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## ORIGINAL CONTRIBUTION

# The revised Approved Instructional Resources score: An improved quality evaluation tool for online educational resources

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### Abstract

**Background:** Free Open-Access Medical education (FOAM) use among residents continues to rise. However, it often lacks quality assurance processes and residents receive little guidance on quality assessment. The Academic Life in Emergency Medicine Approved Instructional Resources tool (AAT) was created for FOAM appraisal by and for expert educators and has demonstrated validity in this context. It has yet to be evaluated in other populations.

**Objectives:** We assessed the AAT's usability in a diverse population of practicing emergency medicine (EM) physicians, residents, and medical students; solicited feedback; and developed a revised tool.

**Methods:** As part of the Medical Education Translational Resources: Impact and Quality (METRIQ) study, we recruited medical students, EM residents, and EM attendings to evaluate five FOAM posts with the AAT and provide quantitative and qualitative feedback via an online survey. Two independent analysts performed a qualitative thematic analysis with discrepancies resolved through discussion and negotiated consensus. This analysis informed development of an initial revised AAT, which was then further refined after pilot testing among the author group. The final tool was reassessed for reliability.

**Results:** Of 330 recruited international participants, 309 completed all ratings. The Best Evidence in Emergency Medicine (BEEM) score was the component most frequently reported as difficult to use. Several themes emerged from the qualitative analysis: for ease of use—understandable, logically structured, concise, and aligned with educational value. Limitations include deviation from questionnaire best practices, validity concerns, and challenges assessing evidence-based medicine. Themes supporting its use include evaluative utility and usability. The author group pilot tested the initial revised AAT, revealing a total score average measure intraclass correlation

Separate components of our data and revised scoring tool were presented separately at the Council of Emergency Medicine Residency Directors Academic Assemblies, Ft. Lauderdale, FL, April 28, 2017, and New York, NY, March 9, 2020.

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coefficient (ICC) of moderate reliability (ICC = 0.68, 95% confidence interval [CI] = 0 to 0.962). The final AAT's average measure ICC was 0.88 (95% CI = 0.77 to 0.95).

**Conclusions:** We developed the final revised AAT from usability feedback. The new score has significantly increased usability, but will need to be reassessed for reliability in a broad population.

## BACKGROUND

The use of traditional medical education resources, such as peer reviewed literature and textbooks, have been at least partially supplanted by the rise in Free Open Access Medical Education resources (FOAM).<sup>1-3</sup> The explosion in FOAM production—60-fold from 2002 to 2013 and then twofold more from 2013 to 2016—coincides with increased use by emergency medicine (EM) residents.<sup>1,2,4,5</sup> FOAM's rise in quantity and popularity is likely to continue as residencies and national organizations integrate it into curricula.<sup>1,2,6,7</sup> For example, EM residency programs seeking to fulfill the Accreditation Council for Graduate Medical Education's individualized interactive instruction option can use the free, internationally available Academic Life in Emergency Medicine Approved Instructional Resources (ALiEM AIR) series that is composed solely of FOAM content.<sup>8,9</sup>

Unfortunately, quality evaluation of FOAM without an evaluation tool (gestalt) has been shown to be subpar. Additionally, great potential exists for significant patient harm secondary to the rapid propagation of incorrect information on social media, an urgent need exists for reliable, valid, and easy-to-use FOAM curation tools to guide learners in quality assessment.<sup>1,10,11,12</sup> To address this, two research groups have developed quality assessment tools. The Medical Education Translational Resources: Impact and Quality (METRIQ) team identified key quality metrics through multiple modified Delphi processes to create the METRIQ-5 and the METRIQ-8 scores.<sup>13-15</sup> Previously, feedback on the METRIQ-8 score among a diverse population of medical students, residents, and attendings resulted in improved usability with the revised METRIQ (rMETRIQ) score.<sup>14-18</sup>

An alternative quality assessment tool, the ALiEM AIR Tool (AAT) emerged from a near opposite, pragmatic approach. This tool originated through discussion among a group of nationally recognized educators, the ALiEM AIR team. After multiple subsequent revisions, the ALiEM AIR team created a FOAM curation tool that demonstrated good reliability and validity among its trained faculty educators. However, limited data exist evaluating its reliability among other levels of learner.<sup>8,19</sup>

While some may feel that tools such as the rMETRIQ or AAT are unimportant for junior learners since they often receive highly curated content, our authorship team has always felt that it is important to begin teaching these skills early in training. Moreover, with the exponential growth and volume of FOAM resources, it is unlikely that even fully trained educators would be able to assess the quality of every FOAM resource that their learners might access. Thus, it has become increasingly important to develop and evaluate quality

assessment tools for nonexpert, diverse populations of learners with the goal of improving nonexpert's ability to evaluate FOAM for quality. The primary objective of this study is to examine feedback on the AAT's usability in this general population. Our secondary objective is to use this feedback to develop a more refined and effective tool.

