Critical Appraisal Tools to Aid Pharmacists in Evidence-Based Practice: A Narrative Review

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ABSTRACT

Background: Pharmacists and allied health researchers need to ensure that their practice is supported by current, evidence-based information. Critical appraisal tools have been developed to aid in this process.

Objectives: To analyze the current landscape of critical appraisal tools and to create an aid for pharmacists and other allied health researchers to use in comparing various tools and choosing the best one for each particular study design.

Data Sources: A literature search of the PubMed, University of Toronto Libraries, and Cochrane Library databases was conducted in December 2021, to generate an up-to-date list of critical appraisal tools. The tools were then summarized in a descriptive table.

Study Selection and Data Extraction: Review articles, original manuscripts, and tool webpages were examined to develop a comparison chart based on the user-friendliness, efficiency, comprehensiveness, and reliability of each tool.

Results: Fourteen tools were found through the literature search. These tools were compared using the findings of included review articles, and a comparison chart was created to aid pharmacists and allied health researchers in selecting the appropriate tool for their practice.

Conclusions: There are many standardized critical appraisal tools that can help in assessing the quality of evidence, and the summary list of tools developed and reported here can help health care researchers to compare among them and choose the best one. No tools were found that have been specifically adapted to serve the needs of pharmacists when assessing scientific articles. Future research should examine how existing critical appraisal tools can better identify common data elements that are essential to evidence-based decision-making in pharmacy practice.

Keywords: critical appraisal tools, risk-of-bias 2 (RoB 2) tool, pharmacist, evidence-based practice, validity

RÉSUMÉ

Contexte : Les pharmaciens et les chercheurs en soins de la santé doivent faire en sorte que leur pratique soit étayée par des informations actualisées et fondées sur des données probantes. Des outils d'évaluation critique ont été développés pour faciliter ce processus.

Objectifs : Analyser le paysage actuel des outils d'évaluation critique et créer une aide que les pharmaciens et les autres chercheurs paramédicaux peuvent utiliser pour comparer divers outils et choisir le meilleur pour chaque conception d'étude particulière.

Sources des données : Une recherche documentaire dans trois bases de données (PubMed, les University of Toronto Libraries et la Cochrane Library) a été menée en décembre 2021 afin de générer une liste actualisée d'outils d'évaluation critique qui ont ensuite été résumés dans un tableau descriptif.

Sélection des études et extraction des données : Des articles de synthèse, des manuscrits originaux et des pages Internet d'outils ont été examinés pour dresser un tableau comparatif basé sur la convivialité, l'efficacité, l'exhaustivité et la fiabilité de chaque outil.

Résultats : Quatorze outils ont été trouvés grâce à la recherche documentaire. Ils ont été comparés à l'aide des résultats des articles de synthèse inclus, et un tableau comparatif a été créé pour aider les pharmaciens et les chercheurs en soins de la santé à sélectionner l'outil approprié pour leur pratique.

Conclusions : De nombreux outils d'évaluation critique normalisés peuvent aider à évaluer la qualité des données probantes, et la liste récapitulative des outils développés et rapportés ici peut aider les chercheurs en soins de santé à les comparer et à choisir le meilleur. Aucun outil spécifiquement adapté pour répondre aux besoins des pharmaciens lors de l'évaluation d'articles scientifiques n'a été trouvé. Les recherches futures devraient se pencher sur la manière dont les outils d'évaluation critique existants peuvent mieux identifier les éléments de données communs qui sont essentiels à la prise de décision fondée sur des données probantes dans la pratique de la pharmacie.

Mots-clés : outils d'évaluation critique, outil Risque de biais 2 (RoB 2), pharmacien, pratique fondée sur des données probantes, validité

INTRODUCTION

Pharmacists regularly use their knowledge and skills to provide patient care, to support decision-making by the health care team, and to conduct research. These activities must be supported by current, evidence-based information, and pharmacists must develop their critical appraisal skills and become experts at synthesizing and interpreting relevant information. National campaigns like Choosing Wisely Canada,[1] which aim to reduce unnecessary tests and treatments, encourage clinicians to follow recommendations

that have been developed following review of scientific evidence to make informed choices with their patients. Similarly, the National Association of Pharmacy Regulatory Authorities (NAPRA)[2] lists expertise in medications and medication use as a requirement for licensed pharmacists practising in Canada. As part of modelling this standard, NAPRA highlights the importance of evidence-based medicine and critical appraisal of the source of information when providing care to patient.[2] Critical appraisal is not only a skill important to pharmacy practice, but also part of pharmacy practice standards in Canada.

