



International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Operating Publisher
SciFormat Publishing Inc.
ISNI: 0000 0005 1449 8214

2734 17 Avenue SW,
Calgary, Alberta, T3E0A7,
Canada
+15878858911
editorial-office@sciformat.ca

ARTICLE TITLE ARTIFICIAL INTELLIGENCE-ASSISTED GASTROSCOPY IN EARLY
GASTRIC CANCER PREVENTION: A REVIEW OF CURRENT
OPPORTUNITIES AND FUTURE TECHNOLOGICAL CHALLENGES

DOI [https://doi.org/10.31435/ijitss.2\(50\).2026.5182](https://doi.org/10.31435/ijitss.2(50).2026.5182)

RECEIVED 21 February 2026

ACCEPTED 22 April 2026

PUBLISHED 04 May 2026

LICENSE



The article is licensed under a **Creative Commons Attribution 4.0 International License**.

© The author(s) 2026.

This article is published as open access under the Creative Commons Attribution 4.0 International License (CC BY 4.0), allowing the author to retain copyright. The CC BY 4.0 License permits the content to be copied, adapted, displayed, distributed, republished, or reused for any purpose, including adaptation and commercial use, as long as proper attribution is provided.

ARTIFICIAL INTELLIGENCE-ASSISTED GASTROSCOPY IN EARLY GASTRIC CANCER PREVENTION: A REVIEW OF CURRENT OPPORTUNITIES AND FUTURE TECHNOLOGICAL CHALLENGES

Julia Koronczok-Matusiak (Corresponding Author, Email: jkoronczok@gmail.com)
J. Gromkowski Voivodship Specialist Hospital in Wrocław, Wrocław, Poland
ORCID ID: 0009-0001-8100-8527

Dominika Jurczak
Bonifraters Medical Center Ltd., St. John of God Brothers' Hospital, Kraków, Poland
ORCID ID: 0009-0007-6042-5659

Zuzanna Kafara
5th Military Hospital with Polyclinic in Kraków, Kraków, Poland
ORCID ID: 0009-0002-5983-5611

Donata Kowalczyk
5th Military Hospital with Polyclinic in Kraków, Kraków, Poland
ORCID ID: 0009-0008-8965-0689

Wiktoria Król
Municipal Hospital in Zabrze, Zabrze, Poland
ORCID ID: 0009-0007-3349-5395

Konrad Kulka
Municipal Hospital in Zabrze, Zabrze, Poland
ORCID ID: 0009-0007-6397-8777

Zuzanna Lechowska
Gabriel Narutowicz Hospital, Kraków, Poland
ORCID ID: 0009-0008-0430-3996

Agnieszka Kafara
Jagiellonian University Medical College, Kraków, Poland
ORCID ID: 0009-0005-7168-5291

Rafał Szarek
Department of Microbiology and Immunology, Faculty of Medical Sciences in Zabrze, Medical University of
Silesia in Katowice, Zabrze, Poland
ORCID ID: 0009-0001-9118-0769

Katarzyna Michta
Medical University of Gdańsk, Gdańsk, Poland
ORCID ID: 0009-0000-2937-0257

ABSTRACT

Endoscopic examination plays a crucial role in the secondary prevention of gastric cancer. However, its effectiveness is often limited by the subjective nature of assessment and the risk of missing neoplastic lesions. The use of deep learning (DL) and machine learning (ML) models allows for a significant improvement in the quality of endoscopic diagnosis of early gastric cancer. Real-time systems increase the sensitivity of the examination and reduce skill-based differences between endoscopists. They also enable precise assessment of tumor invasion depth, which is essential for qualifying patients for minimally invasive treatment. Explainable artificial intelligence (XAI) methods and ML algorithms are gaining increasing importance as they enhance the transparency of the diagnostic process. Despite promising data, the full implementation of AI systems in endoscopy faces challenges such as susceptibility to imaging artifacts, the risk of model overfitting, and regulatory hurdles. A key issue remains the development of representative, multicenter training image databases and the conduct of prospective clinical trials, which may revolutionize standards of care.

The aim of this article is to discuss the role of AI-assisted gastroscopy in the prevention of early gastric cancer, with particular emphasis on its potential in population-based screening programs. The paper presents current clinical data and analyzes the benefits and challenges associated with implementing these technologies into routine clinical practice.

