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# Perception among gastroenterologists to artificial intelligence in a low middle income setting.

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**ABSTRACT… Objective:** To determine the perception among gastroenterologists to artificial intelligence (AI) in a low middle income setting. **Study Design:** Cross Sectional study. **Setting:** Department of Gastroenterology, Liaquat National Hospital, Karachi, Pakistan. **Period:** June 2023 to June 2024. **Methods:** Study included 200 participants. The perception of participants regarding AI was evaluated through self-administrated questionnaire. Scores for questions were coded as 1,2,3,4 and 5. Participants entered their responses regarding use of AI. The perception of participants regarding AI was considered positive when participants achieved a composite score ≥4. Data were analyzed using IBM-SPSS Statistics version 26.0. P-value ≤0.05 was considered as significant. **Results:** Among study participants, 155 (77.5%) were male. Mean age was 34.61±7.41 years. There were 115 (57.5%) residents/fellows, followed by 58 (29%) consultants. Thirty (15.0%) respondents said that they have used AI, among them 22 (73.3%) had used this for at least 10 times. Positive opinions were noted by 94 (47%) gastroenterologists in our investigation. Significant association between gastroenterologists' perceptions of AI with gender (p=0.000), the total number of endoscopies performed each week (p=0.009), and use of AI (p=0.002) was documented. Male gastroenterologists were found more likely to have positive perceptions, (OR=2.079, p=0.039). Compared to gastroenterologists over 35 years, those under 35 were less likely to have a positive perception. (p=0.075, OR=0.571). **Conclusion:** Gastroenterologists showed positive perspectives towards AI. This study discovered a significant association between gastroenterologists perceptions of AI with gender, total number of endoscopies performed each week, and use of AI.

**Key words:** Artificial Intelligence, Endoscopy, Gastroenterologist, Questionnaire, Perception.

## INTRODUCTION

Recent years have seen a rapid increase in processing capacity, which has led to the broad use of artificial intelligence (AI) in many domains involving human-machine interaction, including the analysis of massive volumes of data in the medical area.[1] AI has a lot of potential to impact image-based disciplines including radiology, pathology, and gastroenterology (GE). In medicine, AI is mostly utilized for image classification and natural language processing.[2] Deep learning algorithms have demonstrated enormous promise to enhance endoscopic performance in gastroenterology.[3,4] Recent research has documented the successful application of AI in computer-aided polyp identification (CADe)[5,6], polyp histology categorization (CADx)[7,8], endoscopically resectable polyp distinction (superficial) from aggressive malignancy, and other related tasks.[9] According to a survey conducted in the UK and the USA, 68.7% of participants were aware of the possible applications of AI in gastroenterology. In particular, 81.9% of respondents knew that AI is now being used to detect colonic polyps, 47.9% to monitor Barrett's illness, 42.1% to do capsule endoscopies, 24% to detect early-stage gastric cancer, and 4.1% to treat inflammatory bowel disease.[10] They observed that 39.8% of respondents expressed worries about patient confidentiality and 26.3% expressed concerns about patient safety when using AI. AI, according to respondents, might support individualized therapy, enhance dysplasia surveillance, and

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enhance endoscopic evaluation in inflammatory bowel disease. Three things were thought to be potential barriers: cost, lack of experience with AI technology, and availability of AI courses.[10]

A study conducted among gastroenterologists and endoscopists in the UK revealed a number of perceived advantages, difficulties, and impediments to the use of AI in clinical practice and research. According to their findings, 86% of doctors said they would be interested in using AI to assist in colonoscopy, and 84.7% said that using CADe would enhance their endoscopic skills. As for the use of CADx in support of the "diagnose and leave" approach for hyperplastic polyps, 57.2% of the respondents said they were comfortable with it. Multivariate analysis revealed that the most significant predictor in predicting whether doctors would think that CADe would result in more excised polyps was post-fellowship experience of less than 15 years. 75.2% of respondents expressed worry primarily about cost, 62.8% about operator dependency, and 60.3% about longer procedure times when implementing AI.[11] AI has shown early promise in executing and supporting therapeutic activities, but there is uncertainty over the technology's capabilities, particularly with regard to our population. This study aims to ascertain Pakistani gastroenterologists perceptions on AI in clinical practice settings.