Critical appraisal is a systematic process that is used to identify credible and relevant evidence to support clinical practice and policy.[3] When pharmacists and health care workers read a scientific article, they apply their critical appraisal skills to determine whether the article supports or changes their recommendations and practice. They may look at evidence from randomized controlled trials (RCTs) to understand the efficacy, safety, and appropriateness of new or innovative drugs, disease treatments, and pharmacy interventions.[4] Observational studies can be read for evidence of an association of drug exposure or pharmaceutical interventions with unintended effects or other outcomes of interest.[4,5] Systematic reviews attempt to uncover "all" of the evidence relevant to a specific question, focusing on research that reports data rather than concepts or theory.[6] Systematic reviews are rich resources to gain rapid insight into specific health-related questions in a single document, and they are the pinnacle of evidence synthesis used to create and update guidelines for clinical pharmacists.[7]

Critical appraisal involves interpreting information in a systematic and objective manner. Critical appraisal tools for all types of research methodologies (e.g., case–control studies, observational studies, RCTs) have been developed for quality appraisal of the literature in a formal and systematic process, each with study-specific applicability.[3] As described by Twells,[8] the traditional critical appraisal process for scientific articles involves 3 main questions: Are the results of the study valid (internal validity)? What are the results? Are the results applicable or generalizable to my patient population? In terms of the specific lens of pharmacy practice, in addition to these 3 questions, the pharmacist is also concerned with questions for evaluating appropriate drug use in practice, such as the following: What are the study limitations, and will they affect my recommendation in this situation? Will I make this recommendation (i.e., do the benefits outweigh the risks)? Will this study change my practice? With so much research available, pharmacists and allied health workers need to use the appropriate critical appraisal tools to select the highest-quality evidence and to determine if the quality of the research is applicable to their objectives and practice.

Although other health care professionals, such as nurses, have produced guidance on the use of critical appraisal tools,[9] to our knowledge there are no similar guidance documents comparing current critical appraisal tools that are specifically directed at pharmacists. Therefore, the goal of this narrative review is to analyze the current landscape of critical appraisal tools and to create an aid for pharmacists and other allied health researchers to use in comparing various tools and choosing the best one for a particular study design.

METHODS

A literature search was conducted in December 2021 using the PubMed, University of Toronto Libraries, and Cochrane Library databases. The databases were searched for articles compiling and/or reviewing critical appraisal tools. The keywords used in the search were "critical appraisal", "tools", "risk of bias", and "validated", and the results were restricted to articles published between 2011 and 2021. Relevant articles and their reference lists were examined to obtain a preliminary list of potential critical appraisal tools. Tools that were described for use in critical appraisal, assessments of quality or methodology, and analysis of risk of bias were included. Tools described primarily as reporting guidelines, guides developed with the goal of helping authors know what to include in research reports, and tools described as classifying recommendations or assessing only animal studies were excluded from the preliminary list. The same databases were searched with the additional keywords "pharmacy" and/or "pharmacist" to determine if there were any critical appraisal tool recommendations specific to pharmacy. This initial search process yielded a final list of appraisal tools and where to access them (see Appendix 1, available from https://www.cjhp-online.ca/index.php/cjhp/issue/view/214), at which point the literature was reviewed to determine whether the tools had been validated and compared, and to gauge the frequency of their use in literature reviews.

For each identified tool, the original tool-development manuscript or webpage was reviewed for information. PubMed was also searched with a combination of keywords, including the name of the tool, "critical appraisal", "reliability", and "validation or validated". No publication date filters were applied for this stage of searching, because some of the critical appraisal tools that we identified were developed before 2011.

The final list of appraisal tools was additionally formatted as a comparison chart that could serve as a convenient visual selection aid for pharmacists and allied health researchers. The comparison categories—user-friendliness, efficiency, comprehensiveness, and reliability—were determined through discussion among the authors, and the rating system, from 1 star (lowest rating) to 5 stars (highest rating), was established on the basis of information from the literature search results and an analysis of how the critical appraisal tools compared with each other.