KEYWORDS

Early Gastric Cancer, Artificial Intelligence, Deep Learning, Machine Learning, Endoscopy

CITATION

Julia Koronczok-Matusiak, Dominika Jurczak, Zuzanna Kafara, Donata Kowalczyk, Wiktoria Król, Konrad Kulka, Zuzanna Lechowska, Agnieszka Kafara, Rafał Szarek, Katarzyna Michta. (2026) Artificial Intelligence-Assisted Gastroscopy in Early Gastric Cancer Prevention: A Review of Current Opportunities and Future Technological Challenges. *International Journal of Innovative Technologies in Social Science*. 2(50). doi: 10.31435/ijitss.2(50).2026.5182

COPYRIGHT

© The author(s) 2026. This article is published as open access under the **Creative Commons Attribution 4.0 International License (CC BY 4.0)**, allowing the author to retain copyright. The CC BY 4.0 License permits the content to be copied, adapted, displayed, distributed, republished, or reused for any purpose, including adaptation and commercial use, as long as proper attribution is provided.

Introduction

Gastric cancer is the fifth most frequently diagnosed cancer worldwide (approximately 969,000 new cases in 2022, accounting for 4.9% of all cancer diagnoses) and the fifth leading cause of cancer-related death (approximately 660,000 deaths, representing 6.8% of all cancer deaths) [1, 2]. The global burden of this disease is particularly high in Asia, which accounts for over 70% of all cases and deaths [2]. In the United States, where early diagnoses represent less than 25% of cases, the 5-year survival rate is only 32% [3]. In contrast, in South Korea, thanks to the Korean National Cancer Screening Program (KNCSPP), which offers endoscopy every two years to individuals over the age of 40, more than 70% of gastric cancers are detected at a curable stage. The implementation of the KNCSPP has led to a 41% reduction in the risk of death from this malignancy and achieved survival rates of 95–99% in the early stages of the disease [3, 4].

Esophagogastroduodenoscopy (EGD) is the primary diagnostic method for evaluating the upper gastrointestinal tract and a key tool for detecting early gastric cancer (EGC). However, the effectiveness of endoscopy remains limited; the examination is subjective, highly dependent on the operator's experience, and the miss rate for early gastric cancer ranges from 4.6% to 25.8% [5]. Additionally, although detailed guidelines and EGD quality indicators exist (including minimum inspection time and the requirement to evaluate all parts of the stomach), their adherence in clinical practice can be challenging [6]. Standard white-light imaging (WLI) supplemented by image-enhanced endoscopy (IEE) techniques can significantly increase EGC detection through better mucosal color differentiation. Nevertheless, the widespread use of these endoscopic techniques is still hindered by limited access to equipment and the requirement for highly specialized knowledge and extensive experience [5, 7].

In this context, tools that could support endoscopists in standardizing the assessment of the gastric mucosa are of particular importance. The development of artificial intelligence (AI), specifically deep learning models based on convolutional neural networks (CNN), is revolutionizing the diagnosis of early gastric cancer by facilitating the identification of subtle neoplastic lesions. The use of these advanced technologies in endoscopy allows for a significant increase in the sensitivity of the examination and a reduction in the number of lesions overlooked in routine practice. Through early cancer detection, it is possible to implement minimally invasive treatment methods, such as endoscopic submucosal dissection (ESD) [8].

Methodology

The basis of this article is a literature review of the last 10 years, conducted in the PubMed and Google Scholar databases using the following keywords: "early gastric cancer", "artificial intelligence", "deep learning", "machine learning" and "endoscopy". The analysis included randomized controlled trials, multicenter and single-center studies, controlled clinical trials, meta-analyses and expert reviews. The selected papers were evaluated in the context of artificial intelligence applications in the endoscopic diagnosis of early gastric cancer, as well as the potential opportunities and future technological challenges associated with the use of these systems in cancer prevention.

Results

AI applications in early gastric cancer detection using white-light imaging and image-enhanced endoscopy techniques

Image recognition using artificial intelligence has made significant progress over the last few years and has found numerous applications in medicine. In the field of image analysis, convolutional neural networks (CNN) demonstrate the highest efficiency [8]. Initial systems relied primarily on algorithms performing retrospective analysis of recorded images and videos. An example of such work is the CNN model developed by Hirasawa's team, which achieved a sensitivity of 92.2%, correctly identifying 71 out of 77 neoplastic lesions [8]. The EGD images used in that study were obtained using standard white-light imaging, chromoendoscopy with indigo carmine spray, and narrow-band imaging (NBI). The potential of this technology was further confirmed by a study by Ikenoyama et al., in which the same CNN model was compared with the skills of 67 endoscopists. The CNN demonstrated a sensitivity of 80% in detecting early gastric cancer, significantly outperforming the group of physicians, whose result was 53.4%. This system proved particularly effective in identifying lesions larger than 10 mm and correctly identified all cases with T1b stage [9].

