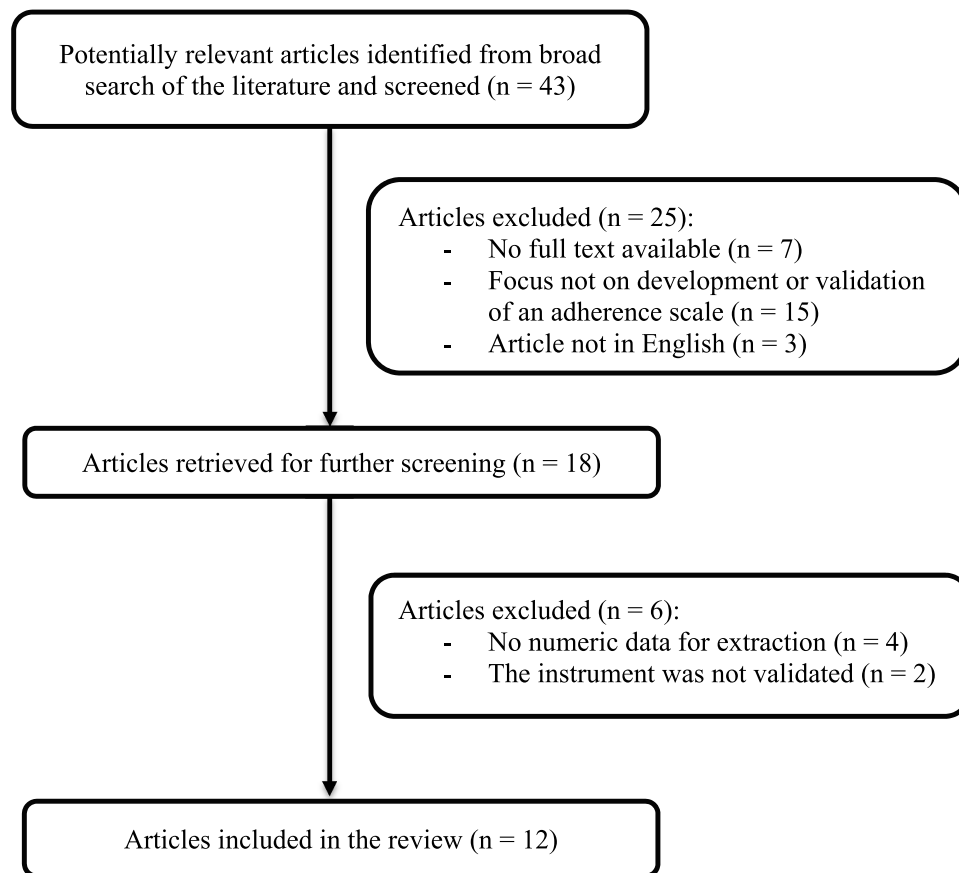
Figure 1 Flow chart of study selection process.

The methods used to assess the criterion validity of each instrument varied widely from one to another; some instruments used subjective validation (therapist report) such as the DAI, while other instruments choose an objective method to assess validity (Medication Event Monitoring Systems (MEMS)) such as the BMQ and the Brief Adherence Rating Scale BARS.[24,26,28]

The Drug Attitude Inventory Questionnaire (DAI)

The DAI was developed based on literature review and patient reports to understand the schizophrenic patient's perception of drug treatment.[28] It has some limitations since it measures attitude instead of behavior, it classifies patients as compliers and non-compliers, which does not concede the complexity of compliance, it was also validated based only on the therapist's judgment and they may overestimate compliance.[31]

Morisky Medication Adherence Scale (MMAS-4)

The MMAS-4 is a widely used questionnaire instrument to assess adherence, and the most adaptable one at the point of care because it is short, simple, easy to score, and it also can identify barriers.[22,23] However, it does not provide any information on unintentional non-adherence,[27] and it is comparatively short and mainly suitable for initial screening.[32] It has been validated in the broadest range of diseases such as heart failure and coronary artery disease, the type two diabetes, dyslipidemia, parkinson's disease, depression, and human immunodeficiency virus infection.[22]

The Brief Medication Questionnaire (BMQ)

The BMQ was developed based on literature review and patient feedback, it is divided into three main question headings; the regimen screen, the belief screen, and the recall screen; it also has multiple sub-questions.[26] It can assess self-efficacy, which is defined as the individual's belief that he/she can successfully complete a specific action to produce a desired

