Assessing perspectives on artificial intelligence applications to gastroenterology

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Applications of artificial intelligence (AI) and machine learning (ML) in medicine are far-reaching and advancing rapidly.[1] In gastroenterology, AI and, more specifically, ML have been used for a wide array of applications, such as polyp detection, histologic analysis, report generation, and reduction of fluoroscopy.[2] Even with the many different types of methods used, a uniting factor is the goal of accurate automated predictive capacities for the clinical task at hand.[2,3]

AI has been used for detection; these systems have been designed so an algorithm functions as a "second observer" to aid the endoscopist in identifying on-screen lesions.[4-6] Examples of detection algorithms are detection of polyps from the colonoscopy feed or detecting GI bleeds or lesions from capsule endoscopy.[7] AI has also been used for diagnostic purposes. These systems mainly function to characterize on-screen lesions; examples of diagnostic algorithms are delineation of dysplasia in the setting of Barrett's esophagus and inflammatory bowel disease.[8-10] Additionally, AI has been used for examination quality assessments for both endoscopy and colonoscopy through blind spot monitoring and calculation of the percentage of surface area visualized.[11-13] Finally, AI has been used for data mining. These systems comb through electronic medical records to mine important clinical information for predictive purposes[14]; examples of these systems are mining clinical and lab values over time for prognosis of cirrhosis progression, calculation of adenoma detection rates, and prediction of the severity of acute pancreatitis.

Further, a number of recent clinical trials have vastly moved AI to the forefront. AI applications to gastroenterology have led the way in the establishment of clinical evidence because many of the first clinical trials that tested AI across all medical specialties were in gastroenterology. These trials have primarily focused on finding adenomas during colonoscopy[5,13,15,16] and for detection of blind spots on upper endoscopy examination.[11] Notably, the first double-blind trial was published in 2020 and showed that the adenoma detection rate was significantly greater for physicians using the computer-aided detection system (34%) versus those who were using a sham system (28%).[15] Additional trials are now underway in the United States to further investigate these systems. Studies are likely to evaluate the effect of computer-aided detection systems on the incidence of interval colorectal cancers in the future.

Despite the progress of AI technologies, challenges remain. Understandability and explainability of AI and ML algorithms are chief concerns.[17] Many physicians still describe AI technologies as "black box" systems without ways to understand how algorithms are developed, trained, and validated—and ultimately what their predictive result might mean for clinical practice. Many have discussed the lack of explainability of AI algorithms and suggest addressing this issue as a prerequisite for translatability of AI technologies into clinical practice. Further, garnering physician involvement in the development of these systems early on could perhaps augment downstream clinical integration.

SURVEY RESULTS

Although a growing number of physicians around the world are involved in AI-related research applications to gastroenterology, many still have concerns about its clinical use. As a first step to understanding these concerns, we developed a short survey geared toward physicians who are not currently

Abbreviations: AI, artificial intelligence; ML, machine learning.

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involved with AI research in gastroenterology. In this 10-question section, questions surrounding the most interesting AI applications, main concerns for AI integration into clinical practice, and anticipated startup costs were assessed (for additional methods, see Supplementary Methods and Appendix 1, available online at www.giejournal.org). A total of 165 participants filled out the survey.

We found a number of informative results when assessing survey response data, summarized in Table 1. We first assessed respondents' interests in a number of popular applications of AI-based research. Polyp characterization and polyp detection were by far the areas that garner the most interest. Further, nearly two-thirds of respondents were interested in quality controls for either colonoscopy or endoscopy. Next, we sought to identify some of the barriers precluding respondents from engaging in AI-based research. Most respondents (61.2%) who were unfamiliar with AI were unsure of how to start an AI-related study. Other essential barriers in starting an AI study were a limitation of available time to investigators (46.5%) and a lack of financial support (45.7%). Finally, 61.2% of respondents identified a lack of collaboration with either data scientists or other clinicians as a concern.

When it came to assessing the concerns of respondents related to the use of AI in medicine, 37.1% of the respondents believed that AI had the potential to replace physicians at some point in the future. Additionally, 32% expressed concern with data security and protecting patient information, although most did not believe that AI entering clinical spaces represented an ethical problem. Additionally, most recipients reported problems understanding the methodology of AI publications, leading them to only consider their clinical relevance. Despite these concerns, most respondents were enthusiastic about the progression of AI: 68.9% predicted it will improve healthcare quality and 61.2% predicted it will improve efficiency.

