Open Forum Infectious Diseases

MAJOR ARTICLE

Beyond Words: Enhancing Clinical Guideline Comprehension With Icons

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Background. The Grading Recommendations, Assessment, Development, and Evaluations (GRADE) framework is widely applied in clinical guidelines to facilitate transparent evidence evaluation. While developing Infectious Diseases Society of America (IDSA) guidelines on the management of patients with coronavirus disease 2019 (COVID-19), panel members suggested developing and implementing a visual aid to enable quicker identification of key information by providers at bedside seeking guidance.

Methods. We conducted a mixed-methods study evaluating the usability of a newly designed infographic/icon using a survey and focus groups. The survey incorporated a simulated COVID-19 IDSA guideline with and without the icon, followed by comprehension questions. Focus group discussions provided qualitative feedback on the GRADE methodology and icon usability.

Results. The survey was returned by 289 health care providers. There was no statistical difference in the correct response rates between icon-aided and non-icon-aided guideline questions (McNemar's chi-square test, $P > .1$ for both questions). Interactions with the icon notably increased the time taken and number of clicks required to respond to the first question (Wilcoxon signed-rank test, $P < .01$). In contrast, response time did not differ between versions for the second question ($P = .38$). Most subjects (85%) indicated that the icon improved the readability of the guidelines. A focus group follow-up suggested alternative designs for the icon.

Conclusions. This study highlights the promise of iconography in clinical guidelines, although the specific icons tested did not measurably improve usability metrics. Future research should focus on icon design and testing within a formal usability framework, considering the impact of GRADE language on user experience.

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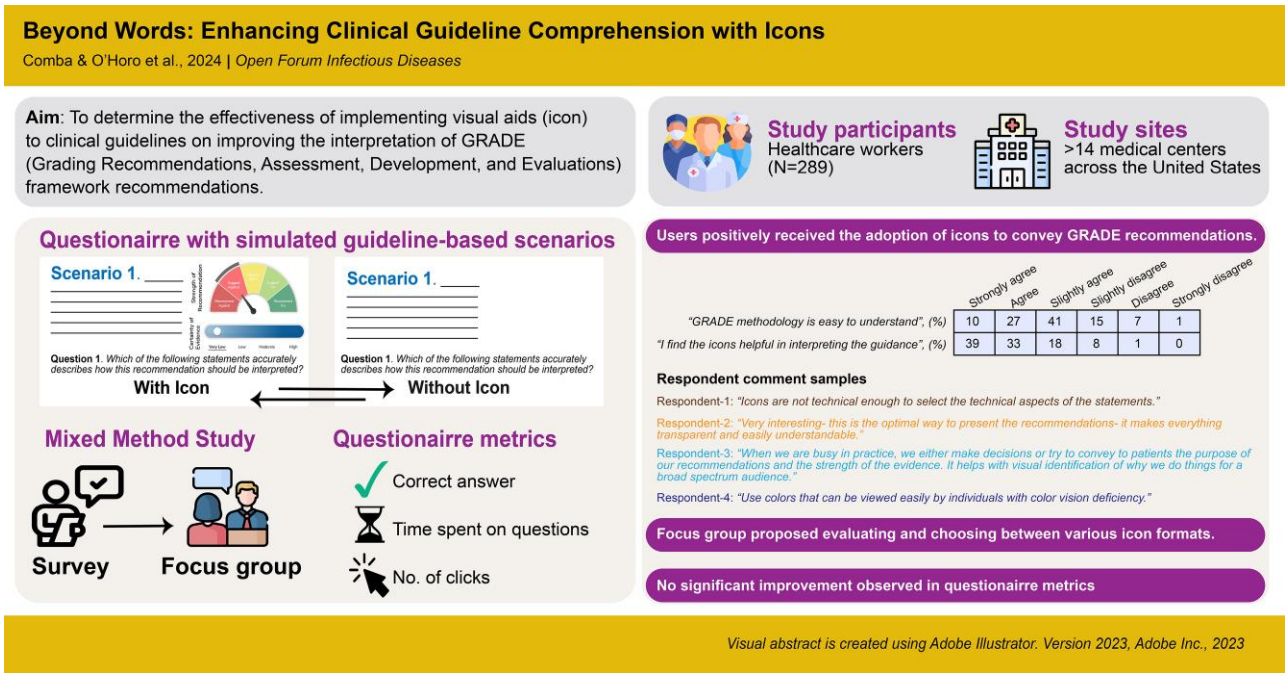
Graphical Abstract