More specifically, user-friendliness was compared to indicate how easy it would be to understand and use the tool without additional training. Tools that reviewers described as requiring extra training, being more complex, and/or being more appropriate for experienced methodologists were given lower ratings. Efficiency was compared to indicate how much time would be required to complete the assessment. Tools with fewer items to complete and those described with words like "convenient" were given higher ratings, whereas tools with many items to complete and those described by reviewers as being "more demanding" or requiring more time than other tools were given lower ratings. Efficiency ratings were also influenced by findings from articles comparing tools, if available. Comprehensiveness was compared to indicate how "complete" the tool was in terms of fulfilling the requirements for the critical appraisal process for scientific articles.

If a tool could be used to assess the 3 main components—internal validity, results, and relevance—and additionally included questions similar to what pharmacists would ask when appraising scientific articles, it was given a rating of 5 stars. Tools allowing assessment of only internal validity were given a rating of 1 star, since all tools included in the review assessed internal validity.

For the last category, reliability, tools with inter-rater reliability testing or other forms of validation were given higher ratings. Tools with criticisms of reliability or limited testing were given lower scores. Tools with unclear results on reliability testing or no reliability testing were given a rating of 1 star.

RESULTS

From the literature search, 5 review articles on critical appraisal tools were identified and examined[3,8-11] (for the PRISMA diagram, see Appendix 2, available from https://www.cjhp-online.ca/index.php/cjhp/issue/view/214). One of the 5 articles was written as a resource for registered nurses,[9] whereas the other 4 articles were general reviews of the available critical appraisal tools. None of the 5 articles provided recommendations specific to pharmacy, and no pharmacy-specific reviews came up during the database searches. Certain universities, including the University of Waterloo,[12] provided links to some critical appraisal resources for pharmacy students. Bashir and Dziemidowicz[13] also published an online article discussing the theory of critical appraisal to assist pharmacists in evaluating research, providing links to selected user-friendly critical appraisal tools. In addition, the Canadian Society of Hospital Pharmacists provides a list of critical appraisal resources, but it was last updated in 2011,[14] and new tools have been developed since then.

From the 5 review articles and the online article by Bashir and Dziemidowicz,[13] a preliminary list of 21 critical appraisal tools was obtained. The National Institutes of Health (US) Study Quality Assessment Tool was excluded because the developer did not consider it to be standardized.[15] Three tools—the revised Quality Assessment of Diagnostic Accuracy Studies 2 (QUADAS-2), for diagnostic studies; the Evidence-Based Practice Process Quality Assessment (EPQA), for evidence-based projects that guide nursing practice; and the Physiotherapy Evidence Database (PEDro) scale, for physiotherapy intervention studies—were excluded because they have limited applicability to pharmacy practice. Three additional tools—the Jadad Scale and the Delphi List for RCTs and the Reisch Tool for non-randomized intervention studies—were excluded because they are no longer commonly used or recommended,[11] likely because of development of newer tools for their respective study designs. The Reisch Tool was also criticized as being too complex and specific for general use.[10] Finally the JAMA user guide was excluded because another, more recent set of tools, the CASP checklists, was developed using its recommendations. The remaining 14 critical appraisal tools and their strengths and limitations are summarized in Table 1 (where each tool abbreviation is also defined), and the selected tools are compared by category in Table 2.

DISCUSSION

In this narrative review, we have summarized the current landscape of critical appraisal tools that can be used to assess scientific articles, with a specific focus on the unique needs of pharmacists. This review can serve as an aid for pharmacists and other health care practitioners, helping them to quickly choose an optimal critical appraisal tool for the study design in question. Of the 14 tools listed in Table 1, all contain components that assess internal validity, answering the question "Are the results of the study valid?" Furthermore, 5 of the 14 tools include other components of the critical appraisal process for scientific articles (i.e., answering the questions "What are the results?" and/or "Are the results applicable or generalizable to my patient population?"). None of the tools analyzed in this narrative review included questions specific to pharmacy per se, although the CASP checklists came the closest, including components that assess internal validity, results, risks and benefits, and relevance. The 14 tools may still be incorporated into the critical appraisal process that pharmacists and allied health researchers apply for scientific articles, given that they do provide value for learning to identify and select high-quality scientific articles to support evidence-based practice.[11]

We have also created an up-to-date comparison chart (Table 2) that will serve as a guide to pharmacists and allied health researchers in selecting the appropriate critical appraisal tool, while acknowledging that these tools do not answer all questions in the critical appraisal process for scientific articles used by these practitioners. More

TABLE 1 (Part 1 of 3). Summary of Critical Appraisal Tools Useful for Pharmacists