In another study, instead of standard WLI, images from magnifying endoscopy with narrow-band imaging (ME-NBI) were used for analysis. Li et al. conducted a prospective evaluation of a CNN model that demonstrated a sensitivity of 91.18%, specificity of 90.64%, and accuracy of 90.91%. Notably, the system achieved higher sensitivity than experts and significantly outperformed less experienced operators across all diagnostic parameters [10].

Another study utilizing ME-NBI images was conducted by Horiuchi's team, with the aim of evaluating the diagnostic capabilities of a CNN model in differentiating EGC from gastric mucosal inflammation. The developed system achieved an accuracy of 85.3%, sensitivity of 95.4%, and specificity of 71.0% [11]. The model's performance was subsequently analyzed using ME-NBI video recordings and compared with 11 experts. The diagnostic effectiveness of the system was comparable to the results obtained by experienced endoscopists [12].

Further progress in this field was brought by the work of Ueyama et al., who developed an advanced CNN system trained on a large dataset of ME-NBI images. This model achieved exceptionally high accuracy of 98.7%, sensitivity of 98%, and specificity of 100%. False-negative findings partially included cases of intestinal metaplasia and gastritis, which are difficult to differentiate even for experts. Another source of errors was insufficient image quality, resulting from focusing problems, inadequate magnification, or artifacts caused by bleeding [13].

A breakthrough in the development of these technologies was the GRAIDS system, which was the first to enable real-time diagnosis of upper gastrointestinal neoplasms based on standard WLI images. In a multicenter study, this model achieved high diagnostic accuracy and expert-level sensitivity, thereby outperforming less experienced endoscopists [14]. Another model that also demonstrated significant potential in real-time EGC detection using WLI was the ENDOANGEL system. Among 196 lesions from which biopsy samples were taken for histopathological examination, the model correctly identified all 5 cancer cases (2 at an advanced stage and 3 EGC). It achieved an accuracy of 84.7%, sensitivity of 100%, and specificity of 84.3% for individual lesions. However, the study highlighted the limitations of the ENDOANGEL system arising from the presence of endoscopic "noise," such as light reflections, foam, and mucus. These elements increased the risk of false-positive results, causing some non-neoplastic lesions, including inflammatory changes and ulcers, to be incorrectly flagged as potential malignancies [15].

The effectiveness of solutions based on the ENDOANGEL system is further confirmed by other clinical studies. These demonstrated that the ENDOANGEL-LD system significantly improves the quality of routine gastroscopy and facilitates the diagnosis of gastric neoplasms [16, 17]. A randomized tandem study showed that AI assistance during endoscopic examination reduces the miss rate of gastric neoplasms approximately fourfold

compared to standard WLI endoscopy [16]. Another multicenter study demonstrated that the ENDOANGEL-ME system, dedicated to EGC detection using ME-NBI imaging, achieves higher diagnostic performance than endoscopists. This was confirmed in analyses performed on both static images and videos. In prospective clinical trial, ENDOANGEL-ME achieved a sensitivity of 92.6% and an accuracy of 83.7% [18].

AI applications in minimizing blind spots and monitoring the quality of endoscopic examination

Complete visualization of the entire stomach is a key requirement for a properly performed EGD examination [19, 20]. Modern AI systems have helped address the problem of so-called blind spots – areas missed during endoscopy that may contain pathological lesions and lead to missed EGC. A model has been developed that identifies individual regions of the stomach with expert-level accuracy, automatically maps them onto a grid-based model of the organ, and informs the operator in real time about areas that have not been adequately evaluated. In addition, this system shows perfect stability (κ 1.0), which helps to overcome the limitations of standard WLI related to variability in technical skills between operators [19].