## METHODS

This cross sectional study was conducted at Department of Gastroenterology, Liaquat National Medical College and Hospital, Karachi. The research proposal was approved by the Research and Ethics Committee of Liaquat National Hospital prior to conduct this study (903-2023LNH-ERC, dated June 01, 2023). The Study duration was from 1st June 2023 to 30 June 2024.Participants were explained about the study purpose and its associated risk and benefits, before obtaining written and informed consent from participants. The sample size was calculated by taking prevalence of interested participants ($P_{)=}$86%[12] using margin of error (d)=5% and 95% confidence level. The calculated sample size was 186 participants. This was calculated with the help of WHO software for sample size calculation. Participants of both genders from diverse clinical roles including consultants and gastroenterology trainees who were performing endoscopy were included in the study. Non clinical staff and undergraduate medical students were not part of this study.

The perception of participants regarding AI was evaluated through self-administrated questionnaire. Participants entered their responses on self-administrated questionnaire regarding use of AI. Questionnaire included participant demographics, experience in artificial intelligence, benefits, awareness and challenges in using AI in healthcare settings. Questions were asked concerning physician degree of training, medical experience, practice characteristics, and physician impression of AI. The outcomes were documented using a proforma. Scores of the responses were calculated and percentage of perception was calculated. Confidentiality of the participants was maintained throughout the study. Their ID number was tagged with other serial number to hide their identity and only principal investigator had the access to original data.

The Statistical Package for Social Sciences (SPSS) Version 26.0 was used to assemble and analyze the patient data. For qualitative characteristics, percentage and frequency were calculated. The Shapiro-Wilk test was used to verify that the data was normal. For the quantitative variable, mean±SD was computed. Median (IQR) were calculated if the data is non normal. Stratification was done and post stratification Chi square test/ fisher exact test was used to see the association of perception among qualitative variables. Student t-test was used to evaluate mean differences of score among different stratified groups. P-value $\leq$0.05 was considered as significant in all analysis.

## RESULTS

There were 200 gastroenterologists enrolled in the current study, and 77.5% of them were men. The mean age was 34.61±7.41 years. Majority of gastroenterologists (71.0%) were over 35 years old. Among all study participants, 57.5% were Residents/Fellows, 13.5% were Registrars /

Senior Registrars, and 29.0% were Consultants. There were 72.0% gastroenterologists who were doing up to twenty endoscopies in a week and 50.0% of them were GI fellows or trainees. There were 15.0% of respondents who said they had used AI, with the majority (73.3%) saying they had used it at least ten times. Table-I presents characteristics of the study population.

| | Frequency (%) |
|---|---|
| **Gender** | |
| Male | 155 (77.5) |
| Female | 45 (22.5) |
| **Age Groups** | |
| ≤35 years | 142 (71.0) |
| >35 years | 58 (29.0) |
| **Designation** | |
| GI Resident/Fellow | 115 (57.5) |
| GI Registrar/SR | 27 (13.5) |
| GI Consultant | 58 (29.0) |
| **Endoscopies per week** | |
| 0-20 | 144 (72) |
| 21-40 | 39 (19.5) |
| >40 | 17 (8.5) |
| **Years of GI Practice** | |
| GI Trainee/Fellow | 100 (50) |
| <5 years of GI practice | 48 (24.0) |
| 5-10 years of GI practice | 35 (17.5) |
| >10 years of GI practice | 17 (8.5) |
| **Whether used Artificial Intelligence** | |
| Yes | 30 (15.0) |
| No | 137 (68.5) |
| Maybe | 33 (16.5) |
| **How many times used AI (n=30)** | |
| ≤10 times | 22 (73.3) |
| 11-20 times | 5 (16.7) |
| 21-30 times | 1 (3.3) |
| >30 times | 2 (6.7) |

Using a self-administered questionnaire, the perception of AI among gastroenterologists was assessed. Table-II presents specific results pertaining to perception. Positive opinions were noted by 94 gastroenterologists (47.0%) in our investigation.

Significant association was found between gastroenterologists' perceptions of AI with gender ($p<0.001$), the total number of endoscopies performed each week ($p=0.009$), and use of AI ($p=0.002$). Table-III displays the comprehensive results of the associations. According to uni-variate logistic regression, male gastroenterologists were found more likely than female gastroenterologists to have positive perceptions, (OR=2.079, $p=0.039$). Additionally, compared to gastroenterologists over 35, those under 35 are less likely to have positive perception. ($p=0.075$, OR=0.571). Compared to gastroenterologists who did not employ AI, those who did have a more favorable perception of them. ($p=0.001$, OR=4.227). Table-III also presents binary logistic regression analysis with respect to prediction of positive perception regarding AI.