HOW DO WE ENGAGE MORE PHYSICIANS IN AI-RELATED RESEARCH?

The results of this survey can help guide our approach to engaging more physicians in AI-related research, leaving many opportunities to proactively generate novel approaches. First, these results indicate that future initiatives should address barriers that preclude physicians from being involved in AI research. This includes finding roles for physicians on AI teams whether or not they have a computational background. Although many of our respondents do not have a computational background, this does not preclude them from working in groups or collaborating with data scientists who can develop the computational, algorithmic side to studies. Having more physicians involved in AI-related research would allow for more perspectives to improve the way we design, develop, and ultimately report methodology and findings in a way that is understandable to a broader audience.

However, to involve more physicians, additional avenues for pilot funding are needed. When asked about barriers to taking up AI projects, most of our respondents stated a lack of sufficient time and lack of funding as primary factors. Although these 2 factors are always cited as a barrier to all types of research, they are unique when it comes to AI. For many research-related initiatives, various funding platforms for clinical research exist, including National Institutes of Health funding and funding from different GI societies. However, no such structured funding exists for piloting AI studies. Most AI studies are funded in partnership with industry. Professional GI societies could also include special funding opportunities for AI projects, which would further help provide a pathway for members to engage in more AI-related projects. Although adequate funding will depend on each project, our respondents found that over $100,000 is required to translate their initial project ideas into substantive outcomes.

Second, many survey respondents had trouble understanding published AI studies in the gastroenterology literature. These respondents were also concerned with reproducible outcomes from AI systems. This finding should guide the field to consider additional ways to explain methodology that is readily interpretable by clinicians. Journals can also implement sections of these AI-related articles to include short boxes highlighting "Key Methods and Outcomes." With a renewed focus across medicine and science with rigor and reproducibility, recent efforts have been published that outline a checklist of key elements that should be described in all ML articles.[18] This checklist should perhaps be enforced at all journals reporting AI and ML studies. Further, as more prospective clinical trials rigorously test these new systems, there is a growing need for transparency and proper reporting. A recent article proposed an extension of the CONSORT reporting guidelines, CONSORT-AI, for proper reporting of clinical trials involving AI.[19] These guidelines recommend 14 new items to be added to the core requirements, which will include instructions and skills required for use, guidance for intended human–AI interaction for optimal use, and an analysis and considerations in the event of error. Adopting both guidelines set forth by van der Sommen et al[18] and Liu et al[19] will greatly enhance the rigor and reproducibility of AI studies and clinical trials and will help the casual reader to critically appraise AI literature.

Third, another key finding of our survey was that an overwhelming majority of our respondents wanted to see more information related to AI that could be put forth by professional gastroenterology societies. A large proportion of respondents lacked the technical skills to start their own AI-related research. We believe these findings present an opportunity for all professional GI societies to have AI-related education topics. In addition to having articles in journals, webinars and educational podcasts should also be used. Last year under the leadership of the American Society for Gastrointestinal Endoscopy, a task force was

TABLE 1. Questions assessing perspectives of AI in gastroenterology and endoscopy and response from those not currently involved in AI research

Questions and responses	Percentage of respondents
What specific AI-based areas of focus interest you the most?	
Polyp detection	67.44
Polyp characterization	58.14
Quality controls for colonoscopy	40.31
Quality controls for upper endoscopy	26.36
AI for extraction of electronic health record data	38.76
AI for capsule endoscopy	42.64
AI for detection of GI bleeds	39.53
What are some of the main barriers to your involvement in the AI research space?	
Limited time	46.51
Limited financial support	45.74
Lack of data scientist collaborators	36.43
Lack of clinician collaborators	24.81
Unsure of how to set up an AI study	61.24
What are your concerns with AI use in gastroenterology practice?	
Ethical	4.84
Data/patient information security	32.36
Replacement of physicians by machines	37.10
Will make you less efficient in caring for patients	17.74
Do you believe the natural progression of AI will	
Improve your efficiency	61.24
Increase your workload	12.40
Make you obsolete in caring for patients	7.75
Help you provide better value care	68.99
Assuming clear evidence of benefit to patients, what do you believe is most important for healthy adoption of AI in gastroenterology?	
Improvement to efficiency in workflow	41.41
Reduction of medical legal risk	5.47
Reproducible outcomes from AI systems	41.41
Reduction of physician fatigue and burnout	8.59
What do you anticipate is the necessary investment to kickstarting a project in AI?	
$0-$25,000	14.73
$25,000-$50,000	20.16
$50,000-$100,000	24.03
>$100,000	35.66
How well do you understand descriptions of AI methods described in published studies?	
I seem to understand most of what is reported	25.58
I am confused by the AI methods presented in the study	25.58
I only look at the clinical relevance of an AI study when it is published	48.84
Are you familiar with any programing language?	
Yes	13.18
No	86.82