Another advanced solution is the WISENSE system, designed to minimize the proportion of blind spots and reduce the impact of human factors on endoscopic quality. This model combines convolutional neural networks with deep reinforcement learning (DRL) and was developed to function effectively in the dynamic conditions of endoscopy. WISENSE monitored blind areas with a mean accuracy of 90.02%, providing real-time quality surveillance of the examination. In a clinical study, its use reduced the proportion of missed areas from 22.46% to 5.86% compared with the control group and significantly improved the completeness of photographic documentation compared with examinations performed by endoscopists alone [20].

A breakthrough in the development of this technology was the ENDOANGEL system, created by Wu's group as a more advanced version of the WISENSE model. Its effectiveness was evaluated in a multicenter, prospective, randomized study, which confirmed its high utility in real-world clinical settings. The use of ENDOANGEL significantly reduced the number of gastric blind spots from a mean of 9.82 to 5.38 areas per patient, out of 26 locations included in the protocol. This reduction was evident in most gastric regions. Moreover, use of ENDOANGEL was associated with an increase in mean procedure time from 4.38 to 5.40 minutes compared with the control group, which favored a more thorough assessment of the stomach lumen [15].

AI applications in determining the depth of tumor invasion

Understanding the true depth of gastric cancer invasion is crucial for selecting the optimal treatment strategy, as it allows clinicians to distinguish lesions eligible for endoscopic resection from those requiring surgical management. An incorrect assessment of invasion depth may lead to unnecessarily extensive operations, significantly prolonging patient recovery time [21]. The most challenging decision-making criterion remains determining whether the tumor is limited to the mucosal layer (T1a) or has already invaded the submucosa (T1b). This distinction is essential because T1a lesions can be effectively removed using endoscopic submucosal dissection, whereas submucosal invasion often necessitates surgical intervention. Despite technological advances, conventional endoscopic ultrasonography (EUS) achieves an accuracy of approximately 70% in this context [22, 23].

High diagnostic performance in assessing the depth of gastric cancer invasion has been demonstrated by a CNN-based computer-aided detection system developed by Zhu et al. The model was trained on static WLI endoscopic images. The AI algorithm differentiated early-stage gastric cancer from deeper submucosal invasion, achieving a sensitivity of 76.5% and a specificity more than 30% higher than that of endoscopists [24]. Similarly, the model developed by Yoon et al., also based on WLI images, achieved a sensitivity of 79.2% and a specificity of 77.8% in predicting invasion depth. However, the authors emphasized a major limitation of the system—its markedly reduced accuracy in tumors with undifferentiated histology [25].

Similar limitations were observed by Goto et al. In their study, only WLI images of depressed-type EGC were analyzed. The performance of their AI classifier was strongly dependent on tumor characteristics because undifferentiated lesions more frequently led to overestimation of submucosal invasion. In contrast, endoscopists tended to underestimate invasion depth, resulting in higher specificity for identifying T1a lesions. The AI classifier achieved an accuracy of 72.5%, sensitivity of 74.0%, and specificity of 71.0% in the test set. Combined assessment by the AI system and endoscopists significantly improved diagnostic performance, reaching an accuracy of 78.0%, sensitivity of 76.0%, and specificity of 80.0% [22].

To better reflect real-world conditions, Cho et al. developed a deep learning model evaluating all gastric lesions with resection potential, regardless of the initial endoscopic diagnosis. Images obtained using WLI were analyzed. In a retrospective clinical simulation on an external dataset, the developed CNN model

achieved results comparable to those of experienced endoscopists. Although the system did not entirely eliminate the risk of error, its application could have prevented unnecessary extensive surgery in 6.7% of patients by qualifying them for less invasive endoscopic resection [21].

An important step toward optimizing AI algorithms capable of predicting tumor invasion depth was the study by Kim et al., who demonstrated that models trained exclusively on static images lose sensitivity under real endoscopy conditions. In response to this limitation, the authors developed a video classifier (VC) analyzing white-light endoscopic videos, which enabled more precise and consistent real-time prediction of invasion depth, better reflecting the demands of clinical practice. This model achieved a sensitivity of 82.3%, specificity of 85.8%, and accuracy of 83.7%, clearly outperforming models based on static WLI images [26].

An equally innovative approach was presented by Chen et al., who developed model for predicting submucosal invasion by additionally incorporating quantitative colorimetric indicators within WLI. Decision tree model and random forest model were constructed, capable of capturing non-linear relationships between key predictors of submucosal invasion, including lesion location, macroscopic type (particularly depressed), size (≥ 30 mm), prominent lesion margin elevation, histological type, and color differences between the tumor and surrounding mucosa. A retrospective study demonstrated that standardization of color assessment in WLI combined with the applied machine learning models increases the precision of invasion depth prediction and may reduce the subjectivity of endoscopic staging of EGC [27]. Notably, the structure of decision tree and random forest models is considerably more transparent to endoscopists than classical CNN architectures, providing high interpretability of the decision-making process and aligning with the principles of explainable artificial intelligence (XAI).