Critical Appraisal Tool	Applicability / Study Design	Description	Components Assessed	Strengths	Limitations	Notes
RoB (Cochrane Risk of Bias tool)[16 a]	RCTs	• Tool to assess risk of bias within 6 bias domains • For each item, the assessor provides a risk-of-bias rating (high, low, or unclear risk) and supporting evidence from the article	• Internal validity only • Risk-of-bias assessment • Summary table + overall risk of bias	• Assesses important threats to internal validity and is practical to use • Results can be presented in a 2- or 3-column table, useful for journal club presentation • Has been widely accepted and recommended • About 8.8 minutes per assessment, according to Cochrane Collaboration[16]	• Requires judgment from the assessor to summarize overall risk of bias • Bias domains (i.e., incomplete outcome data and selective reporting of outcomes) may be confusing or difficult to assess; training may be required[16] • More likely to rate studies as high risk if unblinded	• Commonly recommended for RCTs[11] and was standard for Cochrane reviews (now replaced by RoB 2) • Domains developed using empirical evidence and theoretical considerations, and the tool has been evaluated
RoB 2 (Cochrane Risk of Bias tool 2)[17 a]	RCTs	• Tool to assess risk of bias within 5 domains (22 signalling questions, including conditional questions) • For each domain, the assessor answers signalling questions (total of 22, including conditional) that lead to a risk-of-bias rating (low, high, or some concerns)	• Internal validity only • Risk-of-bias assessment • Overall risk of bias	• Understandable labelling of domains (using descriptions) and bias judgments ("some concerns" instead of "unclear risk") • Signalling questions elicit information required for assessment • Available as Excel spreadsheet file (Microsoft), with macros for automation	• More complex and demanding (about 28 minutes per assessment), even for experienced reviewers[30] • Organization of response options may be confusing/less intuitive (Yes/Probably; Yes = lower risk for some questions but higher risk for others) • Sufficient training required for reliable results	• Revised Cochrane RoB tool based on literature, feedback, and recent developments in understanding of bias • Recommended by Cochrane Collaboration for RCT reviews
NOS (Newcastle-Ottawa Scale)[18]	Nonrandomized studies (cohort studies, case–control studies)	• Tool to assess quality of studies using a "star rating system" to judge quality of selection, comparability, and outcome/exposure • 8 items in each scale	• Internal validity only • Study components • Star-based scoring of components	• User-friendly and convenient to use • Star system provides a quick visual reference of study quality • Established validity and inter-rater reliability, available as just the scale or as a version with short explanations	• Not as comprehensive as other scales • Not intended to generate an overall appraisal score, only individual star ratings for each component	• More widely used in assessments of observational studies than for other types of studies[31]
ROBINS-I (Risk Of Bias In Non-randomised Studies – of Interventions)[19 a]	Nonrandomized studies of interventions	• Tool to assess risk of bias • Risk of bias assessed within 7 domains using signalling questions (total of 34, including conditional)	• Internal validity and results • Review question + study summary • Preliminary consideration of confounders and co-interventions • Risk-of-bias assessment (confounding, selection, classification, deviations, missing data, measurement of outcomes, reporting, overall) • Can use "study summary" with "review question" to determine relevance, separate from tool	• Structured and comprehensive assessment process • Signalling questions elicit information required for assessment • Clear approach for summarizing overall risk of bias • Reliability similar to that of NOS[31] • Refined through expert review, piloting, and user feedback	• Complex and demanding appraisal process, requires methodological expertise • "Too comprehensive to provide a concise critical appraisal"[31] • Took reviewers 3 hours versus 30 minutes for NOS[31]	• Designed primarily for use in developing systematic reviews • Based on popular Cochrane RoB tool and builds on signalling questions used in QUADAS-2[19]

