ORIGINAL RESEARCH—CLINICAL

Usability of a Mobile Point-of-Care App for the Index of Severity for Eosinophilic Esophagitis

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BACKGROUND AND AIMS: A new application (app) allows the Index of Severity for EoE (I-SEE) to be used at the point of care. We aimed to perform usability testing of the I-SEE mobile app and identify areas for improvement. **METHODS:** We recruited 60 practitioners (20 adult and 20 pediatric gastroenterologists; 20 allergists) to use I-SEE on ≥5 EoE patients seen in clinic and undergo interviews by trained qualitative researchers. The interview guide focused on overall user experience, user satisfaction, and desired improvements. It also explored potential perceived barriers to using the app and I-SEE. **RESULTS:** Though I-SEE was new to most providers, they found it took only a few minutes to calculate the score. All interviewees either "agreed" (5%) or "strongly agreed" (95%) with the statement, "The app was easy to navigate," and almost all (95%) either "agreed" (42%) or "strongly agreed" (53%) with "The app's features and functionalities were intuitive and easy to understand". The large majority (85%) reported satisfaction with the app. Responses were similar for allergists, and adult and pediatric gastroenterologists. Areas of suggested improvement included updating design features, incorporation into electronic medical records, addressing if scoring for children and adults should be different, and clarifying clinical implications of I-SEE for management. **CONCLUSION:** The I-SEE app was user friendly and able to be completed rapidly in clinical practice. Interviewee feedback led to app updates to improve visualization and use. In the future, scoring for children should be confirmed and I-SEE should be validated by linking severity to treatment and monitoring recommendations.

Keywords: Eosinophilic Esophagitis; Severity; App; Assessment

Introduction

Eosinophilic esophagitis (EoE) is a chronic esophageal disease that affects people across their lifespan. It is associated with decreased quality of life and leads to esophageal remodeling.[1–3] The presentation of EoE is heterogeneous. Children can have nonspecific symptoms such as feeding difficulties, poor growth, abdominal pain, and vomiting, and often have inflammatory features on endoscopy, such as exudates, edema, or linear furrows.[4,5] In contrast, adolescents and adults typically present with dysphagia and food impaction, and because of a longer symptom duration before diagnosis, frequently have fibrostenotic features on endoscopy such as rings, strictures, or narrowing.[6–8] Additionally, multiple phenotypes beyond endoscopic appearance have been reported, including allergic comorbidities vs no other atopy, pediatric vs adult onset, connective tissue disease–associated, and others.[9–14]

This variable presentation of EoE can also be associated with disease severity, but until recently there was not a formal method for classification of severity in EoE. However, the introduction of the Index of Severity for EoE (I-SEE)[15] allows providers to assess severity of EoE over 3 domains (symptoms and complications; inflammatory features; fibrostenotic features) and calculate a score that categorizes EoE as mild, moderate, severe, or inactive. Initial studies of I-SEE using data from a randomized controlled trial and retrospective and prospective cohorts has shown that severity tracks with clinical and molecular features, and that I-SEE has utility across age ranges for monitoring the disease over time.[16–18] Based on this, a phone-based mobile application ("app") was developed in collaboration with the American Gastroenterological Association as a point-of-care tool to allow easy calculation of I-SEE in real time. The I-SEE app uses all elements from the original publication's table,[15] and allows quick selection of each feature, provides educational information about each domain and feature so that a

Abbreviations used in this paper: **app, mobile application; EoE, eosinophilic esophagitis; I-SEE, Index of Severity for EoE.**

Most current article

2772-5723
https://doi.org/10.1016/j.gastha.2024.100604

user can understand how to answer each question, and automatically calculates the score and severity category.

Because this app was new, and though it had been trialed by the same steering committee that was involved with devising I-SEE, there remained a need to assess the app in a wider group of providers. Therefore, the aims of this study were to perform usability testing of the I-SEE mobile app, gauge overall user reaction to the app, identify areas for improvement, and inform the development of future iterations of the app.

Methods

In collaboration with Knighten Health, LLC, we recruited 60 health-care practitioners purposefully split between 20 adult gastroenterologists, 20 pediatric gastroenterologists, and 20 allergists (across both pediatric and adult practices). All eligible practitioners saw EoE patients at least weekly, and also agreed to use the app with data from at least 5 patients seen clinically. All gastroenterologists, allergists, and 10 pediatric gastroenterologists were recruited using a health-care panel maintained by a market research company. The remaining 10 pediatric gastroenterologists were identified by the steering committee.