Applications of XAI to enhance transparency in the diagnosis of early gastric neoplasms

For many endoscopists, the underlying mechanisms of advanced AI algorithms are difficult to understand. The lack of transparency in the diagnostic process of proposed models reduces physicians' trust in using these innovative technologies. In response to this problem, the ENDOANGEL-LA system was developed. By using a set of clearly defined endoscopic features derived through machine learning algorithms, it enables transparent and logical diagnosis of early gastric cancer within M-IEE. In contrast to earlier deep learning models with a "black box" nature, ENDOANGEL-LA provides the operator with detailed information about the system's decision-making process. A multicenter study confirmed that the system significantly improves the diagnostic performance of less experienced operators, allowing them to achieve results comparable to experts. With ENDOANGEL-LA support, the accuracy, sensitivity, and specificity of novices improved substantially, reaching 87.45%, 85.03%, and 90.42%, respectively [28].

A similar approach was used in the development of the ENDOANGEL-ED system, created using WLI images and videos. Based on a literature review and expert knowledge, 13 morphological features considered crucial for EGC assessment were identified and then analyzed using multiple machine learning models. The random forest model achieved the highest performance and, in its final version, incorporated the six most important diagnostic features. Assigning weights to individual features enabled operators to visualize the diagnostic basis of the system's decisions, making ENDOANGEL-ED an understandable tool that is easier to accept in clinical practice. This model achieved high diagnostic performance, although only slightly higher than the DL model without explainable decision making trained on the same dataset. Support from ENDOANGEL-ED significantly improved endoscopists' accuracy, sensitivity, and specificity in detecting EGC, particularly among less experienced operators. Novices working with ENDOANGEL-ED achieved results almost identical to those of experts. In addition, on external videos, ENDOANGEL-ED achieved better sensitivity than experts [29].

Discussion

Deep learning systems based on convolutional neural networks and machine learning methods demonstrate significant potential in improving the quality of endoscopic diagnosis of early gastric cancer. In studies utilizing both standard white-light imaging and image-enhanced techniques such as ME-NBI, these systems achieved very high diagnostic performance. They demonstrated sensitivity superior to that of experts and markedly better diagnostic parameters compared with less experienced operators, substantially reducing the variability arising from differences in endoscopists' technical skills [9, 10]. The introduction of real-time systems such as GRAIDS and ENDOANGEL has enabled increased detection of early gastric cancer in clinical practice [14, 15]. AI assistance has been shown to significantly reduce the miss rate of gastric neoplasms compared with standard white-light endoscopy [16].

A significant problem in conventional gastroscopy is the presence of so-called blind spots, which may lead to missed EGC. Systems such as WISENSE and its successor ENDOANGEL are capable of recognizing individual gastric regions and informing the operator in real time about areas that have not been adequately assessed. This translated into a significant reduction in the proportion of missed areas, improved completeness of photographic documentation, and an extension of effective endoscopic examination time, all of which favor a more thorough evaluation of the gastric mucosa [15, 19, 20].

An important area of AI application is the assessment of gastric cancer invasion depth, which directly determines the choice between endoscopic resection and surgical treatment. CNN-based models achieve higher performance in differentiating T1a and T1b stages compared with conventional methods such as EUS, and their use could prevent unnecessary extensive surgery in some cases by qualifying patients for less invasive endoscopic resection [21, 23, 24]. Further optimization has been achieved through the incorporation of quantitative colorimetric indicators within WLI and the use of ML algorithms such as decision trees and random forests, which are capable of capturing non-linear relationships between key features in EGC assessment [27]. These solutions not only improve the precision of invasion depth prediction but also increase the objectivity of assessment, reducing the influence of subjective endoscopist interpretation.

Classical CNNs are difficult to understand for clinicians and are often perceived as a "black box," which limits trust and the readiness for their routine application. The ENDOANGEL-LA and ENDOANGEL-ED systems demonstrate that the solutions based on random forest algorithm, make the decision-making process significantly more transparent for the operator [27, 28, 29]. The ability to identify image features that are crucial for prediction of EGC makes the process more understandable for operators and XAI support allows less experienced endoscopists to achieve results comparable to those of experts, fostering broader acceptance and implementation of AI systems in clinical practice [28, 29].