## DISCUSSION

AI has made enormous strides in recent years, and in the ensuing decades, it is predicted to spark a new digital revolution.[12,13] Researchers predict that gastrointestinal endoscopy will be one of the professions that will undergo considerable transformation, and many academics believe that doctors will embrace AI technology in the future, especially deep learning.[12,14] Numerous research have indicated that AI in particular can help endoscopists in a variety of ways.[14-19] Endoscopists may encounter additional difficulties and hurdles as AI develops, including moral dilemmas and shifts in psychological and emotional states. Consequently, we looked into endoscopists' views directly on AI, and our findings can be useful to endoscopic centers as they plan to implement AI. The most important perceived advantage of AI in clinical practice was the enhancement of endoscopy and endoscopic diagnostic quality.[20] Taking responsibility for inaccurate diagnosis and algorithmic bias were noted as the two biggest obstacles to applying AI.AI will undoubtedly lead to errors, and depending on the situation, these errors may have diverse causes that hurt patients.[21] The integration of AI technology into standard clinical endoscopic procedures has been sluggish, despite the technology's availability and regulatory approval. The major obstacle to its acceptance was found to be a lack of guidelines, which if addressed would assist advance the specialty in the clinical translation of AI.[21]

| Item | Questions | SD (%) | D (%) | DK (%) | A (%) | SA (%) |
|---|---|---|---|---|---|---|
| 1 | The endoscopists would be less responsible for medical negligence when using the AI. | 17 (8.5) | 34 (17) | 91 (45.5) | 53 (26.5) | 5 (2.5) |
| 2 | AI willl increase the patient's confidence | 10 (5.0) | 10 (5.0) | 84 (42.0) | 83 (41.5) | 13 (6.5) |
| 3 | AI will reduce the workload of the endoscopist. | 7 (3.5) | 14 (7.0) | 78 (39.0) | 85 (42.5) | 16 (8.0) |
| 4 | AI will bring satisfaction to the endoscopists. | 2 (1.0) | 5 (2.5) | 94 (47.0) | 84 (42.0) | 15 (7.5) |
| 5 | AI will not let miss the diagnosis in endoscopy. | 8 (4.0) | 28 (14.0) | 98 (49.0) | 57 (28.5) | 9 (4.5) |
| 6 | AI will make the endoscopists more interested in performing endoscopy. | 9 (4.5) | 11 (5.5) | 88 (44.0) | 73 (36.5) | 19 (9.5) |
| 7 | AI will make the endoscopists concentrate more on the endoscopy procedure. | 8 (4.0) | 25 (12.5) | 85 (42.5) | 68 (34.0) | 14 (7.0) |
| 8 | AI can improve the accuracy of the diagnosis of lesions. | 5 (2.5) | 6 (3.0) | 83 (41.5) | 85 (42.5) | 21 (10.5) |
| 9 | AI can accurately identify blind spots. | 5 (2.5) | 12 (6.0) | 100 (50.0) | 72 (36.0) | 11 (5.5) |
| 10 | Computer-assisted polyp detection will result in higher patient satisfaction. | 7 (3.5) | 6 (3.0) | 91 (45.5) | 83 (41.5) | 13 (6.5) |
| 11 | Computer-Assisted Polyp Detection will result in higher endoscopist satisfaction. | 8 (4.0) | 6 (3.0) | 81 (40.5) | 89 (44.5) | 16 (8) |
| 12 | Computer-Assisted Polyp Detection will prolong the time per procedure. | 8 (4.0) | 35 (17.5) | 107 (53.5) | 41 (20.5) | 9 (4.5) |
| 13 | Computer-Assisted Polyp Detection will increase cost to the practice per procedure. | 6 (3.0) | 15 (7.5) | 90 (45.0) | 65 (32.5) | 24 (12.0) |
| 14 | Computer-Assisted Polyp Detection will increase the total time required per procedure. | 7 (3.5) | 36 (18.0) | 103 (51.5) | 43 (21.5) | 11 (5.5) |
| 15 | AI will have positive impact on physician-patient relationship. | 3 (1.5) | 12 (6.0) | 87 (43.5) | 89 (44.5) | 9 (4.5) |
| 16 | Computer-Assisted Polyp Detection (CADe) will cause higher number of false positive detections. | 4 (2.0) | 29 (14.5) | 116 (58.0) | 46 (23.0) | 5 (2.5) |
| 17 | Uncertainty about technology. | 3 (1.5) | 25 (12.5) | 98 (49.0) | 68 (34.0) | 6 (3.0) |
| 18 | Endoscopist can reliably classify polyps as hyperplastic vs adenomatous based on endoscopist appearance. | 3 (1.5) | 25 (12.5) | 93 (46.5) | 72 (36) | 7 (3.5) |
| 19 | Will you feel comfortable leaving a hyperplastic polyp with assistance from AI. | 5 (2.5) | 38 (19.0) | 105 (52.5) | 45 (22.5) | 7 (3.5) |
| 20 | CADe will create operator dependence on the technology. | 3 (1.5) | 6 (3.0) | 96 (48.0) | 88 (44.0) | 7 (3.5) |
| 21 | Do you think future gastroenterologists should get training in artificial intelligence? | 14 (7.0) | 7 (3.5) | 28 (14.0) | 109 (54.5) | 42 (21.0) |
| 22 | Do you see AI future in Pakistan? | 2(1) | 10(5) | - | 102 (51.0) | 86 (43.0) |
| 23 | Are you willing to practice Artificial Intelligence in your practice once available? | 2 (1.0) | 4 (2.0) | 0(0) | 51(25.5) | 143(71.5) |
| 24 | Will AI will replace endoscopist in future? | 1 (0.5) | 69 (34.5) | 1 (0.5) | 115 (57.5) | 14 (7.0) |
| 25 | More research is required for the use of AI in endoscopy before implementing in guidelines. | - | 10 (5.0) | - | 23 (11.5) | 167 (83.5) |
| 26 | AI will affect adversely in employ | 12 (6.0) | 21 (10.5) | 97 (48.5) | 60 (30.0) | 10 (5.0) |
| 27 | AI will improve quality of endoscopic findings. | 6 (3.0) | 21 (10.5) | 97 (48.5) | 60 (30.0) | 10 (5.0) |
| 28 | AI will have impact on working practices in future. | 8 (4.0) | 3 (1.5) | 74 (37.0) | 90 (45.0) | 25 (12.5) |