Keywords. evidence-based medicine; GRADE; icons; infectious disease guidelines; visual aids.

Clinical guidelines offer health care providers (HCPs) recommendations to deliver contemporary evidence-based care [1]. However, due to the detailed synthesis of evidence necessary for development, their inherent complexity often poses interpretation challenges. Therefore, HCPs' understanding and interpretation of guidelines are pivotal for effectively translating evidence-based medicine into practical clinical applications [2, 3]. Variations in clinical practice can be attributed to various factors, including the overwhelming volume of guidelines requiring significant time for consistent updates and ambiguous recommendations [3].

The Grading Recommendations, Assessment, Development, and Evaluations (GRADE) approach is a standardized framework initially described in 2004 [4]. It is used extensively in clinical guidelines as evidence appraisal and has been adopted by >110 organizations to date [5]. This framework uses specific terminology to communicate the strength of the recommendations and certainty of the evidence [6]. Although the GRADE approach provides transparent guidance on moving from evidence to recommendations, the technical nature of its terminology may need to be more readily interpretable by busy bedside providers seeking immediate guidance.

Using symbols to communicate the certainty of evidence and strength of recommendations has been previously suggested [7, 8]. Initially, symbols such as arrows, circles, stars, and traffic lights were proposed [8]. The GRADE working group later refined this approach, suggesting a preferred symbolic representation: a combination of a plus inside a circle and empty circles to denote the quality of evidence and upward or downward arrows to indicate the strength of recommendations [7]. To better convey recommendation strength and reduce confusion from varied alphanumeric use by organizations, the working group advocated a dual approach in guideline development, combining words with less ambiguous symbols [7]. Despite these efforts, a recent study revealed a significant heterogeneity in the visual representation of recommendations employed across guidelines [9].

Visual icons, commonly used in other fields to rapidly understand complex concepts, offer a potential solution [10]. These icons can allow for the quick identification of critical information, aiding clinicians in applying guidelines efficiently in their practice [11]. In clinical guideline review, readers process text to determine the appropriateness of actions in specific situations. Adding iconography to supplement text about GRADE criteria could reduce cognitive load, as it engages different neural networks than text-based communication.

The utility of iconography to convey meaning can be multifactorial and dynamic. For instance, familiarity with an icon can be a factor [12]. The effectiveness of icons in enhancing interpretation of the GRADE recommendations is an area with limited data. While developing the Infectious Diseases Society of America (IDSA) guidelines for coronavirus disease 2019 (COVID-19) management, the panel hypothesized that

the efficiency and speed of interpreting the GRADE level of a recommendation could be improved by implementing an iconography accompanying the text-based recommendation. Therefore, we undertook a mixed-methods study to evaluate a candidate icon to assist in communicating GRADE recommendations for a clinical guideline.

METHODS

Study Design

We conducted a mixed-methods assessment of a proposed icon using a combination of survey and focus group methodologies. An icon (Figure 1) was designed collaboratively with input from the authors to capture the certainty of evidence and strength of recommendations within the GRADE approach. We incorporated the icon into a survey (Table 1), which included a simulated COVID-19 IDSA guideline, demographic questions, and queries about survey experiences. The icon was displayed next to the question, with an option to click on it for enlargement. To ensure the validity of the findings and to mitigate potential bias stemming from participants' prior clinical knowledge, a fictional medication recommendation was presented in the survey, utilizing the GRADE language and format, and then a comprehension question was asked regarding the scenario.