Despite these successes, a number of limitations persist. Studies have shown that endoscopic artifacts, such as light reflections, foam, or mucus, increase the risk of false-positive results, leading to the incorrect flagging of inflammatory lesions or ulcers as potentially neoplastic [13, 15]. Other works highlight the poorer performance of models in case of patients with undifferentiated histology cancers, the tendency of AI toward overprediction of deeper invasion, and the decline in effectiveness of models trained exclusively on static images when transferred to real-world endoscopy conditions [22, 25]. These issues are further compounded by broader systemic challenges, including the risk of errors resulting from the quality of training data and insufficient external validation of models. A significant barrier is the substantial heterogeneity of available AI solutions. The requirement for continuous model updates in accordance with evolving endoscopic practices further complicates the process of implementing these tools in clinical practice. Concurrently, attention is drawn to regulatory issues related to the legal liability of physicians making decisions in collaboration with AI. Furthermore, the true clinical value of AI systems can only be fully assessed after their implementation in hospital practice, which requires prior approval by relevant regulatory bodies and the conduct of rigorous real-world validation [30, 31, 32].

Future directions for the development of AI technologies in endoscopy focus on several key areas. There is a need for multicenter, prospective studies conducted under real-world clinical conditions to assess the impact of AI algorithms not only on basic diagnostic metrics, but also on accurate prognostication and treatment planning. Such an approach will enable personalized patient care and provide a solid foundation for integrating AI systems into population-based screening programs [30, 31, 32]. In parallel, efforts are being made to develop multimodal systems that, through the fusion of endoscopic and histopathological data, will provide more integrated diagnostics and markedly increase the reliability of results provided by the models [30]. A crucial issue remains ensuring consistent quality of acquired images and the development of representative, multicenter databases. This is essential to prevent AI models from being limited to the data on

which they were trained and to ensure that they can reliably recognize lesions in patients across diverse clinical settings. These efforts are complemented by the continued development of XAI which, by offering transparent decision-making, may play a key role in lower-volume or less specialized centers effectively shortening the learning curve for less experienced endoscopists [30, 31, 32].

Conclusions

Artificial intelligence represents a promising tool for supporting the endoscopic diagnosis of early gastric cancer. The integration of AI systems into routine gastroscopy not only reduces the risk of missed neoplastic lesions but also enables earlier implementation of minimally invasive treatment through precise prediction of invasion depth, thereby improving patient survival. This technology provides active quality oversight during endoscopic examinations and may play a particularly important role in population-based screening programs by ensuring consistent assessment quality regardless of operator experience. Despite its substantial potential, widespread adoption of these solutions in daily clinical practice still requires confirmation of their effectiveness in prospective multicenter studies.

Funding Statement: The study did not receive special funding.

Conflict of Interest Statement: The authors declare no conflict of interest.

Acknowledgments: All authors have reviewed and approved the final version of the manuscript for publication.