## METHODS

### Study design

We evaluated the AAT as part of a planned secondary analysis of data from a larger METRIQ study. Within this substudy, participants completed an online survey reviewing five clinically oriented EM blog posts with the AAT then evaluated and provided feedback on its usability.

### Survey development and distribution

A complete description of the study's recruitment methodology is published elsewhere.<sup>11,16,20</sup> In brief, participants were recruited through a multimodal strategy that involved contacting members of the FOAM community of practice on social media (Twitter and Facebook) as well as through direct contact by the study authors via email. Potential participants including medical students, EM residents, and EM attending physicians were directed to the website <https://metriqstudy.org> where they were provided study details and a unique survey link via email.

The METRIQ project leaders developed the survey, which was then internally pilot tested by four leaders (FZ, BT, TC, KK, ICG) who suggested minor changes to facilitate rater understanding. For this study, participants rated five blog posts with the AAT and then provided an evaluation of its usability, clarity, and difficulty of each of its items both using a Likert scale and using free-text responses.<sup>11,16</sup> The AAT evaluation survey questions are presented in Data Supplement S1, Appendix S1 (available as supporting information in the online version of this paper, which is available at <http://onlinelibrary.wiley.com/doi/10.1002/aet2.10601/full>).

### Data analysis

We conducted a mixed-methods analysis of the user experience with the AAT.

## Quantitative analysis

We performed a quantitative analysis of the participants evaluation of the AAT using parametric descriptive statistics and tests of significance. Variance with a two-tailed significance of  $<0.05$  was used for ease of use and likelihood of recommendation to evaluate if responses differed significantly based on geography, level of education, and frequency of FOAM utilization.

## Qualitative analysis

Two authors (AG, JJ) experienced in qualitative methods independently analyzed free response survey data using a thematic approach with a constructivist/interpretivist paradigm.<sup>21,22</sup> The constructivist/interpretivist paradigm states that truth is relative and created by the individuals in interacting with the research question at hand, which is unique from the more commonly encountered postpositivist/deductive approaches more commonly encountered in experimental or quasi-experimental quantitative education research or scholarship. The analysts examined data line by line to identify recurring concepts and assigned codes which were then further refined into themes using an iterative process. The two analysts then met to establish a final coding scheme that was applied to all data. Discrepancies were resolved by in-depth discussion and negotiated consensus.

## Creation and reliability testing of the revised AAT

We created the final revised AAT (Figure 1) using an iterative process informed by both the survey data and the additional pilot testing. In response to the feedback of the METRIQ survey data by the two authors that performed the qualitative assessment (AG, JJ) an initial revised AAT was created. Four authors (FZ, BT, TC, KK) not involved in the qualitative assessment performed pilot testing of the initial revised AAT in which they evaluated five clinical EM posts. These posts were selected by choosing the most recently published clinical post from five FOAM sites from the Social Media Index rankings as selected by Google's random number generator (<https://chrome.google.com/webstore/detail/random-number-generator/ninanjeenomfmcihkpoaelaoddaboi>?hl=en; Mountainview, CA).<sup>23,24</sup> After pilot testing, all authors provided usability feedback via in-depth discussion to address the same topics for which the initial general population provided written feedback. Given only four participants provided feedback for this part, we believed that discussion would result in higher-quality feedback than written. A qualitative assessment was not performed on this round of feedback given there were only four participants. The in-depth discussions and negotiated consensus resulted in the final revised AAT. Subsequently, authors experienced with FOAM resources (TC, KK, FZ, BT) pilot tested the final revised AAT by evaluating 20 different FOAM resources, selected

using the same method as the previous five. We calculated average measures intraclass correlation coefficients (ICCs) using SPSS version 25 (IBM Corp., Armonk, NY) for each item and total scores. We made minor additional edits to the final version to clarify items with a lower ICC.

## Ethics

The University of Saskatchewan Research Ethics Board deemed our study protocol exempt from ethical review (BEH 16-09).

## RESULTS

### Initial testing

Of 330 potential participants who expressed interest in the study, 309 participants completed the full survey. Their demographics are described in Table 1. The quantitative data demonstrate that the AAT was thought to be easy to use (93.4% of participants) and participants would recommend it to others (82.2%; Figure 2). The three items on the AAT most frequently reported as difficult to apply were the Best Evidence in Emergency Medicine (BEEM) score (28.2%), accuracy of the resource (13.3%), and evaluation of evidence-based medicine (EBM; 13.3%; Table 2).