**Table-II. Responses of perception among gastroenterologists to artificial intelligence**

SD:Strongly Disagee D:Disagee DK:Donot Know A:Agree SA:Strongly Agree

| Characteristics | Perception Regarding AI | | P-Value | Adjusted OR (95% CI) | P-Value |
|---|---|---|---|---|---|
| | Positive | Negative | | | |
| **Gender** | | | | | |
| Male | 79 (84.0) | 76 (71.7) | 0.037 | 2.079(1.037-4.166) | 0.039 |
| Female | 15 (16) | 30 (28.3) | | Ref | |
| **Age Groups** | | | | | |
| ≤35 years | 61 (64.9) | 81 (76.4) | 0.073 | 0.571(0.308-1.057) | 0.075 |
| >35 years | 33 (35.1) | 25 (23.6) | | Ref | |
| **Designation** | | | | | |
| Gastrointestinal Resident/Fellow | 53 (56.4) | 62 (58.5) | 0.164 | 0.695(0.368-1.310) | 0.260 |
| Gastrointestinal Registrar/SR | 9 (9.6) | 18 (17.0) | | 0.406(0.157-1.054) | 0.064 |
| Gastrointestinal Consultant | 32 (34.0) | 28 (24.5) | | Ref | |
| **Endoscopies per week** | | | | | |
| 0-20 | 58 (61.7) | 86 (81.1) | 0.009 | 0.368(0.129-1.050) | 0.062 |
| 21-40 | 25 (26.6) | 14 (13.2) | | 0.974(0.296-3.204) | 0.965 |
| >40 | 11 (11.7) | 6 (5.7) | | Ref | |
| **Years of GI Practice** | | | | | |
| Gastrointestinal Trainee/Fellow | 39 (41.5) | 61 (57.5) | 0.063 | 0.266(0.087-0.815) | 0.020 |
| <5 years of Gastrointestinal practice | 24 (25.5) | 24 (22.6) | | 0.417(0.127-1.365) | 0.148 |
| 5-10 years of Gastrointestinal practice | 19 (20.2) | 16 (15.1) | | 0.495(0.144-1.705) | 0.265 |
| >10 years of Gastrointestinal practice | 12 (12.8) | 5 (4.7) | | Ref | |
| **Whether used Artificial Intelligence** | | | | | |
| Yes | 22 (23.4) | 8 (7.5) | 0.002 | 4.227(1.755-10.178) | 0.001 |
| Maybe | 18 (19.1) | 15 (14.2) | | 1.844(0.857-3.968) | 0.117 |
| No | 54 (57.4) | 83 (78.3) | | Ref | |

**Table-III. Association of Perception regarding artificial intelligence**

In one survey, participants stated that endoscopic image diagnosis ought to be the top focus for AI research, with quality improvement coming in second. Colonoscopy was identified as the top priority for AI research by 92% of participants, with UGI endoscopy coming in second at 67%. Participants in secondary care gave the UGI system a higher priority than their colleagues in tertiary care.[20] More significantly, it can assist AI in improving regions that endoscopists typically deem improper, hence enhancing compatibility between the two fields. For instance, we discovered that endoscopists had unfavorable opinions about dependency, hence endoscopist dependence on AI has to be reduced as AI advances.