REFERENCES

1. Bray, F., Laversanne, M., Sung, H., Ferlay, J., Siegel, R. L., Soerjomataram, I., & Jemal, A. (2024). Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: A Cancer Journal for Clinicians*, 74(3), 229–263. <https://doi.org/10.3322/caac.21834>
2. International Agency for Research on Cancer, World Health Organization. (2024, October 30). *Stomach fact sheet* [Infographic]. <https://gco.iarc.who.int/media/globocan/factsheets/cancers/7-stomach-fact-sheet.pdf>
3. Kim, G. H., El-Serag, H. B., Corral, J., Buxbaum, J. L., Chandar, A. K., DiMarino, A. J., Dumot, J. A., Gawron, A. J., Genta, R. M., Graham, D. Y., Gupta, N., Iyer, P. G., Jain, A., Jain, R., Kwon, R. S., Lin, O. S., Odze, R. D., Qumseya, B. J., Rubenstein, J. H., ... AGA Clinical Practice Update Committee. (2025). AGA Clinical Practice Update on screening and surveillance in individuals at increased risk for gastric cancer in the United States: Expert review. *Gastroenterology*, 168(2), 235–252. <https://doi.org/10.1053/j.gastro.2024.11.001>
4. Kim, T.-H., Kim, I.-H., Kang, S. J., Choi, M., Kim, B.-H., Eom, B. W., Kim, B. J., Min, B.-H., Choi, C. I., Shin, C. M., Tae, C. H., Gong, C. S., Kim, D. J., Cho, A. E.-H., Gong, E. J., Song, G. J., Im, H.-S., Ahn, H. S., Lim, H., ... Kong, S.-H. (2023). Korean practice guidelines for gastric cancer 2022: An evidence-based, multidisciplinary approach. *Journal of Gastric Cancer*, 23(1), 3–106. <https://doi.org/10.5230/jgc.2023.23.e11>
5. Abe, S., Kitagawa, Y., Hatta, W., Maekita, T., Kato, M., Nagahara, A., Osawa, H., Dohi, O., Nakashima, H., Furukawa, K., Oka, S., Yokoyama, T., Ito, T., & Oda, I. (2025). A multicenter pivotal study on the artificial intelligence system for neoplastic lesions detection in upper gastrointestinal endoscopy. *Digestive Endoscopy*, 37(12), 1306–1314. <https://doi.org/10.1111/den.70015>
6. Wu, L., He, X., Liu, M., Xie, H., An, P., Zhang, J., Zhang, H., Ai, Y., Tong, Q., Guo, M., Huang, M., Ge, C., Yang, Z., Yuan, J., Liu, J., Zhou, W., Jiang, X., Huang, X., Mu, G., ... Yu, H. (2021). Evaluation of the effects of an artificial intelligence system on endoscopy quality and preliminary testing of its performance in detecting early gastric cancer: A randomized controlled trial. *Endoscopy*, 53(12), 1199–1207. <https://doi.org/10.1055/a-1350-5583>
7. Tang, D., Wang, L., Ling, T., Lv, Y., Ni, M., Zhan, Q., Fu, Y., Zhuang, D., Guo, H., Dou, X., Zhang, W., Xu, G., & Zou, X. (2020). Development and validation of a real-time artificial intelligence-assisted system for detecting early gastric cancer: A multicentre retrospective diagnostic study. *EBioMedicine*, 62, Article 103146. <https://doi.org/10.1016/j.ebiom.2020.103146>
8. Hirasawa, T., Aoyama, K., Tanimoto, T., Ishihara, S., Shichijo, S., Ozawa, T., Ohnishi, T., Fujishiro, M., Matsuo, K., Fujisaki, J., & Tada, T. (2018). Application of artificial intelligence using a convolutional neural network for detecting gastric cancer in endoscopic images. *Gastric Cancer*, 21(4), 653–660. <https://doi.org/10.1007/s10120-018-0793-2>
9. Ikenoyama, Y., Hirasawa, T., Ishioka, M., Namikawa, K., Yoshimizu, S., Horiuchi, Y., Ishiyama, A., Yoshio, T., Tsuchida, T., Takeuchi, Y., Shichijo, S., Katayama, N., Fujisaki, J., & Tada, T. (2020). Detecting early gastric cancer: Comparison between the diagnostic ability of convolutional neural networks and endoscopists. *Digestive Endoscopy*, 33(1), 141–150. <https://doi.org/10.1111/den.13688>