(*continued on the next page*)

TABLE 1. Continued

Questions and responses	Percentage of respondents
Would you like to see more information put forth from the various gastroenterology professional societies regarding AI?	
Yes	80.62
Not necessary at this time	19.38
Have you attended any conferences or courses related to AI?	
Yes	12.40
No	46.51
No, but I am interested in learning more about the field of AI by attending an event	41.09

AI, Artificial intelligence.

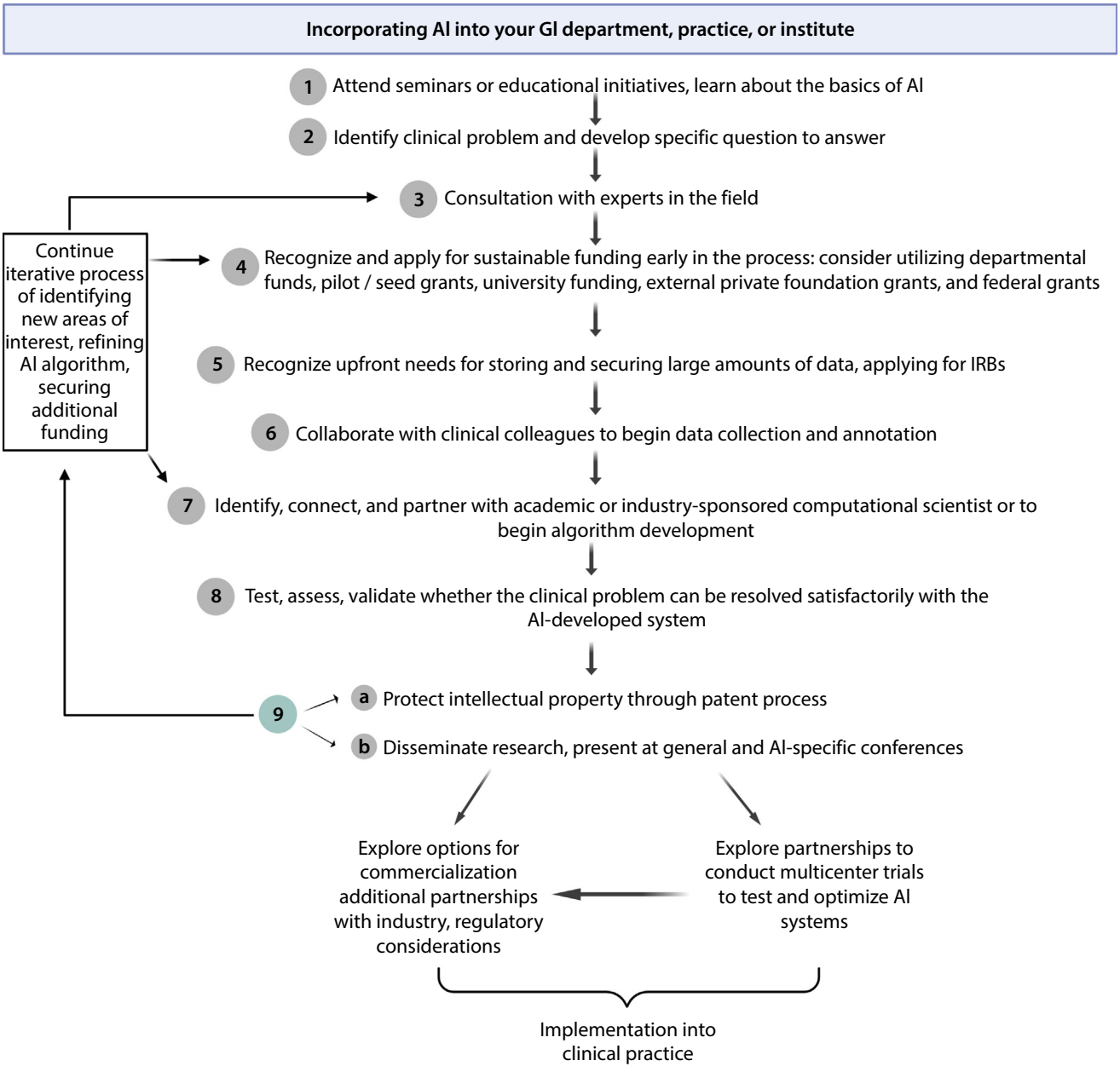

Figure 1. Proposed framework to incorporate AI into GI practice, department, or institute. *AI*, Artificial intelligence; *IRB*, institutional review board.

specifically established to explore opportunities related to AI in endoscopy. Additionally, the first Global Conference on AI in Gastroenterology and Endoscopy was held in September 2019, bringing together physicians, industry, and regulatory agency representatives.[20] Finally, for the past 3 years, a computer-aided diagnosis in colonoscopy meeting has occurred at the annual Digestive Disease Week. Such meetings, special task forces, and more AI-related sessions at national GI meetings would help impart the relevant AI-related skills to the community. The opportunity lies herein for professional societies to consider having AI-related subcommittees within societies and foundations to disseminate knowledge in a variety of media with regard to AI.

Additionally, keeping the future in mind, we believe it is imperative to include AI in the GI fellowship curriculum. Fellows currently in training should have at least some elective time to focus on or be exposed to areas related to AI. For programs that are part of significant universities, resources are typically available on campus for their trainees to divulge in the field of AI. For programs that do not have such resources, distant learning opportunities designed by professional GI societies and foundations could be created in collaboration with current users of AI in GI. Further, opportunities for visiting fellowships to centers with expertise in AI could be considered. As societies develop AI committees and task forces, AI Centers of Excellence may become a natural progression. Such centers could play a pivotal role in pioneering trainee education.