The qualitative analysis revealed several major themes (Table 3). The AAT usability was described as having clarity, logical structure, conciseness, and alignment with educational value. Themes for tool limitations included deviation from survey design best practices (e.g., double-barreled questions and lacking an anchor for each value), validity concerns, and challenges and limitations of EBM assessment. One theme, that the user's knowledge base limits the tool's application, was skewed based on the evaluator's level of training. Nine attendings (15%), two residents (4%), and one medical student (1%) commented broadly that a lack of knowledge would limit scoring tool use. By comparison, no attendings, three residents (7%), and 19 medical students (15%) reported that they personally lacked the experience or knowledge to easily apply the tool. Themes in support of the tool included evaluative utility and usability.

By simplifying the scale, providing a complete rubric with anchors and clarifying criteria, the new tool addresses concerns identified by users and pilot testers. The initial revised AAT simplifies the scale from 7 points to 3 points and provides anchors for each score. To eliminate double-barreled questions, we simplified the BEEM score by narrowing its focusing to clinical impact alone. We also separated the author and reference tiers. We added in anchors for references to reward in-line references over listing references unanchored to the text. For content accuracy, educational utility, and EBM, we simplified the language used. Finally, for authorship we sought to provide increased scores for increased authorship transparency by scoring not just author name, but training, degrees, and conflict of interest statements.

The final revised Approved Instructional Resources (rAIR) Tool				
An evaluation tool for FOAM resources designed for medical educators				
		0	1	2
<b>BEEB RATER SCALE</b>	<b>1</b> How much does this article impact clinical practice?	Would not change clinical practice	Would change clinical practice for some clinicians	Would change practice for most clinicians
<b>CONTENT ACCURACY</b>	<b>2</b> How concerned are you about the accuracy of this article?	Extremely concerned about inaccuracies	Somewhat concerned about inaccuracies	Not at all concerned about inaccuracies
<b>EDUCATIONAL UTILITY</b>	<b>3</b> What is the educational value of this article for residents?	Not at all valuable for residents	Somewhat valuable for residents	Extremely valuable for residents
<b>EVIDENCE-BASED MEDICINE</b>	<b>4</b> Does this article reflect the practice of evidence-based medicine?	Not at all evidenced based	Somewhat evidenced based	Extremely evidenced based
<b>REFERENCES</b>	<b>5</b> Is the literature cited?	None	References are cited	References are cited inline with the text
<b>AUTHORSHIP</b>	<b>6</b> Are the authors clearly listed?	The author is named without credentials* OR no author is named or a pseudonym is used	The author is named and credentials* are listed	The author is named, credentials* are listed and conflicts of interest are declared
BEEM = Best Evidence in Emergency Medicine EBM = Evidence Based Medicine  *Listed credentials may include a certification (e.g. MD, ABEM, FRCPC), level of training (e.g. Registrar, Postgraduate Year), or relevant position (e.g. Assistant Professor, Director)			<b>TOTAL SCORE</b> (out of 12):	

**FIGURE 1** The final revised Approved Instructional Resources (AIR) tool

**TABLE 1** ALiEM AIR usability testing rater demographics

Level of training	
Medical student	38.2% (126/330)
Resident	28.8% (95/330)
Attending	33.0% (109/330)
Gender split	
Female	39.4% (130/330)
Male	60.0% (198/330)
Other	0.6% (2/330)
Age (y), mean (±SD)	31.2 (±7.3)
Manage, own, or operate a blog	
Yes	14.5% (48/330)
No	84.5% (279/330)
Country of origin	
United States	37.9% (125/330)
Canada	45.2% (149/330)
Other	16.9% (56/330)

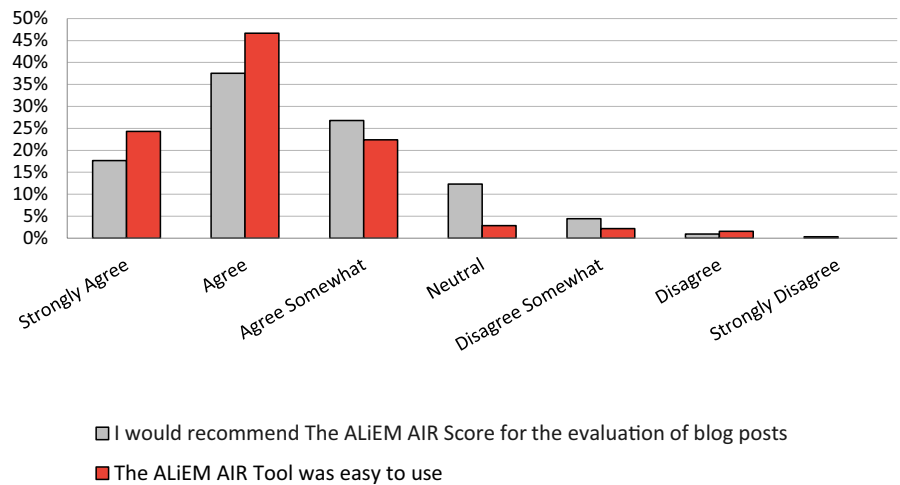
Abbreviations: AIR, Approved Instructional Resources; ALiEM, Academic Life in Emergency Medicine.