Survey Distribution and Data Collection

Clinicians in infectious diseases, hospital medicine, and emergency departments at participating institutions were invited to participate in the study through email-only invitations. We distributed the surveys with and without the icon to >14 academic medical centers. The survey presented each participant with 2 identical scenarios, differing only by the presence or absence of an icon. We randomized the order in which they encountered the scenarios: half of the subjects saw the scenario with the icon first and half without. We administered the survey using Qualtrics [13]. Various outcome metrics were employed to assess outcomes, including the accuracy of responses, time spent on each activity, and total mouse click counts. Additionally, we used a Likert scale to determine participants' perceptions regarding the icon's effectiveness in clarifying the recommendation.

Following the survey, we invited some participants to join voluntary focus groups to gain deeper insights guided by the results from the survey portion. These semistructured interviews were conducted in small groups to gather detailed feedback on the GRADE methodology and icon usability. A trained user experience designer and researcher facilitated 2 focus group sessions with 2 participants.

Statistical Analysis

We used descriptive statistics using frequencies and proportions for categorical data and median and interquartile range (IQR) for continuous variables. Categorical data were analyzed using McNemar's chi-square test with continuity correction, while paired comparisons for continuous variables were performed using the Wilcoxon signed-rank test. Comparisons between agreement groups were conducted using the Fisher exact test and Pearson's chi-square test. We set statistical significance at $P < .05$ and performed analysis and

Figure 1. Visual aid implemented in a simulated IDSA COVID-19 guideline–based questionnaire. The visual aid was developed to efficiently convey the GRADE framework. The strength of the recommendation is shown in the upper section as a speedometer-style icon, with colors ranging from red ("recommend against") to green ("recommend for"), and intermediate recommendations in between. The certainty of the evidence is illustrated in the lower section as a blue gradient bar, scaled from "very low" to "high." The icon was placed alongside guideline recommendations, with an option to enlarge it for clearer visibility. Abbreviations: COVID-19, coronavirus disease 2019; GRADE, Grading Recommendations, Assessment, Development, and Evaluations; IDSA, Infectious Diseases Society of America.

Table 1. Simulated Guideline Questions

1. Among hospitalized patients with COVID-19, the IDSA guideline panel suggests against the use of inflamomodulin (conditional recommendation, very low certainty of evidence). Which of the following statements accurately describes how this recommendation should be interpreted? (a) Would be inappropriate for all patients under all circumstances. (b) May be used in some patients but would not be routinely recommended. (c) Is based on high-quality evidence synthesis and assessment. (d) Would be recommended for most patients and settings. (e) Should only be given in the context of a clinical trial or research environment.
2. Among hospitalized patients with COVID-19, the IDSA guideline panel recommends the use of roxyquinolone (strong recommendation, moderate certainty of evidence). Which of the following statements accurately describes how this recommendation should be interpreted? (a) Would be inappropriate for most patients and settings. (b) May be used in some patients but would not be routinely recommended. (c) Is based on high-quality evidence and synthesis. (d) Would be recommended for most patients in all settings. (e) Should only be given in the context of a clinical trial or research environment.

Abbreviations: COVID-19, coronavirus disease 2019; IDSA, Infectious Diseases Society of America.

visualization using the "arsenal" [14] and "ggplot" [15] packages in R statistical software (version 4.2.3; R Core Team 2023) [16].

Patient Consent

The Mayo Clinic Institutional Review Board exempted this study as per 45 CFR 46.104d, Category 2. The study does not include factors necessitating patient consent.

RESULTS

Overall, 289 providers from >14 institutions responded to the survey (Table 2). About two-thirds (63%) of these participants were attending or consulting providers. The remainder primarily comprised advanced practice providers (27.5%) and residents/fellows (4%). Regarding specialty representation, primary care was the most prevalent at 38%, followed by infectious diseases (20%) and emergency medicine (15%). Regarding their guideline reading habits, most respondents preferred reading guidelines on a PC rather than on tablets or mobile devices, and most preferred summaries or secondary sources to the entire guideline (Table 2).