Table 1 Comparison Between Different Types of Questionnaires

Questionnaire Name	Number of Items	Sample Size	Reliability	Sensitivity	Specificity	Questionnaire Completion Time	Criterion Validation	Country	Primary Reference
Drug Attitude Inventory (DAI)	The original form consists of 30 true or false items The modified form consists of 10 true or false items	150 schizophrenic patients (93 were males), the males mean age = 40.0 (SD =12.4), while the female mean age = 42.1 (SD = 10.8)	α = 0.93 Test- retest reliability (after 4 weeks) α = 0.82	0.72[41]	0.63[41]	Not reported[41]	Therapist Decision[41]	Canada	[28]
Morisky Medication Adherence Scale (MMAS-4)	4 items	290 patients (70% were females), their mean age = 54	α = 0.61	0.81	0.44	Not reported[41]	Clinical outcome (Blood pressure)	USA	[23]
The Brief Medication Questionnaire (BMQ)	5-item in the regimen screen 2-item in the belief screen 2-item in the recall screen	43 patients (60% were males), their mean age = 52.6	α = 0.66 (according to a follow-up study that assess the internal consistency for the BMQ)[42]	All of the sensitivity findings were for detecting repeat non-adherence 0.8 for the regimen screen 1.0 for belief screen 0.4 for the recall screen	All of the specificity findings were for detecting repeat non-adherence 1.0 for the regimen screen 0.8 for belief screen 0.4 for the recall screen	Not reported[41]	Electronic monitoring devices (the medication event monitoring system MEMS)	USA	[26]

Scale	Items	Sample	Reliability			Time	Validity	Country	Ref
Hill- Bone Compliance Scale	14 items	In study 1, 309 men, their mean age = 41.3 (SD = 5.3) In study 2, 718 patients (30.8 were males), their mean age = 59.2 (SD = 13.1)	α = 0.74 (in study 1) α = 0.84 (in study 2)	Not reported[41]	Not reported[41]	5 minutes	Clinical outcome (blood pressure)[41]	USA	[33]
Medication Adherence Rating Scale (MARS)	10 yes or no items	66 patients (51 women and 15 men), their mean age = 32.89 years (SD = 11.07)	α = 0.75 Test- retest reliability (after 2 weeks) α = 0.72	Not reported[22,41]	Not reported[22,41]	Not reported[41]	Multitrait-multimethod matrix (drug level and caregiver report)	Australia	[31]
Medication Adherence Report Scale for Asthma (MARS-A)	10 items	318 patients with persistent Asthma (83% were females), their mean age = 48 years (SD = 13) 245 patients completed the 3-month follow-up	α = 0.85 Test- retest reliability r = 0.65	0.824	0.694	Not reported	Electronic monitoring devices	USA	[34]
Personal Evaluation of Transitions in Treatment (PETiT)	30 items	335 schizophrenic patients (62.4% were males), their mean age = 35.33 years (SD = 12.12)	α = 0.92 Split half reliability (spearman- Brown coefficient = 0.85)	Not reported	Not reported	2–5 minutes	By using some other clinical and quality of life measures (positive and negative syndrome scale PANSS, global assessment scale of functioning GAF, and quality of life scale QLS)	Canada	[25]
Pediatric Inhaler Adherence Questionnaire (PIAQ)	6 items	Parents or caregiver of 64 children with asthma, their mean age = 3.6 years (SD = 2.2)	Not reported[41] Test- retest reliability Lin (r_c) concordance correlation coefficient = 0.82 Intraclass correlation = 0.83	0.63[41]	0.9[41]	1–3 minutes	Dose count (canister weight change)	Colombia	[30]
Self-efficacy for Appropriate Medication Use Scale (SEAMS)	13 items	436 patients with coronary heart disease and other comorbid conditions (55.7% were females), their mean age = 63.8 (SD = 10.4)	α = 0.89 Test- retest reliability Spearman's ρ = 0.57	Not reported[22,41]	Not reported[22,41]	Not reported[41]	Medication Adherence Questionnaire (MAQ) scale	Georgia	[36]

(*Continued*)

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Table 1 (Continued).

