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ARTIFICIAL INTELLIGENCE IN DETECTION AND DIAGNOSIS OF UPPER GASTROINTESTINAL LESIONS: A LITERATURE REVIEW

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ABSTRACT

Background: Esophageal and stomach cancers pose a serious threat to patients due to their nonspecific symptoms and aggressive nature. By the time an accurate diagnosis is obtained, the disease has frequently progressed to an advanced stage, resulting in a significantly limited range of treatment options. Recently, computer-aided detection and computer-aided diagnosis systems have been developed to identify and characterize subtle gastric mucosal lesions, precancerous lesions, and early-stage cancers.
Methodology: A literature review of the PubMed and Scopus databases was conducted in search of studies published from 2015 to 2025. Included publications were analyzed to assess the potential of artificial intelligence-based models in the clinical diagnosis of upper gastrointestinal tract lesions.
Results: Artificial intelligence provides automated, accurate and consistent diagnostic performance for the detection and characterization of Barrett's esophagus, esophageal squamous cell carcinoma and early gastric cancer. It significantly reduces blind spots and is capable of determining invasion depth and tumor margins. Artificial intelligence models can greatly improve the diagnostic accuracy of endoscopists enhancing success rate of lesion detection and minimizing the incidence of misdiagnosis.
Conclusions: The assistance of artificial intelligence-based models holds particular potential for the diagnosis of upper gastrointestinal tract lesions. However, current evidence is limited by idealized datasets and lack of real-world validation, highlighting the need for larger, diverse, and clinically representative studies.

KEYWORDS
Artificial Intelligence, Deep Learning, Esophageal Cancer, Gastric Cancer, Gastroscopy

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Introduction

Gastroscopy is considered as the gold standard for the diagnosis and management of upper gastrointestinal (UGI) diseases, particularly cancers and associated premalignant conditions, mainly located in the esophagus and stomach (Kamran et al., 2025). According to the most recent GLOBOCAN statistics, in the year 2022, gastric cancer (GC) was the fifth most common cancer worldwide, with 968 000 new cases and 660 000 associated deaths. Esophagus cancer was the eleventh most prevalent cancer, with 511 000 new cases and 445 000 related deaths (Bray et al., 2024). The aggressive nature and nonspecific symptoms of UGI cancers frequently result in diagnoses at advanced stages, where treatment options are significantly limited (Hou et al., 2023; Jiang et al., 2025). Consequently, the most efficacious approach to enhance the prognosis of UGI cancers is the early detection and treatment of the disease. One method of achieving this is through the utilization of endoscopy screening. This method, when applied to asymptomatic patients, has yielded favorable outcomes, particularly among high-risk populations (Gong et al., 2014). A study conducted by Jun et al., revealed that patients in Korea who received the gastroscopy screening demonstrated a 47% reduction in mortality rates (Jun et al., 2017). Similar analyses were performed in Japan and China, where a 30% and 28% decline in mortality was observed, respectively (Q. Chen et al., 2016; Hamashima et al., 2013). However, the considerable number of examinations and the insufficient number of highly qualified specialists have led to a concomitant increase in adverse events, including incomplete examinations, inadequate observations, overlooked diagnoses and misdiagnoses. Moreover, due to the limited training of endoscopists, restricted time during the procedure, and the uncomfortable reactions of patients during ordinary gastroscopy, some areas of the gastric mucosa may be overlooked, and subtle changes indicative of early-stage UGI cancers may remain undetected (Qiu et al., 2024; Song et al., 2021). Furthermore, a meta-analysis conducted by Menon and Trudgill showed that up to 10% of UGI cancers are missed during the standard gastroscopy (Menon & Trudgill, 2014). To overcome these limitations and increase the effectiveness of diagnostic gastroscopy, scientists have initiated the incorporation of artificial intelligence (AI) into endoscopic examinations.