Table 2. Description of Survey Participants

	Study Cohort (n = 289), No. (%)
Site	
Cleveland Clinic	27 (9)
Cleveland VA Medical Center	3 (1)
Johns Hopkins	1 (0.3)
Massachusetts General Hospital	1 (0.3)
Mayo Clinic Arizona	2 (0.7)
Mayo Clinic Health System	60 (21)
Mayo Clinic Jacksonville	1 (0.3)
Mayo Clinic Rochester	100 (35)
Northwestern University	15 (5)
Other/not specified	69 (24)
Temple University	1 (0.3)
Tufts Medical Center	1 (0.3)
University of Wisconsin School of Medicine and Public Health	7 (2)
VA Northeast Ohio Healthcare System	1 (0.3)
Which of these describes your current role?	
Attending/consulting provider	182 (63)
Advanced practice provider	79 (27)
Resident/fellow	11 (4)
Nurse	5 (2)
Other	10 (3)
Missing	2 (1)
What is your primary specialty?	
Primary care medicine	103 (36)
Infectious diseases	54 (19)
Emergency medicine	41 (14)
Critical care medicine	36 (12)
Hospital medicine	28 (10)
Other	10 (3)
Missing	17 (6)
I prefer to read guidelines on a PC	215 (74)
I prefer to read guidelines on a phone or tablet	96 (33)
I prefer to read whole guidelines	32 (11)
I prefer to read guideline summaries	201 (70)
I prefer to read guidelines at the point of care	159 (55)
I prefer to read guidelines from secondary sources	199 (69)

Abbreviation: VA, Department of Veterans Affairs.

Survey Evaluation

We then presented the 2 questions with and without the icon. In the paired analysis, we saw no statistically significant difference in the accuracy of responses for both questions ($P > .1$) (Table 3). For question 1, we noted significant differences in the time taken to answer and the click count, with the icon version requiring more time and clicks ($P < .01$). For question 2, response times did not significantly differ between versions ($P = .38$). However, the icon version resulted in a higher click count, like the findings in question 1 ($P < .01$).

When asked about the guideline methodology on a Likert scale, a majority (40%) slightly agreed that the IDSA guideline methodology was easy to understand, with considerable response variation (Figure 2*A*). Fourteen percent slightly disagreed, and 7% disagreed with this statement. A more substantial majority believed the icon improved guideline readability (Figure 2*B*). For example, 18% slightly agreed, 32% agreed, and 35% strongly agreed that the icon helped improve guideline readability. The survey results were dichotomized into 2 groups: a positive agreement group ("slightly agree," "agree," and "strongly agree") and a negative agreement group ("slightly disagree," "disagree," and "strongly disagree"). These groups were compared based on baseline characteristics to elucidate factors associated with Likert responses, as detailed in Supplementary Tables 1 and 2. For the question related to the perceived easiness of the IDSA guideline methodology, the positive agreement group exhibited higher proportions of professionals in infectious diseases and critical care medicine ($P = .03$). In contrast, the negative agreement group tended to prefer consulting guidelines at the point of care ($P = .05$).

Before the focus group assessment, 40 respondents provided comments at the end of the survey. Some respondents stated that the icon facilitated quicker interpretation and reduced the need for re-reading. Specifically, respondents noted that the use of icons enhanced the comprehension of guideline recommendations and reduced misinterpretations, with 1 provider stating their potential role in visually conveying the reasoning for his recommendations to patients during busy clinical practice. Criticisms primarily focused on the survey's wording and the icon's design. Key suggestions for improvement centered on refining the wording for clearer question stems and choices, particularly by indicating the clinical setting (eg, hospitalized, ambulatory), and revising the icon design. Recommendations for the icon design included adopting color