Although the topic of utilizing AI to create dependencies has never been investigated, given the growing popularity of AI, this might potentially become a significant concern. Based on the findings of a study, endoscopists had a lot of hope for this technique. However, the results may be skewed because senior physicians make up the majority of endoscopists employing AI at the moment. There is an urgent need to ascertain if the endoscopic process can be carried out and whether the lesions can be detected without AI, especially for novices who utilize AI or comparable systems for training.[12]

AI is highly sensitive, specific, and accurate in recognizing lesions and blind areas, according to earlier research.[18,19] Three factors were discovered to have significant differences: age, professional title, and length of time using AI. Higher professional title holders and older endoscopists were more likely to express satisfaction with the AI system. This is not what we initially thought because AI as a novel system would be more acceptable to youth, and additional research might be required.[12] According to another research[22], people generally have a good opinion of AI and its application in healthcare. In addition to technological difficulties, the public's acceptance and trust in AI are also critical factors

in the successful integration of AI into standard healthcare practice.

In one investigation, GI fellows were far less progressive than gastroenterologists about AI. Compared to fellows in the GI field, gastroenterologists held greater hopes for how AI will alter their profession and thought it would happen far more quickly. GI fellows, as opposed to gastroenterologists, come from a younger generation and were reared in a digital age, which makes their results intriguing and often contentious. GI-fellows' reports of deskilling, employability, and detrimental career repercussions, although gastroenterologists did not, might provide one explanation.[22] Moreover, gastroenterologists have a greater understanding of the sector, its challenges, and their own faults than their GI colleagues. In earlier research, the interest in AI-assisted capsule endoscopy and colorectal polyp identification among gastroenterologists was strong.[23,24]

There are a few limitations of this research. Compared to endoscopists at primary hospitals, our respondents' acceptance of AI may differ because the majority of them worked in first-class hospitals. The items now on our formal scale may not accurately reflect endoscopists adoption of AI, as many AI systems are relatively new as medical products. Because of these constraints, we want to address these issues in our subsequent study to improve the use of our scale for endoscopy facilities and researchers alike.

## CONCLUSION

Gastroenterologists showed positive perspectives towards AI. Gastroenterologists have favorable opinions about AI and its application in healthcare. AI in healthcare can only be helpful if doctors and patients are aware of it and supportive of it. Thus, research and development of AI should be done with patients and doctors in mind.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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## REFERENCES

1. Pannala R, Krishnan K, Melson J, Parsi MA, Schulman AR, Sullivan S, et al. **Emerging role of artificial intelligence in GI endoscopy.** Gastrointest Endoscop. 2020; 92(6):1151-2.

2. Pannala R, Krishnan K, Melson J, Parsi MA, Schulman AR, Sullivan S, et al. **Artificial intelligence in gastrointestinal endoscopy.** Video GIE. 2020; 5(12):598-613.

3. Togashi K. **Applications of artificial intelligence to endoscopy practice: The view from Japan Digestive Disease Week 2018.** Digest Endosc. 2019; 31:270-2

4. Cohen J, Desilets DJ, Hwang JH, Baig KR, Leung FW, Maranki JL, et al. **Gastrointestinal endoscopy editorial board top 10 topics: Advances in GI endoscopy in 2018.** Gastrointest Endosc. 2019; 90:35-43

5. Misawa M, Kudo SE, Mori Y, Cho T, Kataoka S, Yamauchi A, et al. **Artificial intelligence-assisted polyp detection for colonoscopy: Initial experience.** Gastroenterol. 2018; 154:2027-9.

6. Urban G, Tripathi P, Alkayali T, Mittal M, Jalali F, Karnes W, et al. **Deep learning localizes and identifies polyps in real time with 96% accuracy in screening colonoscopy.** Gastroenterol. 2018; 155(4):1069-78.

7. Alagappan M, Brown JRG, Mori Y, Berzin TM. **Artificial intelligence in gastrointestinal endoscopy: The future is almost here.** World J Gastrointest Endosc. 2018; 10: 239-49.