After agreeing to participate, one-on-one 30-minute interviews were conducted with each provider virtually via Zoom. All interviewees were paid a stipend to participate and promised confidentiality to ensure robust and frank discussion. The interviews were conducted by trained qualitative researchers. The interview guide focused on overall user experience with the app, user satisfaction, and desired improvement of features. It also explored potential perceived barriers to using the app and delved into additional opportunities for using I-SEE. For this usability testing, patient data were not stored or analyzed in the app, as the goal was to assess usability of the app itself rather than assess patient severity.

At the end of the interview, participants completed a survey rating their levels of agreement on a scale of strongly disagree, disagree, agree, and strongly agree with the following statements: 1) The app was easy to navigate; 2) The app's features and functionalities were intuitive and easy to understand; 3) The app is visually well-designed; 4) Overall, I'm satisfied with this app; and 5) I will continue to use this app. Given the sample size of 60 practitioners, it was felt appropriate to include this quantitative aspect in an otherwise qualitative study, and the responses from these questions were summarized. However, it should be noted that the in-depth interview is a qualitative research technique. Results of in-depth interviews are not statistically projectable to the population from which participants are drawn. Like other qualitative research techniques, in-depth interviews enable researchers to gain insight into the attitudes, beliefs, motivations, and behaviors of the target population.

Results

The 60 interviewees practiced in a variety of settings including solo private practice (n = 8; 13%), small medical practices with 2–5 providers (n = 9; 15%), large medical group practices with more than 5 providers (n = 17; 28%), small hospital-based practices with fewer than 100 beds (n = 1; 2%), and large hospital-based practices (n = 25; 42%). Study participants were recruited from various regions across the country. All 60 selected practitioners were able to complete the interview.

Overall, though I-SEE was new to the majority of them, the interviewees said that the app was very "user-friendly" and "intuitive" (Figure). Many were pleasantly surprised that it took them only a few minutes to calculate the score. None of the interviewees had issues with the app download or encountered any technical issues while using the app. Responses to the survey were relatively similar for allergists, adult gastroenterologists, and pediatric gastroenterologists (Table 1). All interviewees either "agreed" (5%) or "strongly