In 2019, the First Global Artificial Intelligence in Gastroenterology and Endoscopy Summit convened a multidisciplinary meeting of academic, industry and regulatory experts from a range of disciplines. In reference to recent and ongoing research, the specialists agreed that AI will transform the field of gastroenterology, particularly in the domains of endoscopy and image interpretation. This technological advancement has the potential to yield enhanced prediction and treatment outcomes for patients, possibly resulting in a shift in the approach of managing gastrointestinal diseases (Parasa et al., 2020). Rather than entirely replacing the role of a physician, the most promising potential for AI lies in the domains of image detection, analysis and diagnosis, eliminating human errors and reducing the time required to initiate the appropriate treatment. This is made possible by machine learning, which can be described as the study of computer algorithms that are automatically enhanced through training and practice over a period of time. This traditional concept requires manual input of significant image features such as size, color and surface pattern, along with the accurate description of these images within a database, before an algorithm can process them (van der Sommen et al., 2020). Consequently, the computer assimilates that information to establish a generalized rule for mapping the input data to the outputs, thereby creating a predictive model known as an artificial neural network (ANN). ANNs are models whose organizational structure is quite similar to that of the human central nervous system. They consist of numerous neurons, which act as computational units and are interconnected to form a network comprising an input layer, several hidden layers and an output layer. On top of the manual data input, these models require subsequent verification of results, with the objective of eliminating errors and enhancing the efficacy of the predictive algorithm (Han et al., 2018). The pursuit for enhanced performance has culminated in the development of increasingly complex neural networks, thereby giving rise to the concept of deep learning. Deep learning, eliminates the necessity for manual feature extraction by employing multilayered ANNs that can learn patterns directly from raw data. Within this architecture, the initial layers typically capture basic features, such as image edges, while subsequent deeper layers progressively detect more complex structures, including vascular patterns in endoscopic images. This capability positions deep learning as a particularly effective tool for image analysis tasks, which is crucial for the implementation of AI in UGI endoscopy. Regarding that task, the most commonly used deep learning model is a convolutional neural network (CNN). CNNs are a specialized type of ANNs designed primarily for spatial data, especially images. They use convolutional layers for spatial feature extraction and fully connected layers to classify the gathered information. Due to the fact that the neural layers are connected to the subsequent layer only, combined with a repetitive learning process, the algorithm is capable of independently identifying and learning the distinguishing features of images from a large database. Despite the fact that this model eliminates the necessity for manual input of the distinctive features of each image, it does demand a substantially greater quantity of training data (R. Y. Choi et al., 2020).

In the field of gastroscopy, AI applications mainly include computer-aided detection (CADe) for identifying suspicious lesions and computer-aided diagnosis (CADx) for lesion characterization. CADe systems use CNNs to identify suspicious lesions such as, Barrett's esophagus (BE)-related neoplasia, esophageal squamous cell carcinoma (ESCC), and early GC in real time during endoscopy. CADx algorithms characterize detected lesions, distinguishing between benign and malignant pathology, and can assist in optical biopsy, risk stratification, and prediction of invasion depth. Moreover, AI can enhance advanced imaging techniques such as narrow-band imaging (NBI), linked-color imaging, iSCAN, and confocal laser endomicroscopy to further improve diagnostic precision (Rey, 2024).

In this review, we explore the current state of research on the incorporation of AI into advanced endoscopic imaging, with a particular focus on the detection and diagnosis of malignant and premalignant lesions. The utilization of AI has the capacity to reduce blind spots during endoscopies, improve success rate of lesion and polyp detection, and minimize the incidence of misdiagnosis. A more thorough investigation into this technology has the potential to enhance the quality of gastroscopy, consequently leading to an improvement in the standard of patient care.

Methodology

This review was based on publications sourced from the PubMed and Scopus databases, published between 2015 and 2025. The objective of this research was to identify studies that assessed the performance of AI-based models in detecting BE lesions, ESCC, and GC during gastroscopy procedures. The literature search was conducted using medical subject headings and keywords such as “artificial intelligence”, “deep learning”, “esophageal cancer”, “gastric cancer”, “gastroscopy”. Only clinically relevant studies published in English were included. Articles lacking original data or sufficient methodological details were excluded.

Results

Thus far, the utilization of AI in endoscopy has been studied far more extensively in the context of colonoscopy. The ongoing and emerging clinical trials in this field have clearly defined endpoints, namely the adenoma detection rate and the polyp detection rate (Parasa et al., 2020). In contrast, studies examining the implementation of AI in gastroscopy exhibit diverse outcome thresholds, thereby significantly complicating the aggregation and comparison of results. Nevertheless, we have collected several studies that compared the efficacy of AI in gastroscopy with that of conventional gastroscopy in the diagnosis of BE, ESCC and GC.