The initial revised tool pilot testing among four authors revealed an average ICC of 0.68 (95% confidence interval [CI] = 0 to 0.962), indicating moderate reliability. We incorporated feedback from the pilot testing in the development of the final revised AAT. The average ICC from additional testing among the author group using this final tool was 0.88 (95% CI = 0.77 to 0.95), indicating fairly high reliability for users of the revised AAT.

## DISCUSSION

To the best of our knowledge, this is the first study to evaluate the usability of the AAT among a general population of learners.<sup>11</sup> Generally, the qualitative analysis identified limitations secondary to the evaluator’s knowledge base as well as deviation from survey design best practices. Evaluator knowledge limitations resulted in reported difficulty determining the BEEM score, educational utility, EBM, and accuracy. The BEEM score was found to be the most difficult component to use. The original AAT deviated from best practices of question design by not having a descriptor for each anchor,

**FIGURE 2** Approved Instructional Resources (AIR) scoring tool usability and recommendation



**TABLE 2** Quantitative data—ALiEM AIR tool component usability

ALiEM AIR tool component	Item instructions	Total % of raters that found this item difficult
BEEM rater scale	Assuming that the results of this article are valid, how much does this article impact on EM clinical practice?	28.2 (87/309)
Accuracy	Do you have any concerns about the accuracy of the data presented or conclusions of this article?	13.3 (41/309)
EBM	Does this article reflect EBM and thus lack bias?	13.3 (41/309)
Educational utility	Are there useful educational pearls in this article for residents?	11.0 (34/309)
Referencing	Are the authors and literature clearly cited?	10.7 (33/309)

Abbreviations: AIR, Approved Instructional Resources; ALiEM, Academic Life in Emergency Medicine; BEEM, Best Evidence in Emergency Medicine; EBM, evidence-based medicine.

**TABLE 3** Qualitative analysis major themes

Question	Major themes	Subthemes	Exemplar quotes
Describe why the ALiEM AIR tool was easy to use	Clarity		<p>"It gave relatively clear cut criteria for evaluating a blog post."</p> <p>"The ALiEM AIR tool asked simple questions and offered simple responses."</p>
	Logical structure		<p>"It contains logical questions that are easily applied to each resource."</p> <p>"I think the tool was fairly intuitive to use."</p> <p>"Overall questions were direct and easy to apply to blog posts."</p>
	Concise		<p>"Relatively short."</p> <p>"It was easy to use because it was short and concise."</p>
	Alignment with educational value		<p>"The questions are very relevant."</p> <p>"The tool is simple and hits on several major aspects of what makes a good quality blog post."</p>
What was unclear about this/ these items?	Questionnaire best practices	<p>Double-barreled questions</p> <p>Lack of written anchors for all response items</p>	<p>"Gaps in the anchors levels leave some level of interpretation which reduced utilization."</p> <p>"More than a few blog posts did not match with any of the answers because some were 'Interesting' but not 'new', some were not 'new' but were definitely 'important.'"</p>
	Validity concerns	<p>Score utility may vary according to blog's purpose</p> <p>Score may vary depending on audience/learner level</p> <p>Score dependent on assessor's knowledge and experience</p>	<p>"'Useful educational pearls for residents' is a little too subjective and the group is too broad. Perhaps stratifying by year? Interns, juniors, seniors?"</p> <p>"FOAM has been criticized for overemphasizing sexy new topics and underrepresenting core concepts and this question could systematically down-rate important topics that are not strictly 'new.'"</p> <p>"Clinical pearls [was] challenging since I do not feel qualified to know whether the information presented would change current practice. I also did not feel qualified to comment on the key educational pearls with confidence since at this point in my training I'm just starting to learn the basics of clinical medicine."</p> <p>"Regarding accuracy. I think this implies the reader of the blog has some previous knowledge which is often not the case, making it difficult at times to answer."</p>
	EBM limitations and assessment challenges		<p>"Just because it's "EBM" doesn't mean it's without bias."</p> <p>"Without going to the source, which I didn't for any of the blogs, it is hard to say if any were actually EBM based and thus not at least partially biased (selection bias, reporting bias, etc.)."</p>
Why would you recommend the ALiEM score for the evaluation of blog posts?	Evaluative utility		<p>"It's more relevant and reflects usability better for clinical practice."</p> <p>"Seems to encompass what I would care about in a blog."</p> <p>"Criteria used to rate the blogs are those that I feel are most important to establish valuable medical education sources."</p>