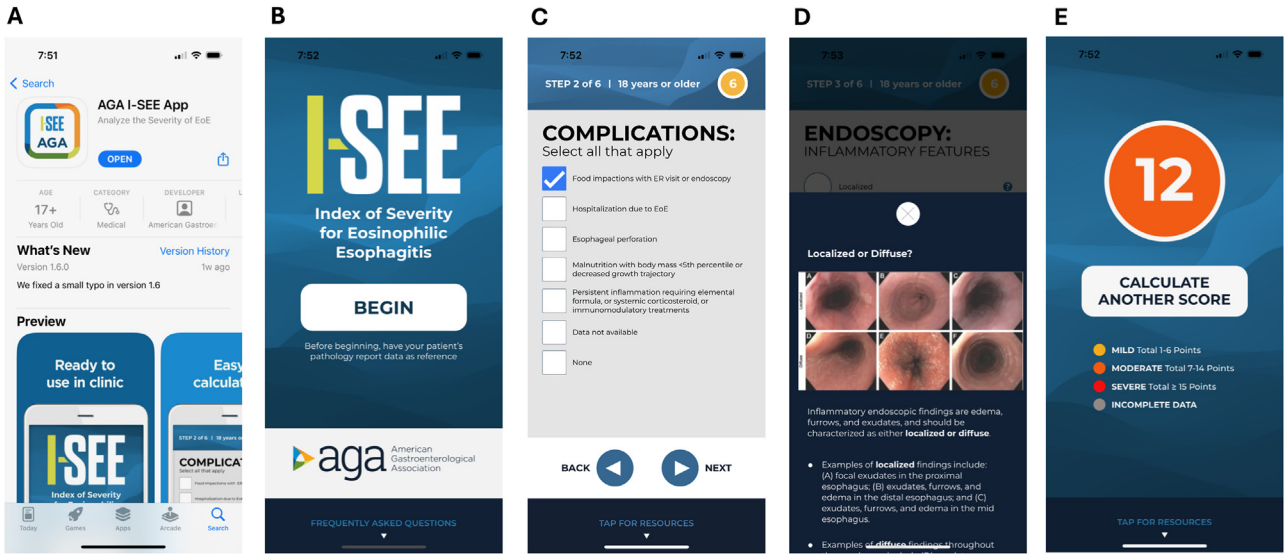

Figure. Selected screenshots from the I-SEE app. (A) The download screen for the app. (B) The home page to start calculating I-SEE. (C) An example of a page to fill out the complications domain. (D) The "tap for resources" page for the inflammatory endoscopy features explaining how to score this element. (E) The final page providing a score of 12, in the moderate range.

Table 1. Responses of Allergists (n = 20), Adult Gastroenterologists (n = 20), and Pediatric Gastroenterologists (n = 20) to Questions About Usability of the I-SEE App

Survey question	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly agree (%)
The app was easy to navigate				
Allergists	0	0	10	90
Adult gastroenterologists	0	0	0	100
Pediatric gastroenterologists	0	0	5	95
The app's features and functionalities were intuitive and easy to understand				
Allergists	0	0	55	45
Adult gastroenterologists	0	5	30	65
Pediatric gastroenterologists	0	10	40	50
The app is visually well-designed				
Allergists	0	10	40	50
Adult gastroenterologists	0	0	45	55
Pediatric gastroenterologists	0	5	45	50
Overall, I'm satisfied with this app				
Allergists	0	10	40	50
Adult gastroenterologists	0	0	45	55
Pediatric gastroenterologists	0	5	45	50
I Will continue to use this app				
Allergists	5	30	45	20
Adult gastroenterologists	0	30	30	40
Pediatric gastroenterologists	5	25	55	15

agreed" (95%) with the statement, "The app was easy to navigate," and almost all (95%) either "agreed" (42%) or "strongly agreed" (53%) with the statement, "The app's features and functionalities were intuitive and easy to understand" (Table 1). Similarly, the large majority (85%) of the interviewees said that they were satisfied with the app, with 56% agreeing and 28% strongly agreeing. Additionally, 65% of allergists, 70% of gastroenterologists, and 70% of pediatric gastroenterologists said that they would continue to use the app, with 30%–35% noting they would not continue to use it.

Representative quotations from interviewees are shown in Table 2. Most were excited to have an objective score to track patient progress and could project several uses and benefits for I-SEE including having a numerical dimension to assessing a patient's condition, having a common language among practitioners, having data to show patients their progress and help with adherence, and performing clinical research. Some participants did not see the practicality until I-SEE could be incorporated into electronic medical record system. Interviewees also raised potential issues with availability of data required to complete I-SEE, including related to fibrostenotic features on histology and the need to perform endoscopies (or have endoscopic data) for completion of I-SEE, particularly if a patient did not have a recent procedure. Moreover, if there were gaps in data, the utility of a score with missing components was questioned. Pediatric providers were not sure that the severity metrics reflected the clinical severity they are seeing in their own patients. Both adult and pediatric providers also expressed the need to understand the clinical implications of the I-SEE score and link I-SEE to treatment and monitoring recommendations.

Finally, interviewees provided feedback for adjustments to the app in terms of font size and other visual aspects, clarification of instructions, ease of tapping on icons on the screen, and additional features such as linking to guidelines and current EoE treatment data. Beyond monitoring the clinical course of the disease, interviewees saw other opportunities for using I-SEE including clinical trials and validation studies.

Discussion

The I-SEE is a clinician-completed tool that assesses severity in EoE, categorizing patients as mild, moderate, or severe.[15] Developed by a consensus group and incorporating clinical elements that define severity, the original I-SEE tool has been shown to correlate with clinical features that are not elements used to define severity, be responsive to treatment, and have utility for longitudinal follow-up of patients.[16–18] However, to implement I-SEE in wider clinical settings, an app was developed for point-of-care use. In this study, we assessed usability of this app in 60 providers, split evenly between allergists, adult gastroenterologists, and pediatric gastroenterologists. Overall, the app was easy to use and received positive comments, but some elements required clarification which resulted in updates to the app to implement these suggestions.