Critical Appraisal Tool	Applicability / Study Design	Description	Components Assessed	Strengths	Limitations	Notes
MINORS (Methodological Index for Non-randomized Studies)[20]	Nonrandomized studies of interventions	• Tool for assessing methodological quality • Contains 12 items scored from 0 to 2	• Internal validity only • Study components • Scoring of components	• Simple scoring system, user-friendly and convenient to use for readers and researchers • Total score thresholds for overall quality scores	• Only tested by 2 reviewers (junior surgeon and senior surgeon)	• Originally developed for assessing surgical studies, with goal of expanding applicability
AMSTAR 2 (A Measurement Tool to Assess Systematic Reviews 2)[21]	Systematic reviews (randomized studies, nonrandomized studies, or both)	• Tool for assessing methodological quality (based on 16 items) in a checklist format • Questions framed so that Yes = positive result, No = negative result	• Internal validity only • Study components in checklist format	• Uses simple response categories that are convenient, quick, and easy to use; user only needs to understand study design • Designed for health professionals and policy-makers • Intended for reviews of health care interventions[21]	• Not intended to generate an overall appraisal score[21] • Limited binary response options	• Revision of widely used AMSTAR tool based on critiques and feedback
ROBIS (Risk of Bias in Systematic Reviews)[22][a]	Systematic reviews	• Tool for assessing risk of bias • Use of signalling questions to help judge concerns and risk of bias	• Internal validity, relevance • Assessing relevance (optional) • Identifying concerns with review process • Judging risk of bias • Overall risk of bias	• In-depth tool to assess risk of bias • Designed to evaluate reviews applicable to health care settings • Rigorously developed, with reliability similar to that of AMSTAR 2[32]	• More complex and requires more consideration to complete[22] • Developers designed the tool for use by experienced reviewers/methodologists	
AGREE II (Appraisal of Guidelines for Research & Evaluation Instrument 2)[23]	Clinical practice guidelines	• Framework to assess quality of guidelines; also provides strategy for guideline development • 6 domains (23 items), followed by 2 global rating items rated on a 7-point scale	• Internal validity only • Scope and purpose of guideline • Stakeholder involvement • Rigour of development • Clarity of presentation • Applicability • Editorial independence • Overall assessment	• Intended for health care providers, guideline developers, policy-makers, and educators • User manual contains definitions, examples, and tips to help standardize use of the tool	• Recommended that multiple reviewers use the tool to improve reliability • Tool provides only overall scores for each domain, not an overall score	• Refined version of the original AGREE tool
GRACE (Good Research for Comparative Effectiveness checklist)[24]	Comparative effectiveness research	• 11-item checklist about the key attributes of high-quality noninterventional comparative effectiveness studies	• Internal validity only • Study components • Scoring of components	• Tested on articles comparing treatment effectiveness and/or safety of drugs, medical devices, and medical procedures[24]	• No scoring system • Use limited to noninterventional studies that assess comparative effectiveness • No inter-rater reliability study	• Rigorously developed, with validation testing by multiple reviewers
CASP checklists (Critical Appraisal Skills Programme)[25]	RCTs, cohort studies, case–control studies, qualitative studies, systematic reviews	• Checklists to be used when reading and assessing research • Three sections: Are the results of the study valid? What are the results? Will the results help locally?	• Internal validity, results (including risk versus benefit), relevance • Validity of study design • Results (reporting, precision, benefits outweigh risks) • Will the results help locally? • Summary of appraisal	• Simple, quick, and easy to use • Designed for health care professionals • Good resource for framing journal club sessions	• Possibly less sensitive than other tools; unclear if validated • Designed for education workshops, primarily as a pedagogic tool (not validated as an appraisal tool)	• Developed using JAMA user guide (1994) and updated using CONSORT[25] • Developed for educational use

TABLE 1 (Part 3 of 3). Summary of Critical Appraisal Tools Useful for Pharmacists