Abbreviations: AIR, Approved Instructional Resources; ALiEM, Academic Life in Emergency Medicine; EBM, evidence-based medicine.

the scale size being too large, and including double-barreled questions.<sup>25</sup> For example, the BEEM score rates both recency and importance together. Similarly, the authors and references tier rates both of those together. Positive feedback described the tool as concise, clear, and containing components important in assessing quality. Additional feedback from the authors' pilot testing of the first

revision of the tool contributed to a final revised AAT with improved usability and reliability.

The only component of the original AAT that was not created by the ALiEM AIR Team was the BEEM score. Despite being described as more difficult to use in our population, the BEEM score previously demonstrated high inter-rater reliability and validity.<sup>26</sup> Our results

indicate the BEEM score reliability and usability could be improved with the revisions proposed here.

While this study parallels the development of the rMETRIQ score, the original focus of the two tools are quite different. The rMETRIQ is meant to be accessible even for junior learners, focusing on easily recognized markers of quality analogous to study quality checklists.<sup>25</sup> Conversely, the original AAT was designed for expert use.<sup>15</sup> Perhaps as a result of this, we identified different limitations of the AAT among different levels of learners. For example, all levels of learners felt comfortable identifying the authors and reference listed, but a greater proportion of medical students reported difficulties in evaluating the accuracy, impact, EBM, and educational value components of the AAT. Although the final revised AAT still requires the user to evaluate quality components and, importantly, the educational relevance of a FOAM resource, we suspect that its increased clarity and usability may increase its accessibility for junior learners.

Based on the improvement in ICC scores in our investigatory team use, the final revised tool is more usable and reliable for the assessment of quality in FOAM resources than the initial revised tool. We believe that the final revised tool may be more usable to the general population of users as well as expert evaluators. We anticipate that it will be used in multiple ways. First, the final revised AAT could play a role in helping end-users assess the quality of FOAM resources. Next, we anticipate that it could guide creators of FOAM content on how to improve the quality of their work. Finally, it may play a role in assessing the quality of resources for research and curricula (e.g., the Systematic Online Academic Resource [SOAR] review series, the ALiEM AIR series, and Foundations of EM).<sup>7,8,27</sup>

## LIMITATIONS

The METRIQ study included a large sample of FOAM users at different stages of their career. However, the recruitment method intentionally targeted clinicians who already used resources such as blog posts. While this was our target population, our results may not be generalizable to a less experienced population (i.e., users new to social media). While the METRIQ study recruited internationally, most participants did come from North America and other predominantly English-speaking countries so challenges with the usability of the AAT among nonnative English speakers may not have been fully addressed. Next, our study is survey-based and thus subject to the inherent limitations of this methodology. While we feel that our revision of the AAT has improved its usability significantly, it has not been reevaluated among a broad population of clinicians and learners.

## CONCLUSIONS

We developed the final revised ALiEM AIR tool to address usability feedback on the original ALiEM AIR tool. The new tool has

significantly increased usability and reliability, but still needs reassessment in a broad population. The refinement of the ALiEM AIR tool can offer structure to evaluating a Free Open-Access Medical education resource and ensuring that clinicians are not misled by potential bias or inaccuracies. We anticipate that the final revised ALiEM AIR tool will continue to be used by educators to identify high-quality resources for their learners and as more broadly as a tool by clinicians and learners seeking to assess the quality and educational relevance of Free Open-Access Medical education resources.

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### CONFLICT OF INTEREST

The authors have no potential conflicts to disclose. All authors had full access to all the study data and had final responsibility for the decision to submit for publication.

### AUTHOR CONTRIBUTIONS

Andrew Grock, Fareen Zaver, Brent Thoma, and Teresa Chan developed the study design. Isabelle Colmers-Gray and Andrew Grock organized the quantitative data, Teresa Chan conducted the data analysis, and Jaime Jordan and Andrew Grock performed the qualitative analysis. All authors contributed to the revisions of the AIR score and the writing of the paper.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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