Questionnaire Name	Number of Items	Sample Size	Reliability	Sensitivity	Specificity	Questionnaire Completion Time	Criterion Validation	Country	Primary Reference
The Brief Adherence Rating Scale (BARS)	4 items	61 patients (35 with schizophrenia, and 26 with schizoaffective disorder; 50.8% were females), their mean age 44.3 (SD = 9.1)	α = 0.92 Test- retest reliability robust regression coefficient ranged from 0.53 to 0.92 and Spearman correlation ranged from 0.46 to 0.86	0.73	0.74	Less than 5 minutes	Using electronic monitoring devices (MEMS)	USA	[24]
The Adherence to Refills and Medications Scale (ARMS)	12 items	435 patients with coronary heart disease (55.6% were females), their mean age = 63.7 (SD=10.3)	α = 0.814 Test- retest reliability spearman's rho = 0.693	Not reported[41]	Not reported[41]	Not reported[41]	1.Clinical outcome (blood pressure) 2.Pharmacy record- MAQ scale	USA	[29]
The Test of the Adherence to Inhalers (TAI)	12 items	1009 patients with asthma or COPD (56% were males), their mean age = 58.0 (SD = 16.3)	α = 0.86 α = 0.873 (for the 10 item patient domain) Test- retest reliability α = 0.883	0.674 (when the cut-off was 50) 0.848 (when the cut-off score was 45) *Sensitivity and specificity of TAI were assessed based on identifying the groups of adherent (cut off TAI score = 50), intermediate adherent (46–49) and non-adherent patients (≤ 45)	0.660 (when the cut-off was 50) 0.226 (when the cut-off score was 45)	Around 5 minutes	1.Electronic monitoring devices (Smart-inhalers) 2.Morisky-Green questionnaire.	Spain	[27,35]

outcome.[22] It is sensitive, brief, has the ability to discover different types of non-adherence, identify barriers, and evaluate multidrug regimen.[22,32] On the other hand, it is difficult to score, a long time is needed to complete it, and patients are required to list their medication regimen as it assumes that this regimen is comprehensive.[22]

The Hill-Bone Compliance Scale

The Hill-Bone Compliance Scale was developed based on literature review and clinical expertise, it is used to assess patients' behaviors for three important behavioral domains (reduced sodium intake, appointment keeping, and medication taking) of high blood pressure treatment.[33] It can identify barriers and assess self-efficacy, and it is suitable for low literacy patients (5th grade),[22,33] however, it focuses on hypertension patients limiting its generalizability.[33]

The Medication Adherence Rating Scale (MARS)

The MARS was developed based on the Medication Adherence Questionnaire (MAQ) and the DAI, it is a specific questionnaire instrument used for psychiatric patients. It can identify barriers, and it has an adequate reliability. However, it has a weak to moderate validity and it is limited in generalizability.[22,31]

The Medication Adherence Report Scale for Asthma (MARS-A)

The MARS-A is a self-reported measure of adherence to inhaled corticosteroids among patients with asthma.[34] It does not assess the patient's inhalation technique because the questionnaire instrument is self-administered. Sometimes the patient may be confused by the way in which the questions are written.[27]

The Personal Evaluation of Transitions in Treatment Questionnaire (PETiT)

The PETiT was developed based on literature review, consultation with experts, individual interviews with patients and caregivers, and patients' focus groups, it is a scale used to capture aspects of subjective responses to, and tolerability of, antipsychotic drugs, treatment adherence, and impact of antipsychotic drug therapy on the quality of individuals treated for schizophrenia.[25]

The Pediatric Inhaler Adherence Questionnaire (PIAQ)

The PIAQ was developed based on literature review, expertise and focus groups, it is used to permits quantitative assessment of metered-dose inhaler adherence in children with asthma.[30]

The Self-Efficacy Appropriate Medication Use Scale (SEAMS)

The SEAMS was developed based on literature review, expertise and patient interviews, it provides a valuable assessment of medication self-efficacy in chronic disease management, it is a valid and reliable instrument used to measure self-efficacy, can identify barriers, and is suitable for several levels of patient literacy.[22] However, it is difficult to score, and it has limited generalizability.[22,36]

The Brief Adherence Rating Scale (BARS)

The BARS was developed based on the lengthier adherence questionnaire used in the CATIE trial, it also has a visual analog rating scale (0%-100%). It is a brief medication adherence instrument designed to assess oral antipsychotic medication adherence of outpatients with schizophrenia or schizoaffective disorders. The study conducted looking at its validity was brief, with a modest sample size, limiting the generalizability of the results.[24]

The Adherence to Refills and Medications Scale (ARMS)

The ARMS was developed based on literature review, MAQ, and Hill-Bone Compliance Scale, it is a medication adherence scale used in chronic disease populations and it is suitable for several levels of patient literacy.[29]

The Test of the Adherence to Inhalers (TAI)

The TAI was developed based on literature review and suggestions of the study scientific committee, it is an instrument that can identify non-adherence related to the use of inhalers in asthma and COPD patients. It can classify barriers from a clinical perspective.[35]

Component Analysis for the Adherence Questionnaire Instruments

For all of the identified instruments, the factors it contained accounted together for a total variance that ranges from 45% (ARMS) to 89% (MARS-A).[29,34]