1. Barrett's esophagus

BE is a precancerous condition that remains a significant challenge, even for experienced endoscopists. The columnar epithelium is often subtle, patchy, and easily missed, particularly in cases of short-segment disease. When coupled with sampling errors and a lack of expertise, these factors can contribute to the underdiagnosis of cases (Iyer & Chak, 2023).

De Groof et al. conducted one of the earliest major studies on the detection of BE-related neoplasia. In their study, the researchers utilized a highly trained CAD system known as ResNet-UNet, which was trained by analyzing 1704 distinct esophageal high-resolution images of confirmed early-stage neoplasia in BE and nondysplastic BE, derived from 669 patients. A comparison of the system's performance with that of non-expert endoscopists demonstrated the former's superiority. The system achieved an accuracy of 88%, a sensitivity of 93%, and a specificity of 83%, surpassing the performance of 53 non-expert endoscopists. Moreover, the algorithm successfully identified the optimal biopsy site for detected neoplasia in over 90% of cases (de Groof, Struyvenberg, van der Putten, et al., 2020). Subsequently, de Groof et al. employed their established model during live endoscopic procedures to assess the efficacy of artificial intelligence algorithms in facilitating clinical decision-making processes. White-light endoscopy (WLE) images acquired during the course of the procedures on 20 patients were immediately subjected to analysis by the aforementioned CAD system, thereby providing instantaneous feedback. The CAD system misdiagnosed one patient with confirmed Barrett's neoplasia and generated a single false-positive result, suggesting its potential for implementation in large-scale clinical trials (de Groof, Struyvenberg, Fockens, et al., 2020). Ebigbo et al. advanced this work by creating a more efficient algorithm and evaluating it on a larger dataset. Their system exhibited high diagnostic performance, with a sensitivity of 83.7%, specificity of 100%, and overall accuracy of 89.9%, while also showing strong concordance with assessments made by expert endoscopists. However, the system required the endoscopist to manually pause the live endoscopy video prior to analysis, potentially restricting its broader applicability outside highly specialized centers (Ebigbo et al., 2020). On the contrary, relying exclusively on still images introduces a selection bias and limits the application of AI systems in routine endoscopy procedures. Abdelrahim et al. addressed this issue by developing a deep learning model based on both images and previously recorded video footage. The model demonstrated an overall accuracy of 92%, with sensitivity and specificity of 93.8% and 90.7%, respectively. These results surpassed those of endoscopists, whose corresponding performance metrics were 63.5%, 77.9%, and 71.8% (Abdelrahim et al., 2023). Furthermore, Hussein et al. trained a CNN to classify images as dysplastic or non-dysplastic using annotations from full endoscopic recordings. On the test dataset, the system achieved a sensitivity of 91%, a specificity of 79% and an area under receiver operator curve of 93% in the detection of dysplasia (Hussein et al., 2022). Further exploring the potential of AI in detecting early neoplasia from full motion endoscopic videos, Fockens et al. conducted a large multicenter study on their CADe system. In contrast to the previous studies, the model was trained on images and prerecorded videos, with no particular focus on neoplastic lesions. This approach enabled approximating the conditions of a routine examination. Overall, the CADe system exhibited superiority over general endoscopists in detection of neoplasia, achieving a sensitivity of 90% vs 74% for images and a sensitivity of 91% vs 67% for videos. Moreover, the AI model showed non-inferior sensitivity when compared with BE experts (Fockens et al., 2023). Yet, the studies described thus far have uniformly relied on a single imaging modality for the training of AI models, thereby limiting the potential of this technology. Hashimoto et al. implemented training that incorporated two imaging techniques: WLE and NBI. Consequently, this strategy led to an additional enhancement in the performance of the CNN algorithms (Hashimoto et al., 2020).

Table 1. Relevant studies assessing AI in BE-related neoplasia.