Finally, for those interested in developing AI projects, we provide a proposed algorithm to optimize success of this rapidly evolving field (Fig. 1). In our experience (N.M.C., S.T.)[12,17] the ability to develop AI software requires close collaboration with a data scientist. Small institutional seed funding that generated initial data paved the way for larger proposals that can provide substantial funding to allow recruitment of Masters and PhD candidate support and medical research fellows. Such support teams are necessary to create secure recording and image capture platforms, secure transfer of data, create cross-pollination of knowledge between medical and data scientists, and maintain HIPAA compliant formats and managing Institution Review Board protocols with data-sharing agreements. Once the innovation has developed, rigorous utilization in test sets determines the opportunity of commercialization versus further iterations through lab to bench to bedside algorithm training.

CONCLUSION

AI in gastroenterology is an area poised to make a difference in the way we practice and provide high-quality care to patients. Most believe that AI can help us improve clinical efficiency and improve our patient care. In this article, we outline a number of suggestions to increase the involvement of gastroenterologists in AI-related research. Such strategies can support ongoing initiatives to boost the field of AI in gastroenterology for years to come.

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SUPPLEMENTARY METHODS

Survey Design

A 30-question survey was designed using the SurveyMonkey platform (San Mateo, CA, USA) to assess the current patterns and perspectives around applications of AI in gastroenterology (Appendix 1). The survey was divided into sections depending on if the respondent was or was not currently involved in research with AI in gastroenterology. In the 17-question section for those who were currently involved in AI research, questions surrounding estimating startup costs, data collection, data annotation, and data storage and security were included – these results are not included in this manuscript. In the 10-question section for those who were not currently involved in AI research in gastroenterology, questions surrounding the most interesting AI applications, main concerns for AI integration into clinical practice, and anticipated startup costs were assessed – these results are presented in this manuscript.