Critical Appraisal Tool	Applicability / Study Design	Description	Components Assessed	Strengths	Limitations	Notes
CEBM guides (Centre for Evidence Based Medicine)[26]	RCTs, qualitative studies, systematic reviews	• List of questions asking if the study is valid and if the results are important and applicable	• Internal validity, results, relevance • Validity of results • What were the results? • Will the results help in caring for my patient?	• Simple and easy to use, especially for beginners in critical appraisal • Has questions and explanations for steps in the critical appraisal process	• More introductory and less elaborate than other tools • Less frequent use in literature reviews (based on PubMed keyword search) • Unclear if it has been validated	• Available in multiple languages • Developed for educational use
JBI critical appraisal tools (Joanna Briggs Institute, University of Adelaide)[27]	RCTs, cross-sectional studies, case–control studies, case reports, case series, cohort studies, qualitative research, quasi-experimental studies, systematic reviews	• Checklists for critical appraisals • Includes explanations for each question to guide assessor	• Internal validity only • Study components in checklist format	• Easy-to-use checklists with explanations • Checklists available for many different study designs • Relatively frequent use in literature reviews (based on PubMed keyword search)	• Checklists for additional study designs primarily used for qualitative research in field of nursing[10] • Unclear if it has been validated	• Designed for systematic reviews but can also be used in selecting critically appraised topics, journal clubs, and as an educational tool • Developed using JBI's standards for articles
SIGN (Scottish Intercollegiate Guidelines Network)[28]	RCTs, cohort studies, case–control studies, systematic reviews, meta-analyses	• Checklists for methodology assessments • Two files for each checklist: the checklist tool and notes with explanations for the components/questions	• Internal validity, relevance • Study components in checklist format • Overall assessment (includes section for relevance + additional comments)	• Easy-to-use checklists with explanations • Checklists available for many study designs	• Less frequent use in literature reviews (based on PubMed keyword search) • No scoring system • Described as meeting SIGN's requirements, but method of evaluation was not described, and unclear if it has been validated	• Developed using SIGN's standards for articles
CCAT (Crowe Critical Appraisal Tool)[29]	General, "designed to assess health research across all research designs"[33]	• Fillable form that must be used together with detailed user guide • 8 categories scored from 0 to 5, with checklist used as a guide	• Internal validity, results, relevance • Research design • Scores (summary) • General notes • Scored categories assessing study components	• Not specific to a particular research design; can be applied to any type of evidence • Tool tested for reliability using papers encompassing 6 research designs[34]	• Developer described tool as demanding[29] • Requires knowledge or references on research methodology to appropriately score categories • Less frequent use in literature reviews (based on PubMed keyword search)	• Developed following analysis of 44 critical appraisal tools available in 2010

RCT = randomized controlled trial.

[a]See Appendix 3 (available from https://www.cjhp-online.ca/index.php/cjhp/issue/view/214) for risk-of-bias domains assessed by these tools.

Critical Appraisal Tool and Elements	Applicability	User-Friendliness	Efficiency	Comprehensiveness	Reliability	Notes
RoB: table (various formats)	RCTs	★★★☆☆	★★★★☆	★☆☆☆☆	★★★☆☆	Developed for Cochrane reviews
RoB 2: table and signalling questions (pdf + Excel templates)	RCTs	★★★☆☆	★★☆☆☆	★☆☆☆☆	★★★★☆	Developed for Cochrane reviews
NOS: list rated with "star" scale (pdf)	Nonrandomized studies (cohort studies, case–control studies)	★★★★★	★★★★★	★☆☆☆☆	★★★★★	
ROBINS-I: table and signalling questions (pdf template)	Nonrandomized studies of interventions	★☆☆☆☆	★☆☆☆☆	★★★☆☆	★★★★★	Developed for Cochrane reviews; intended for experienced methodologists
MINORS: scored list (pdf)	Nonrandomized studies of interventions	★★★★★	★★★★★	★☆☆☆☆	★★☆☆☆	Originally developed for surgical studies
AMSTAR 2: checklist (pdf)	Systematic reviews (randomized studies, nonrandomized studies, or both)	★★★★☆	★★★★☆	★☆☆☆☆	★★★★★	Developed for clinicians and policy-makers
ROBIS: table and signalling questions (pdf)	Systematic reviews	★☆☆☆☆	★☆☆☆☆	★★★☆☆	★★★★★	
AGREE II: list rated with 7-point scale (pdf)	Clinical practice guidelines	★★★★☆	★★☆☆☆	★☆☆☆☆	★★★★☆	Developed for clinicians and guideline developers; available in multiple languages
GRACE: checklist (pdf)	Comparative effectiveness research	★★★★☆	★★★★☆	★☆☆☆☆	★★★☆☆	Developed for clinicians
CASP: checklists (pdf)	RCTs, cohort studies, case–control studies, qualitative studies, systematic reviews	★★★★★	★★★★☆	★★★★★	★☆☆☆☆	Developed for educators and clinicians
CEBM guides: checklist (pdf)	RCTs, qualitative studies, systematic reviews	★★★★★	★★★★★	★★★★☆	★☆☆☆☆	Developed for educators and clinicians; available in multiple languages
JBI critical appraisal tools: checklist (pdf)	RCTs, cross-sectional studies, case–control studies, case reports, case series, cohort studies, qualitative research, quasi-experimental studies, systematic reviews	★★★★★	★★★★★	★☆☆☆☆	★☆☆☆☆	More commonly used in nursing than in other fields[9,10]; developed to meet JBI's standards
SIGN: checklist (pdf)	RCTs, cohort studies, case–control studies, systematic reviews and meta-analyses	★★★★★	★★★★★	★★★☆☆	★☆☆☆☆	Developed for clinicians; designed to meet SIGN's standards
CCAT (Crowe Critical Appraisal Tool): checklist	General, "designed to assess health research across all research designs"[33]	★☆☆☆☆	★★☆☆☆	★★★★☆	★★★★★	Intended for those familiar with research designs and methodology; developer suggests having a general research methods textbook available when appraising papers[29]