As most of the participants who assessed the app were new to the I-SEE, which was purposeful to obtain initial impressions, based on their feedback it was clear that education related to severity in EoE as well as the I-SEE itself, will be needed. This is not surprising with a new tool, and

Table 2. Representative Quotes on I-SEE Usability

Topic	Representative quotes
Overall experience	"I thought it was easy to use. The instructions were clear. The response time is good. There was no lag in making selections. The look of it is ok. Very user-friendly, very fast to get the final score. Whatever features you are going to add, the app should stay easy to use." "It didn't take a long time to complete the score. Good balance between capturing key information and something I can use quickly and easily when I'm with a patient."
Continued use	"This is helpful because it gives you a number to keep track of over time. If I see a patient in a clinic, and I give them a score of 8, let's say, because of that I keep therapy the same, or escalate therapy. And then when I see them again in 4 or 5 mo, I can get an idea of okay, this is what I scored them at, and now we've seen an improvement, so it might help over time with a trend, I think it would be really helpful" "I see it as a client communication tool with patients and other physicians. Instead of explaining patients about histology, you can just give them a score. It can also be a shorthand for talking to other physicians 'This is a moderate patient.' It can be useful in a multi-partner practice where any of the specialists might see you." "I kind of have an idea if the person has a severe condition. I don't need a validated score to know that a patient is really sick if they have a perforation. Maybe this is something that insurance can use. Maybe if you need to submit the score to the drug company so they can approve a certain drug treatment." "I already capture most of this data in my note. I have this table that I copy and paste from record to record. I would use this only if it were integrated with my electronic medical record. This just creates more work for me"
User experience	"Initially when I saw Tap for Resources, I thought, this is gonna be literature or stuff that people can look stuff up. But actually, it was more of kind of examples. And it's like a nice user guide to help people go through the app."
Data availability and scoring	"I had some trouble with the histology section. I'm not the one doing endoscopies. Under fibrostenotic features, they ask if the endoscope passed easily, but as an allergist I wouldn't know. So, I would be underreporting the severity and I-SEE would be an underestimate of the patient score." "I definitely don't have histology data. Pathologists just don't share that kind of detail." "If you're hearing from a lot of doctors that we don't have the fibrostenotic scoring, eg, and, at the end of the app the score essentially is incomplete cause you didn't have all the data, it might be good to be able to index it." "What is the utility of an incomplete score? How accurate is it? How does it correlate with treatment?"
Score implications	"Now I have the score and what am I supposed to do with it? If the patient has a higher score, does this mean that I need to use more aggressive treatment? Will the insurance sign off on more expensive treatment if the patient has a higher score?" "This is so simple, if you have someone in the office you can do it in 30 s. It gives you objective score. If they fall into severe category, you might want to be more aggressive with treatment. If they are mild, then you want to do something mild. They come back and you recalculate the score to see how they respond to therapy." "If the I-SEE score determined a particular treatment, I would use it. But I don't think it does."

efforts are underway to disseminate knowledge about the tool at various meetings and educational endeavors. Based on the feedback received, information about I-SEE, instructions related to completing it, and details regarding the data elements were added, clarified, or highlighted in the app itself. This should increase the ability of clinicians to educate themselves about the app as needed, at the point of care. It remains unclear what to do if data elements, such as histologic components or endoscopic features, are not available. Some allergists may not have access to all endoscopic and biopsy results, and it is not standard for pathologists to always report basal zone hyperplasia or lamina propria fibrosis. Additionally, there may be the need to modify the scoring system based on perceived severity in a pediatric population, given that some providers in this study felt that I-SEE could potentially underestimate severity in their patients. However, emerging data suggest that I-SEE in the current algorithm performs equally well in children and adults, with essentially identical total I-SEE scores, and even with slightly more severity in the pediatric population.[19] This finding will need to be confirmed as more data emerge, and anchoring I-SEE scoring on provider-reported global severity will be an important next step in I-SEE research.