References	Design	Purpose	Training set	Test set	Modality	Endoscopic platforms	Diagnostic performance (Acc/Sen/Spe)	Description
(de Groof, Struyvenberg, van der Putten, et al., 2020)	Pilot study	Detection of BE-related neoplasia	493,364 GI + 1,544 BE images	Two data sets containing 40 BE images each from a total of 80 patients	HD-WLE	Fujifilm	Data Set 4: 89%/90%/88 % Data Set 5: 88%/93/83%	First study validating image-based CADe system for BE. Large dataset used for training
(de Groof, Struyvenberg, Fockens, et al., 2020)	Pilot study	Detection of BE-related neoplasia during live procedures	493,364 gastrointestinal + 1,544 BE images	Live WLE images from 10 neoplastic and 10 non-dysplastic patients	HD-WLE	Fujifilm	90%/91%/89 %	First application of still-image CADe during live endoscopy
(Ebigbo et al., 2020)	Prospective study	Detection of BE-related neoplasia during live procedures	129 endoscopic images	62 endoscopic images assessed during live endoscopy	HD-WLE	Olympus	90%/84%/100 %	Faster CADe but requires pausing of live video
(Abdelrahim et al., 2023)	Multicenter trial	Detection of BE-related neoplasia	1,090,171 images and videos	471 images, 75 videos	HD-WLE	Fujifilm, Olympus, Pentax	92%/94%/91 %	Multicenter (3 centers), video-based CADe, different platforms
(Hussein et al., 2022)	Multicenter trial	Detection of BE-related neoplasia	148,936 video frames	28 dysplastic BE: 168 iSCAN frames, 108 WLE frames	HD-WLE and iSCAN	Pentax	WLE: 83%/92%/73 % iSCAN: 86%/91%/79 %	First study assessing CADe on iSCAN images, multicenter (4 centers)
(Fockens et al., 2023)	Multicenter trial	Detection of BE-related neoplasia	14,046 images	809 images, 439 videos	HD-WLE	Olympus	Images: -/95%/- Videos: -/97%/-	Multicenter (15 centers), video-based CADe
(Hashimoto et al., 2020)	Pilot study	Detection of BE-related neoplasia during live procedures	9,016 endoscopic images	458 endoscopic images assessed during live endoscopy	WLE and NBI	Olympus	95%/96%/94 %	No pausing required during live video, multimodal

Abbreviations: BE: Barrett's esophagus, GI: gastrointestinal, WLE: white-light endoscopy, HD-WLE: high-definition white-light endoscopy, NBI: narrow-band imaging, CADe: computer-aided detection.

2. Esophageal squamous cell carcinoma

Another challenge facing modern gastroscopy is the detection of ESCC. The initial symptoms of this condition are usually subtle and non-specific, which complicates the diagnostic process (Wei & Friedland, 2021). By the time a diagnosis is made, the disease has often already progressed to an advanced stage, making treatment ineffective (van Rossum et al., 2018). Early superficial lesions are subtle, flat and non-ulcerated, causing them to blend in with the normal mucosa. This poses a significant problem for traditional WLE, resulting in an incidence of undetected esophageal cancer ranging from 6.4% to 7.8% (Chadwick et al., 2014; Rodríguez de Santiago et al., 2019). Consequently, a novel technology, NBI, has emerged as the current endoscopic standard for the detection of superficial esophageal cancer lesions. This technique has been shown to enhance the visualization of mucosal microvessels and surface structures, thereby leading to a substantial improvement in the efficacy of neoplasia detection (Morita et al., 2017; Muto et al., 2010). However, given its high dependence on the operator's expertise, the effectiveness of this method is considerably reduced for less experienced endoscopists, particularly in the context of subtle lesions. It is here that an opportunity is seen in AI's potential to increase the sensitivity and accuracy of endoscopic examinations.

Arribas et al. evaluated the performance of AI models for the identification of ESCC based on three studies. The results of this analysis indicated a sensitivity of 93%, a specificity of 89%, and a negative predictive value of 97% for ESCC detection. Nevertheless, concerns have been raised regarding the selection and operator bias present in the training datasets utilized, as well as the limited size of the validation datasets, potentially compromising the quality of the research conducted (Arribas et al., 2021). Two separate studies carried out by Waki et al. and Shiroma et al. evaluated the effectiveness of AI systems under simulated real-world conditions, either by using unedited endoscopic recordings or by limiting the procedure time for endoscopists. The findings of both studies indicated the remarkable efficacy of AI models under such circumstances. However, in both cases, the systems failed to detect precancerous lesions, significantly limiting their clinical utility (Shiroma et al., 2021; Waki et al., 2021). Further elaborating the performance of AI models, Meng et al. utilized a CAD system based on the YOLO v5 algorithm to analyze inaccurately identified lesions. The system achieved significantly better results compared to non-expert endoscopists and comparable with those of expert endoscopists (Meng et al., 2022). A recent clinical study conducted by Yuan et al. evaluated the effectiveness of an AI system in detecting superficial ESCC and precancerous lesions using two imaging methods: WLE and NBI. AI assistance resulted in a reduction of miss rates, both per lesion and per patient, indicating the potential benefits associated with the implementation of this system in daily practice (Yuan et al., 2024). Despite the promising outcomes achieved by AI systems in research settings, their practical implementation is currently very limited. Nonetheless, there have been isolated instances of real-world applications of these systems emerging within the scientific community. Recently, Zhou et al. reported a successful attempt to use a multimodal AI system to detect and delineate a small, flat lesion during clinical esophagogastroduodenoscopy, that was later confirmed to be high-grade squamous intraepithelial neoplasia (Zhou et al., 2025). In addition to AI systems' ability to detect esophageal lesions, these models have the capability to assist in the assessment of tumor infiltration depth. Shimamoto et al. and Nakagawa et al. used their CNN models to characterize superficial ESCC. In predicting tumor infiltration depth, both models demonstrated high performance, with accuracies of 89.2% and 91%, respectively (Nakagawa et al., 2019; Shimamoto et al., 2020).