RCT = randomized controlled trial.
[a]Ratings are based on findings from literature search and analysis by the authors.

specifically, Table 2 summarizes comparisons among the 14 tools covered in this narrative review based on user-friendliness, efficiency, comprehensiveness, and reliability. Some of the tools are user-friendly, including the NOS scale, which, according to Wells and others,[18] was developed as "an easy and convenient tool for quality assessment" and is available in the form of a brief manual that walks the reviewer through each item in the scale. The MINORS tool[20] is also user-friendly, formatted as a list with a simple scoring system. The CASP, CEBM, SIGN, JBI, AMSTAR 2, and GRACE tools are all formatted as checklists (Table 2), which makes them easy to understand and would make the appraisal process efficient, allowing users to check off the study criteria as they read a research article. In addition, the CEBM tool, while not allowing in-depth assessment and not frequently used in literature reviews (Table 1), has clear explanations that would make it a good introductory tool for beginners, such as pharmacy students.

The Cochrane Collaboration's risk-of-bias (RoB) tool requires training to interpret the bias domains[16] but can be efficient and easy to present once the reviewer has gained some familiarity. The RoB 2 tool[30] is an updated tool that is more comprehensive than the original RoB tool but, as a result, can require more consideration and understanding of the training materials to obtain reliable results. The ROBINS-I and ROBIS tools are the most in-depth tools and are best used by experienced methodologists.[31,32] In a study comparing the NOS with the ROBINS-I, both intended for assessing non-RCTs, Zhang and others[31] found that the ROBINS-I took more time to complete (3 h versus 30 min to assess a single study), which would limit its use in practice. The AMSTAR 2 and ROBIS tools, which are used for assessing systematic reviews, were compared in another study. According to Perry and others,[32] "raters felt AMSTAR-2 was more straightforward and user-friendly than ROBIS" possibly because "it does not require expertise in systematic reviewing … just knowledge of trial design." Thus, pharmacists may find the AMSTAR 2 tool more practical to use.

In terms of reliability, the NOS, ROBINS-I, AMSTAR 2, and ROBIS tools have demonstrated good inter-rater reliability.[18,21,31,32] The Cochrane Collaboration's RoB tool, while widely accepted (Table 1), has only modest inter-rater reliability because of its emphasis on assessor judgment, nonstandard implementation, and the need for training to interpret the bias domains.[16,17] The RoB 2 tool is an improvement over its predecessor, but given its greater complexity, training would still be beneficial to improve reliability in application.[17,30] The AGREE II tool is a refinement of the original AGREE tool, intended to improve validity and reliability, but it still requires multiple assessors to achieve the increased reliability.[23] The MINORS tool also had limited reliability testing, with only 2 surgeons as reviewers.[20] The GRACE checklist was piloted with comparative efficacy studies on drugs, medical devices, and medical procedures,

which resulted in good specificity and sensitivity scores relative to other quality assessment methods.[35] However, no inter-rater reliability studies have been completed (Table 1). The CASP, CEBM, JBI, and SIGN tools also had no inter-rater reliability testing completed or validation method specified, so they would be less appropriate for use in literature reviews.

Most of the tools identified were developed for conducting research, primarily research to support systematic reviews or clinical guidelines, although tools such as the MINORS, GRACE, JBI, and SIGN tools were developed with clinicians or health care decision-makers as additional end-users (Table 1). The AGREE II tool was developed for health care providers, guideline developers, policy-makers, and educators.[23] The AMSTAR 2, CASP, and CEBM tools were developed for educational purposes or for use by consumers of research, such as clinicians (Table 1). The MINORS tool was initially developed for surgical studies,[20] whereas the JBI tools are mainly used in nursing.[10] None of the tools were developed specifically for pharmacy, although the GRACE checklist was successfully applied to comparative effectiveness studies of drugs.[24]

As for possible bias and conflicts of interest, it should be noted that the RoB, RoB 2, and ROBINS-I tools were developed by the Cochrane Collaboration, and their criteria are specifically applicable to the development of Cochrane reviews (Table 1). The JBI and SIGN tools were also described as meeting the standards of their respective organizations (Table 1), but these standards were not specified and may not be applicable to other practice settings. The Critical Appraisal Skills Programme[25] and the Centre for Evidence-Based Medicine[26] provide critical appraisal workshops, so their tools may be adapted to suit an educational setting, which may in turn make the tools more appropriate for students or as introductions to critical appraisal.