Another important area of future research relates to I-SEE validation. While the providers agreed it was important and helpful to understand the severity of EoE patients individually, the ability to link severity to treatment algorithms was felt to be critical, and this may be a reason that approximately a third of patients did not wish to continuing using the app. To date, a secondary analysis of clinical trial data in adults showed that EoE severity decreases with successful treatment, from 82% of patients with moderate or severe disease at baseline to 85% with inactive or mild disease post-treatment.[16] Similarly, in a pediatric cohort,

severity decreased over long-term follow-up with ongoing treatment, with 57% as moderate or severe at baseline and 88% either inactive or mild after an average of 6.9 years of follow-up.[17] Data presented in abstract form showed decreased histologic, endoscopic, and symptomatic response rates to topical steroids in an adult and pediatric population as EoE severity increases,[19] and also that treatment response was maintained to dupilumab even in the severe EoE patients.[20] However, to extend these data and ultimately make substantial treatment recommendations based on severity, there will need to be additional studies, ideally prospective, that track treatment outcomes after a variety of dietary and pharmacologic treatments with stratification by pretreatment severity. This will also be a need for compatibility between I-SEE and electronic medical record systems, and while a majority said they would continue to use the app, this could potentially be increased with integration into electronic medical records.

There are some limitations of this study. As it focused on usability testing, we were not able to collect the patient data for analyses of severity features, but this is a plan for the future. The set of providers included was relatively small, but the number was sufficient for the qualitative research approach and for thematic saturation, and spanned adult and pediatric providers, as well as gastroenterology and allergy specialists, who are most likely to use I-SEE going forward. It is also a strength of this study that providers used the I-SEE with at least 5 real-world EoE patients, participated in structured interviews, and provided feedback that could be rapidly incorporated in an app update that is now available.

In conclusion, this usability study of the I-SEE app focusing on adult and pediatric gastroenterologists and allergists found that the app was user friendly, intuitive, and able to be completed rapidly in the course of clinical practice. Feedback provided from the interviewees led to updates in the app that provided more background and instructions on how to use I-SEE, clarifications of the rationale for some components, and overall improvement in visualization and use. In the future, scoring for pediatric severity should be confirmed, I-SEE will need to be validated by linking severity to treatment outcomes as well as monitoring and treatment recommendations, and ultimately incorporated into the electronic medical record.

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Received October 15, 2024. Accepted December 21, 2024.

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Authors' Contributions:
Evan S. Dellon: Project conception, study design, data interpretation, manuscript drafting, critical revision. Glenn T. Furuta: Project conception, study design, data interpretation, critical revision. Seema S. Aceves: Project conception, study design, data interpretation, critical revision. Nick Tomeo, Anya Karavanov, Zoe Smernoff, Joy Harrington: Project conception, study design, data collection/analysis/interpretation, critical revision.

Conflicts of Interest:
These authors disclose the following: Evan S. Dellon is a consultant for Abbvie, Adare/Ellodi, Akesobio, Alfasigma, ALK, Allakos, Amgen, Apollo, Aqilion, Arena/Pfizer, Aslan, AstraZeneca, Avir, Biocryst, Bryn, Calypso, Celgene/Receptos/BMS, Celldex, EsoCap, Eupraxia, Dr Falk Pharma, Ferring, GI Reviewers, GSK, Holoclara, Invea, Knightpoint, LucidDx, Morphic, Nexstone Immunology/Uniquity, Nutricia, Parexel/Calyx, Phathom, Regeneron, Revolo, Robarts/Alimentiv, Sanofi, Shire/Takeda, Target RWE, Upstream Bio; receives research funding from Adare/Ellodi, Allakos, Arena/Pfizer, AstraZeneca, Celldex, Eupraxia, Ferring, GSK, Meritage, Miraca, Nutricia, Celgene/Receptos/BMS, Regeneron, Revolo, Sanofi, Shire/Takeda; and has received an educational grants from Allakos, Aqilion, Holoclara, Invea. Glenn T. Furuta is CMO of EnteroTrack, consultant for Takeda, Regeneron Sanofi and Bristol Meyer Squibb. Seema S. Aceves is the co-Inventor, oral viscous budesonide, UCSD patented, Takeda licensed; and is a consultant for Regeneron and AstraZeneca. Anya Karavanov is a consultant for Novo Nordisk. The remaining authors disclose no conflicts.

Funding:
This study was supported by the American Gastroenterological Association. Dr Furuta also reports support as the LaCache Chair for GI, Allergic, and Immunologic Diseases.

Ethical Statement:
This study was not deemed to be human subject research as it was an assessment of an app, so institutional review board approval was not required.

Data Transparency Statement:
Data will not be made available.

Reporting Guidelines:
STROBE.