3. Gastric cancer

Early GC frequently remains asymptomatic or presents with nonspecific complaints, including mild dyspepsia, bloating, early satiety, and mild nausea. These symptoms can be easily mistaken for benign conditions, resulting in delays in diagnosis and missed opportunities for early detection (Huang et al., 2024). The overall 5-year survival rate of early GC approximates 90%, although, as the disease progresses, this rate drops sharply, falling below 50% (Shah et al., 2025). This underscores the crucial need to develop technologies that allow the earliest possible detection of precancerous lesions or early-stage cancers.

Atrophic gastritis and intestinal metaplasia are well-known precancerous conditions caused by chronic inflammation. Guimarães et al. evaluated the performance of a fine-tuned, pretrained CNN in detecting atrophic gastritis on two datasets of endoscopic images comprising a total of 270 images. Although the AI model achieved significantly higher accuracy compared to endoscopists, due to the small sample size, the results of this study should be interpreted with caution (Guimarães et al., 2020). In their multicenter study, Xu M et al. used a significantly larger dataset to evaluate the effectiveness of the ENDOANDEL CADe system. The research team achieved high diagnostic accuracy in detecting gastric atrophy (90.1% internal, 86.4%

external, and 87.8% in prospective video sets) and intestinal metaplasia (90.8% internal, 85.9% external, and 89.8% in prospective video sets), significantly surpassing that of non-expert endoscopists and matching the results of experts in this field (M. Xu et al., 2021). Over time, the ENDOANGEL system has undergone continuous refinement, and its efficacy has been further validated in a recent single-center clinical trial conducted by Xu Z et al. This study demonstrated that AI assistance led to a substantial improvement in the detection rates of gastric precancerous lesions (Z. Xu et al., 2025). According to the findings of several studies, the ENDOANGEL system has also demonstrated proficiency in detecting and diagnosing subtle mucosal changes (Ling et al., 2021; Wu et al., 2019, 2022). Wu et al. used both WLE and NBI to evaluate the system's efficacy. It demonstrated a significant advantage over endoscopists in detecting early GC, while also showing comparable effectiveness in assessing tumor invasion depth and differentiation status (Wu et al., 2019, 2022). Moreover, this system has been shown to markedly reduce the miss rate for gastric neoplasms during conventional WLE by up to 20% (Wu et al., 2021). Another AI-based diagnostic tool, termed Tango, developed by Ishioka et al., demonstrated its superior performance in detecting early GC compared to specialists and outperformed non-experts in both sensitivity and accuracy (Ishioka et al., 2023). Luo et al. developed GRAIDS, an AI diagnostic system enabling real-time automated detection of UGI cancers during gastroscopies, using one of the most extensive datasets comprising 1,036,496 endoscopy images. Notably, it is the first AI-aided image recognition system in history to be implemented in clinical practice for identifying GCs, providing assistance for endoscopists at the Sun Yat-sen University Cancer Center in China. In their multicenter study, GRAIDS performance was evaluated using internal, prospective and external validations sets from a total of five primary care hospitals and compared with endoscopists with three levels of expertise: expert, competent, and trainee. It outperformed less experienced practitioners and achieved diagnostic sensitivity outcomes consistent with those of expert endoscopists, demonstrating its potential for worldwide use (Luo et al., 2019).