8. Mori Y, Kudo SE, Misawa M, Saito Y, Ikematsu H, Hotta K, et al. **Real-time use of artificial intelligence in identification of diminutive polyps during colonoscopy: A prospective study.** Ann Intern Med. 2018; 169(6):357-66.

9. Chen PJ, Lin MC, Lai MJ, Lin JC, Lu HH, Tseng VS. **Accurate classification of diminutive colorectal polyps using computer-aided analysis.** Gastroenterol. 2018; 154(3):568-75

10. Nigam GB, Patel RN, Iacucci M, Hayee BH, Farraye FA, Limdi JK. **A survey of knowledge, perceptions, and barriers on the use of artificial intelligence in patients with inflammatory bowel disease in the US and UK.** Official J Am Col Gastroenterol. 2020; 115:S340.

11. Wadhwa V, Alagappan M, Gonzalez A, Gupta K, Brown JR, Cohen J, et al. **Physician sentiment toward artificial intelligence in colonoscopic practice: A survey of US gastroenterologists.** EndoscopInternation Open. 2020; 8(10):1379-84.

12. Tian L, Zhang Z, Long Y, Tang A, Deng M, Long X, et al. **Endoscopists' acceptance on the implementation of artificial intelligence in gastrointestinal endoscopy: Development and case analysis of a scale.** Front Med. 2022; 9:760634.

13. LeCun Y, Bengio Y, Hinton G. **Deep learning.** Nature. 2015; 521:436-44.

14. Topol EJ. **High-performance medicine: The convergence of human and artificial intelligence.** Nat Med. 2019; 25:44-56.

15. Holme O, Aabakken L. **Making colonoscopy smarter with standardized computer-aided diagnosis.** Ann Intern Med. 2018; 169:409-10.

16. Mori Y, Kudo SE, Misawa M, Saito Y, Ikematsu H, Hotta K, et al. **Real time use of artificial intelligence in identification of diminutive polyps during colonoscopy: A prospective study.** Ann Intern Med. 2018; 169:357-66.

17. Chen D, Wu L, Li Y, Zhang J, Liu J, Huang L, et al. **Comparing blind spots of unsedated ultrafine, sedated, and unsedated conventional gastroscopy with and without artificial intelligence: A prospective, single-blind, 3-parallel group, randomized, single-center trial.** Gastrointest Endosc. 2020; 91:332-9 e3.

18. Wu L, Zhang J, Zhou W, An P, Shen L, Liu J, et al. **Randomised controlled trial of WISENSE, a real-time quality improving system for monitoring blind spots during esophagogastroduodenoscopy.** Gut. 2019; 68:2161-9.

19. Wu L, Zhou W, Wan X, Zhang J, Shen L, Hu S, et al. **A deep neural network improves endoscopic detection of early gastric cancer without blind spots.** Endoscopy. 2019; 51:522-31.

20. Kader R, Baggaley RF, Hussein M, Ahmad OF, Patel N, Corbett G, et al. **Survey on the perceptions of UK gastroenterologists and endoscopists to artificial intelligence.** Frontline Gastroenterol. 2022; 0:1-7.

21. Ahmad OF, Stoyanov D, Lovat LB. **Barriers and pitfalls for artificial intelligence in gastroenterology: Ethical and regulatory issues.** Tech Gastrointest Endosc. 2019;22

22. Aggarwal R, Farag S, Martin G, Ashrafan H, Darzi A. **Patient perceptions on data sharing and applying artificial intelligence to healthcare data: A cross sectional survey.** J Med Internet Res. 2021 Aug 26; 23(8):e26162. Available at: https://doi.org/10.2196/26162 (2021)

23. Wadhwa V. **Physician sentiment toward artifcial intelligence (AI) in colonoscopic practice: A survey of US gastroenterologists.** Endosc Int Open. 2020; 8:1379-84.

24. Leenhardt R. **PEACE: Perception and expectations toward artificial intelligence in capsule endoscopy.** J Clin. Med. 2021. https:// doi.org/10.3390/jcm10235708.


| AUTHORSHIP AND CONTRIBUTION DECLARATION | |
|---|---|
| 1 | **Lubna Kamani:** Conception, design, critical revision, proof reading. |
| 2 | **Mir Nosherwan Khan:** Data Collection, drafting, responsible for data's integrity. |
| 3 | **Baseer Ahmad:** Literature review, data collection, data analysis, proof reading. |