For DAI, Exploratory Factor Analysis (EFA) was used to evaluate the underlying internal structure for some variables and uncover the relationship between them.[29] Seven factors emerged from the DAI, labeled as 1. positive subjective attitudes, 2. negative subjective attitudes, 3. health/illness, 4. physician, 5. control, 6. prevention, and 7. harm. Factor 1 accounted for 59.8% of the total variance while factor 2 accounted for 11.7%. Thus, the first two factors accounted for almost 3/4 of the variance and reflected patients' experiences of medication use. The five remaining factors reflected attitudes or beliefs. Factor 3 reflected the patient's model of health. Factor 4 and 5 reflected patient's control in taking his/her medication. Factor 6 reflected patient beliefs about the effect of medication use. Factor 7 reflected concerns about potential side effects.[28]

For the Morisky questionnaire instrument, The principal component analysis identified only a single factor confirming the unidimensionality of the scale.[23]

For Hill-Bone Compliance Scale, two studies were done to conduct the principal component analysis for this questionnaire instrument; five factors were extracted from the first study, and four factors from the second study.[33]

For MARS, factor analysis highlighted three factors, the first factor represented medication adherence behavior and accounted for 32% of the variance, the second factor represented subjects' attitude to taking the medication and accounted for 16% of the variance, and the third factor represented negative side effects and attitudes to psychotropic medication and accounted for 12% of the variance. All these factors together accounted for 59% of the total variance.[31]

For MARS-A, the principal component analysis showed that 89% of the variance was due to one factor only, suggesting that MARS-A can only measure adherence.[34]

For PETiT, construction of it yielded 12 themes that were identified as relevant domains. Factor analysis confirmed the robustness of the initial construct.[25]

For SEAMS questionnaire instrument, two dimensions were revealed by the factor analysis; factor one represented self-efficacy for taking medications under difficult circumstances and accounted for 45% of the variance, while factor two represented self-efficacy for continuing to take medications when circumstances surrounding medication-taking were uncertain and accounted for 8% of the variance. In the analysis of this study, any item that loaded 0.4 or more was considered to measure a factor. Of noteworthy, one item in the SEAMS questionnaire loaded more than 0.4 on both factors, and it was decided to add it to factor one because it agreed more conceptually with that factor, so it was grouped according to interpretability rather than the highest loading outcome.[36]

In ARMS, a two-factor solution was forced and the items clustered as expected. The first factor contained eight items related to taking medications as prescribed and explained 35% of the variance, while the other factor contained four items related to refilling medications on schedule and explained 10% of the variance.[29]

For TAI, a factor analysis highlighted two domains, the patient domain and the healthcare professional domain. The two domains explained 51% of the total variance of the results.[35]

Discussion

Medication adherence is a dynamic process that has various patterns at consecutive time points, and it is critical to provide optimal medication management.[37] Adherence to treatment has been studied extensively and collated findings of such research indicate that a low level of adherence can increase mortality and morbidity rates, in addition to healthcare costs.[38,39] Assessing adherence to medications is considered to be an essential step to guide adherence enhancing interventions.[40] However, sometimes it is difficult for clinicians to easily identify patients who are nonadherent. Thus, self-reported medication adherence instruments can be used as a tool to identify nonadherent patients. Furthermore, self-reports remain the most appropriate, available, accessible,

cheap, useful, and practical method to assess patient's adherence to medication which can be used routinely.[9,15] Ideally, a self-report adherence tool must be brief, reliable, and valid.[15] Reviewing the instrument characteristics such as the number of the items in the instrument, the sample size, reliability, sensitivity, specificity, questionnaire completion time, and criterion validity is important when selecting a tool to use at the point of care.

The difference between the methodologies used in the different adherence instruments development regarding the test-retest reliability assessment presents a barrier for the reader to compare and contrast the utility of the different instruments developed. It is recommended for researchers to unify the methodology of assessment used in the future. Considering the fact that most researchers based this analysis on the two weeks difference period of assessment, we propose for all future questionnaire instruments development to be based on this type of assessment.

Pharmacists can offer numerous services that contribute to increasing patient adherence since data from different research showed a positive association between pharmacists and patient adherence to medication; a link for teamwork between the pharmacists and the patients is needed. This link can be a validated instrument to assess patient's adherence found in every pharmacy. More studies are needed hoping that the results of these studies will help in providing a better contribution of pharmacists in patient's treatment.

Conclusion

Various questionnaire instruments can be used to assess patient's adherence to medications, however, no single one performs well on all criteria. A particular instrument can be used as an indicator of non-adherence to medications after considering some criteria such as the specific requirements, population, and the available time of administration.

There is a recognized need to form primary care medication adherence services that are customized to patient's needs. Continuous quality enhancement of such services needs a regular working method of measuring adherence to monitoring the effectiveness of treatment. This presents an important and exciting avenue for further research.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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