In addition to the detection of gastric lesions, their subsequent classification and assessment of invasion depth are also of significant importance in clinical practice. Currently, endosonography is being used for staging classification of early GC due to its ability to delineate gastric wall layers. However, research has demonstrated its efficacy in this domain to be rather limited (J. Choi et al., 2010; Kim et al., 2007; Lee et al., 2016). Building upon these findings, Nam et al. proceeded with the development of CNN models for the identification, differential diagnosis and invasion depth determination of gastric mucosal lesions. Their differential diagnosis model exhibited higher diagnostic performance compared to novice and intermediate endoscopists, and demonstrated similar efficacy to that of experts. Moreover, when assessing lesion invasion depth, their AI system exhibited superiority over endosonography performed by specialists (Nam et al., 2022). Similar outcomes in determining invasion depth of early GC were achieved by AI models constructed by Zhu et al. and Chen et al. The AI systems exhibited a high diagnostic accuracy of 89.16% and 86.18%, respectively, substantially outperforming endoscopists and conventional imaging methods (T.-H. Chen et al., 2024; Zhu et al., 2019).

Furthermore, determining the resection margins for gastric tumors remains a fundamental component of the therapeutic process. This step is critical for improving treatment outcomes and mitigating the risk of recurrence. In a review conducted by Lei et al., six studies measuring the effectiveness of AI models in identifying lesion boundaries achieved accuracy rates ranging from 82,7% to 96,3%. Nevertheless, the limited number of images used to evaluate these systems, requires further studies to validate these promising results (Lei et al., 2025).

Conclusions

Gastroscopy is widely regarded as one of the most valuable innovations in modern medicine. It allows physicians to directly visualize a patient's upper gastrointestinal tract in a relatively simple, safe, minimally invasive, and cost-effective manner. Consequently, it enables the identification of lesions, erosions, ulcers, inflammation, or tumors. However, despite advancements and the emergence of novel imaging techniques, endoscopists, particularly those with limited experience and access to lower-quality equipment, frequently encounter challenges in identifying and diagnosing subtle lesions. In particular, Barrett's esophagus, early superficial lesions of esophageal squamous cell carcinoma, and early gastric cancer can be easily overlooked during routine gastroscopy. This can result in delayed diagnosis and, consequently, limited therapeutic options and poorer treatment outcomes for patients. The utilization of artificial intelligence-based models to assist in diagnostic endoscopy appears to effectively address these issues. Tools developed using deep neural networks have proven to be highly effective in detecting subtle gastric mucosal lesions, precancerous lesions, and early-stage cancers. Furthermore, these algorithms have the capacity to significantly reduce blind spots and determine invasion depth and tumor margins, thereby considerably enhancing the diagnostic process. However, the models that have been tested thus far present certain limitations. The majority of the studies reviewed in this article, utilized a limited set of selected, high-quality endoscopic images, lacking factors like motion blur, bleeding or mucus, to evaluate the performance of artificial intelligence systems. These limitations render the application of these research results to real clinical scenarios rather challenging. Furthermore, existing studies primarily used endoscopic images captured by endoscopes of the same brand, generally relying on only two of the most common imaging techniques: white light endoscopy and narrow-band imaging. Typically, the evaluation of emerging systems has been conducted using post-endoscopic still images, introducing operator bias and restricting the assessment of their real-time effectiveness. Moreover, too few studies have focused on video footage rather than images for the training and evaluation of artificial intelligence performance, and even fewer have estimated the actual contribution of artificial intelligence support in daily clinical practice. Additionally, a notable body of current research is conducted exclusively in Asian countries, namely China, Japan and Korea, frequently utilizing the same available datasets, thereby constraining their broader applicability. Nevertheless, the mounting body of research continues to demonstrate the efficacy of artificial intelligence-assisted upper gastrointestinal endoscopy, particularly in circumstances where there is a shortage of highly qualified and experienced endoscopists, as well as where financial constraints prevent the utilization of high-end equipment and various modern imaging technologies. Future studies should direct their attention towards the utilization of a substantially larger number of low-quality images and video footage. Furthermore, the validation of artificial intelligence models should be based on their use in daily clinical practice across various populations in order to verify their broad applicability.

Ethics Approval: The study was a descriptive one. No humans or animals were a subject of examinations.

Conflicts of Interest: No conflicts of interest to declare.

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