Table 3. Results of Paired Analysis

	Icon Version (n = 289)	Nonicon Version (n = 289)	P^a
Question 1			
Correct answer, No. (%)	175 (61)	161 (56)	.14
Time, median (Q1, Q3), sec	8.78 (2.18, 27.75)	3.80 (1.60, 13.38)	<.01
Click count, median (Q1, Q3)	1.0 (1.0, 3.0)	1.0 (1.0, 2.0)	<.01
Question 2			
Correct answer, No. (%)	184 (64)	187 (65)	.79
Time, median (Q1, Q3), sec	5.42 (1.99, 16.04)	3.98 (1.66, 14.95)	.38
Click count, median (Q1, Q3)	1.0 (1.0, 3.0)	1.0 (1.0, 2.0)	<.01

We report categorical variables as No. (%) and continuous variables as median (Q1, Q3).

[a]*P* values were generated using McNemar's chi-square test with continuity correction and Wilcoxon signed-rank test.

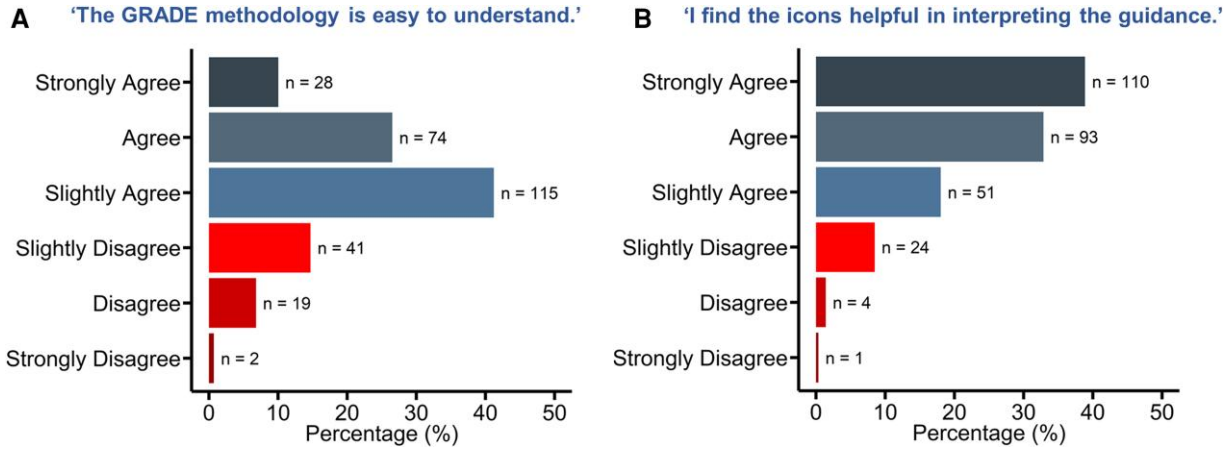


Figure 2. Likert responses to the statements (*A*) "The GRADE methodology is easy to understand" and (*B*) "'I find the icons helpful in interpreting the guidance." In both panels, the vertical bars indicate the percentage of respondents for each category of agreement, arrayed along the horizontal axis. The data annotations above the bars denote the number of respondents per category. Abbreviation: GRADE, Grading Recommendations, Assessment, Development, and Evaluations.

schemes that are friendly to color-blind individuals and incorporating sound elements to enhance understanding. Three respondents found the icon unnecessary and stated that it needed more technical aspects to deliver the GRADE framework.

Focus Group Evaluation

The focus group, consisting of 2 sessions with 2 participants each from a single institution, provided valuable feedback. The participants agreed that the icon effectively communicated the certainty of evidence. However, there was some disagreement regarding its representation of the strength of the GRADE recommendations, leading to some controversy. The group proposed evaluating and choosing between various icon formats and recommended a study on the effectiveness and preference of varying formats to aid in interpreting the GRADE criteria.

DISCUSSION

The primary outcome of our study was that while users preferred the icons, this did not translate to any measurable improvement in usability. Users positively received and supported the adoption of an icon to convey GRADE recommendations. The observed shortcomings could be attributed to the specific icon selected for our study. Future icon research should concentrate on the design phase, emphasizing thorough validation through A/B testing of different icons.