Survey Administration

Before the distribution of the final survey to study participants, multiple drafts of the survey were tested by all authors. The survey was sent to a mix of clinicians and data scientists. The survey was distributed in multiple ways: first, the survey was distributed using an internal email list of 691 clinicians and data scientists using a specific link generated by SurveyMonkey. This list was composed of clinicians who had graduated from our institutions fellowship in the past 10 years who went on to practice in a variety of academic, community, and private practice settings. Further, the email list also included fellowship directors from around the country who then sent the survey to fellowship trainees and members of their department. Each person who was emailed received the same link; however, we only allowed one response per email / IP address. Additionally, the list was distributed on social media platforms (Twitter and LinkedIn) using a different link, thus allowing the authors to track where responses came from. In addition, another 85 responses were received from social media platforms. All responses were recorded anonymously. Completion of the survey was voluntary and consent to participate in the study was inferred from completion of the survey. Survey distribution and response period occurred for two months from March 1, 2020 to April 26, 2020. Survey results were reviewed by senior authors (GSK & ST). All questions with "other" as response were independently reviewed by GSK & ST and incorporated in the manuscript after assessing their importance based on each question.

Data Analysis

Statistical analyses were performed with STATA (Version 15, StataCorp LLP, College Station, TX, USA) and the GraphPad Prism software (San Diego, CA, USA). All survey data is reported as percentage values. The study was certified exempt from review by the Allegheny General Hospital Institutional Review Board.

APPENDIX 1. Questions included in distributed survey

Survey for Research Groups Involved with AI in Endoscopy

1. Sex:
   a. Male
   b. Female
   c. Other
2. What best describes your current position?
   a. Clinician with 0-10 years of experience
   b. Clinician with 10-20 years of experience
   c. Clinician with > 20 years of experience
   d. Data scientist with 0-10 years of experience
   e. Data scientist with 10-20 years of experience
   f. Data scientist with > 20 years of experience
   g. Other (specify):
3. Are you currently involved in research with AI in gastroenterology? [logic/branching question]
   a. Yes (if yes, proceed to question 4)
   b. No (if no, proceed to question 21)
4. If you are not currently involved in AI in GI and want to be involved, what specific areas of focus interest you the most? (Can select multiple options)
   a. Polyp detection
   b. Polyp characterization
   c. Quality controls for colonoscopy
   d. Quality controls for upper endoscopy
   e. AI for extraction of EHR data
   f. AI for capsule endoscopy
   g. AI for detection of GI bleeds
   h. Other (describe):
5. What are some of the main barriers to your involvement in the AI space? (Can select multiple options)
   a. Limited time
   b. Limited financial support
   c. Lack of data scientist collaborators
   d. Lack of clinician collaborators
   e. Unsure of how to set up an AI study
   f. Other reasoning (describe):
6. What are your concerns with AI use in gastroenterology practice?
   a. Ethical
   b. Data security
   c. Replacement of physicians by machines
   d. Will make you less efficient in caring for patients
   e. Other
7. Do you feel that the natural progression of AI will: (can select multiple options)?
   a. Improve your efficiency
   b. Increase your workload in patient care
   c. Make you obsolete in caring for patients
   d. Help you provide better value care
   e. Other (describe):
8. Assuming clear evidence of benefit to patients, what do you feel is most important for healthy adoption of AI in gastroenterology?
   a. Improvement to efficiency in workflow
   b. Reduction of medical legal risk
   c. Reproducible outcomes
   d. Reduction of physician fatigue
   e. Other (describe):
9. What do you anticipate is the necessary investment to kickstarting a project in AI?
   a. $0-$25,000
   b. $25,000-$50,000
   c. $50,000-$100,000
   d. > $100,000
   e. Other (describe):
10. How well do you understand descriptions of AI methods described in published studies?
    a. I seem to understand most of what is reported
    b. I am confused by the AI methods presented in the study
    c. I only look at the clinical relevance of an AI study when it is published in the literature
    d. Other (describe):
11. Have you heard of the programming language Python?
    a. Yes
    b. No
    c. Comment:
12. Would you like to see more information put forth from the various gastroenterology professional societies regarding AI?
    a. Yes
    b. Not necessary at this time
    c. Other comment:
13. Have you attended any conferences or courses related to AI?
    a. Yes
    b. No
    c. Comment