Two of the tools have been translated into other languages. The AGREE II tool is available in multiple languages, with more translations in progress and available on request,[23] and the CEBM checklists are also available in several languages (Table 2). In terms of formats, all tools are available as printable pdfs, with the exception of the RoB tool, for which the documentation only provides examples of how to format the tool, and the RoB 2 tool, which is available as both a pdf and an Excel (Microsoft) template. High-reliability tools such as RoB 2 (see Table 2) are available for pharmacists to evaluate RCTs for quality of evidence. Although RCTs represent the "gold standard" for experimental design, a trial's execution and the resulting article's analysis and reporting can influence the quality of the evidence. By selecting the appropriate tools, pharmacists working in different settings can support their evidence-based practice. Pharmacists who work in a hospital setting often have opportunities to work on collaborative projects spanning all types of evidence-based research (e.g., case–control

study, cohort study, RCT, cross-sectional study, meta-analysis). The applicability column of Table 2 shows that the Critical Appraisal Skills Programme and the Joanna Briggs Institute offer tools for several study types based on the same checklist formats, which can be efficient, since pharmacists need to learn how to use only one type of tool.

A pharmacist serving on an internal interprofessional committee may be involved in developing local drug therapy manuals for their organization and would need to examine systematic reviews to find evidence for recommendations. Table 2 includes 2 tools for systematic reviews, AMSTAR 2 and ROBIS. A tool like AMSTAR 2, which was developed for health professionals and policy-makers, would be ideal for this purpose. Alternatively, if the interprofessional team has an experienced methodologist available for consultation, the pharmacist could use the ROBIS tool, and then compare tool outcomes and reach a consensus with the methodologist. In contrast, a pharmacist working in a pediatric neonatal care unit might be caring for a unique patient whose condition has only been described in case reports. In this situation, the pharmacist could review the applicability column of Table 2 and would find that the Joanna Briggs Institute has a checklist for case reports, which can be used to assess the quality of each case report identified.

Pharmacists involved in education initiatives such as journal clubs present and critique new research articles to other pharmacists. For journal club presentations, a pharmacist would likely want to employ a user-friendly and efficient tool. If presenting findings from a novel and timely RCT, for example, the pharmacist could use the RoB assessment tool to easily translate the RCT data into tables or figures for succinct presentation. If presenting findings on a cohort study or case–control study, the pharmacist could use the NOS tool to create pleasing visuals based on a star rating system.

Of the many validated tools available, most address only internal validity, with few asking questions that would provoke judgments of study applicability, limitations, and practice-changing outcomes. Moreover, no tools have been developed specifically for pharmacists, and no literature was found indicating how pharmacists could apply critical appraisal skills in practice or commenting on whether a standardized approach would be beneficial. A potential future project could take an approach similar to that used in the development of the MINORS tool,[20] with involvement of pharmacists and pharmacy leaders in the development and piloting of a critical appraisal tool specific to the literature on drugs and pharmacy interventions. In addition, many current tools are available only as pdf files that must be printed for use. Newer tools such as the RoB 2 allow creation of Excel spreadsheet files,[17] which can be more efficient but are still not as accessible as applications developed for other uses, such as MDCalc for medical calculations (www.mdcalc.com). It would be interesting to see the development of an accessible application for critical appraisals.

This narrative review had some structural limitations. In particular, it was not a systematic review and did not generate an exhaustive list of all critical appraisal tools currently available. A limitation of the comparison chart (Table 2) is that the rating score was based on findings from the included review articles rather than being determined systematically through expert consensus. The scoring system would benefit from incorporating a survey or results from a study piloting these tools with pharmacists and allied health researchers.

CONCLUSION

Critical appraisal is an essential skill for pharmacists and health care practitioners alike. Many standardized critical appraisal tools are available that can help in systematically assessing various aspects of the quality of evidence, and the current narrative review summarizes 14 tools useful for pharmacists and allied health care researchers. In examining the current landscape of critical appraisal tools, we found that no tools that have been specifically modified to serve the needs of pharmacists when assessing scientific articles. As such, future research should examine how critical appraisal tools could be improved to better identify common data elements that are essential to evidence-based decision-making in pharmacy practice.

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