The GRADE framework comprises 2 principal elements: evidence certainty and recommendation strength. Certainty of evidence has 4 categories: very low, low, moderate, and high. These are a continuum of each other, and the continuum grades the overall body of evidence. The strength of the recommendations has 2 categories: strong and weak (conditional) [17]. This dichotomous classification has distinct implications for clinicians and is determined by 4 main factors: (1) the balance between desirable and undesirable effects, (2) the certainty of evidence, (3) patient values and preferences, and (4) resource allocation [7, 18, 19]. Therefore, interpretation of the GRADE recommendations can be complex. Enhancing the clarity and simplicity of the GRADE framework is essential to support evidence-based clinical decisions, thereby improving its practical use in clinical settings.

Griffon et al. studied the usability of a user interface based on compositional iconic language [20, 21] to enhance information retrieval in a French guideline search engine. The interface with filtering based on icons significantly increased the success of relevant information from the search engine. Despite the improvement in performance in finding the resource, it cost significantly more time [20]. However, another study [22] incorporating a graphical summary and iconic indexation on a clinical guideline showed that response time was similar to a textual interface. Like the findings of Griffon et al., we found that the use of icons resulted in a statistically significant increase in response time and number of clicks. This likely stems from participants needing time to acquaint themselves with the new visual aid and verify its relevance. No significant differences were observed in response times for the second question when comparing the icon and nonicon versions. As users routinely engage with and become familiar with the visual aid, their efficiency in processing the information may improve, potentially reducing response times [23, 24].

The main strengths of this study are its size and the volume of feedback we received from frontline clinicians. The enrollment from multiple institutions strengthens the study's validity and the generalizability of its results. Additionally, this study is the first to examine the usability of a specially designed infographic/visual aid for the GRADE approach. The initial acceptance of this method by end users is a promising sign for its future implementation.

This study has multiple limitations; the use of an artificial guideline, while helpful in limiting the role of prior knowledge in response/performance on the tasks, also takes the application of the guideline further from actual clinical practice application. Additionally, a larger sample size and diversifying the institutional representation from different settings (teaching, nonteaching) and locations could help better assess the impact of these visual aids on a broader scale. The survey was distributed to 14 medical centers in a short period of time, making it difficult to monitor and accurately assess the crude response rate. The authors recognize this as a limitation of the study and potential source of sampling bias. Last, the providers did see the same question twice, which would allow for "learning" between the sessions and potentially generate some bias in performance when confronted with the same scenario a second time.

There are several potential directions for future work. First, incorporating participant feedback into the icon design and testing the feasibility of using multiple icons in clinical guidelines through pilot studies could enhance usability and improve the perception of icons among a broader audience. Second, while we employed a counterbalancing approach to minimize individual differences in comprehension and interpretation by exposing all participants to both versions (with and without the icon), we recognize the potential for learning effects. To mitigate this, a randomized controlled study design could be implemented in future research. Last, integrating and testing auditory aids as a complementary sensory component could enhance the user experience. This approach would provide valuable insights into how visual and aural aids can improve the interpretability and usability of clinical guidelines.

CONCLUSIONS

In conclusion, the iconography approach appears promising and was well received by end users. However, the lack of impact on end user interpretation suggests that there are better solutions to this identified gap than the specific icons used here. Evaluation of future icons should involve design and testing with a formal usability framework and a design to assess further the GRADE language's impact on user experience and interpretation. Additionally, we need to point out the likelihood that the utility of and preference for iconography will grow over time. Unsurprisingly, this study showed no difference in accuracy with the first interaction with an icon. Similarly, the amount of time and attention conjured by the first red octagon placed at the roadside in 1954 was likely greater than the amount of time and consideration it takes to hit the brakes when confronted by today's intersection signage. While we may have yet to identify the optimal icon, selecting and consistently using iconography in guidelines could lead to a more helpful heuristic over time.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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Availability of data. Data available upon request.

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