10. Li, L., Chen, Y., Shen, Z., Zhang, X., Sang, J., Ding, Y., Yang, X., Li, J., Chen, M., Jin, C., Chen, C., & Yu, C. (2019). Convolutional neural network for the diagnosis of early gastric cancer based on magnifying narrow band imaging. *Gastric Cancer*, 23(1), 126–132. <https://doi.org/10.1007/s10120-019-00992-2>
11. Horiuchi, Y., Aoyama, K., Tokai, Y., Hirasawa, T., Yoshimizu, S., Ishiyama, A., Yoshio, T., Tsuchida, T., Fujisaki, J., & Tada, T. (2019). Convolutional neural network for differentiating gastric cancer from gastritis using magnified endoscopy with narrow band imaging. *Digestive Diseases and Sciences*, 65(5), 1355–1363. <https://doi.org/10.1007/s10620-019-05862-6>
12. Horiuchi, Y., Hirasawa, T., Ishizuka, N., Tokai, Y., Namikawa, K., Yoshimizu, S., Ishiyama, A., Yoshio, T., Tsuchida, T., Fujisaki, J., & Tada, T. (2020). Performance of a computer-aided diagnosis system in diagnosing early gastric cancer using magnifying endoscopy videos with narrow-band imaging (with videos). *Gastrointestinal Endoscopy*, 92(4), 856–865.e1. <https://doi.org/10.1016/j.gie.2020.04.079>
13. Ueyama, H., Kato, Y., Akazawa, Y., Yatagai, N., Komori, H., Takeda, T., Matsumoto, K., Ueda, K., Matsumoto, K., Hojo, M., Yao, T., Nagahara, A., & Tada, T. (2021). Application of artificial intelligence using a convolutional neural network for diagnosis of early gastric cancer based on magnifying endoscopy with narrow-band imaging. *Journal of Gastroenterology and Hepatology*, 36(2), 482–489. <https://doi.org/10.1111/jgh.15190>
14. Luo, H., Xu, G., Li, C., He, L., Luo, L., Wang, Z., Jing, B., Deng, Y., Jin, Y., Li, Y., Li, B., Tan, W., He, C., Seeruttun, S. R., Wu, Q., Huang, J., Huang, D., Chen, B., Lin, S.-B., ... Xu, R.-H. (2019). Real-time artificial intelligence for detection of upper gastrointestinal cancer by endoscopy: A multicentre, case-control, diagnostic study. *The Lancet Oncology*, 20(12). [https://doi.org/10.1016/s1470-2045\(19\)30637-0](https://doi.org/10.1016/s1470-2045(19)30637-0)
15. Wu, L., He, X., Liu, M., Xie, H., An, P., Zhang, J., Zhang, H., Ai, Y., Tong, Q., Guo, M., Huang, M., Ge, C., Yang, Z., Yuan, J., Liu, J., Zhou, W., Jiang, X., Huang, X., Mu, G., ... Yu, H. (2021). Evaluation of the effects of an artificial intelligence system on endoscopy quality and preliminary testing of its performance in detecting early gastric cancer: A randomized controlled trial. *Endoscopy*, 53(12), 1199–1207. <https://doi.org/10.1055/a-1350-5583>
16. Wu, L., Shang, R., Sharma, P., Zhou, W., Li, J., Yao, L., Dong, Z., Ji, Y., Zeng, Z., Yu, Y., He, C., Xiong, Q., Li, Y., Deng, Y., Cao, Z., Huang, C., Zhou, R., Li, H., Hu, G., ... Yu, H. (2021). Effect of a deep learning-based system on the miss rate of gastric neoplasms during upper gastrointestinal endoscopy: A single-centre, tandem, randomised controlled trial. *The Lancet Gastroenterology & Hepatology*, 6(9), 700–708. [https://doi.org/10.1016/s2468-1253\(21\)00216-8](https://doi.org/10.1016/s2468-1253(21)00216-8)
17. Wu, L., Xu, M., Jiang, X., He, X., Zhang, H., Ai, Y., Tong, Q., Lv, P., Lu, B., Guo, M., Huang, M., Ye, L., Shen, L., & Yu, H. (2022). Real-time artificial intelligence for detecting focal lesions and diagnosing neoplasms of the stomach by white-light endoscopy (with videos). *Gastrointestinal Endoscopy*, 95(2), 269–280.e6. <https://doi.org/10.1016/j.gie.2021.09.017>
18. He, X., Wu, L., Dong, Z., Gong, D., Jiang, X., Zhang, H., Ai, Y., Tong, Q., Lv, P., Lu, B., Wu, Q., Yuan, J., Xu, M., & Yu, H. (2022). Real-time use of artificial intelligence for diagnosing early gastric cancer by magnifying image-enhanced endoscopy: A multicenter diagnostic study (with videos). *Gastrointestinal Endoscopy*, 95(4), 671–678.e4. <https://doi.org/10.1016/j.gie.2021.11.040>
19. Wu, L., Zhou, W., Wan, X., Zhang, J., Shen, L., Hu, S., Ding, Q., Mu, G., Yin, A., Huang, X., Liu, J., Jiang, X., Wang, Z., Deng, Y., Liu, M., Lin, R., Ling, T., Li, P., Wu, Q., ... Yu, H. (2019). A deep neural network improves endoscopic detection of early gastric cancer without blind spots. *Endoscopy*, 51(6), 522–531. <https://doi.org/10.1055/a-0855-3532>
20. Wu, L., Zhang, J., Zhou, W., An, P., Shen, L., Liu, J., Jiang, X., Huang, X., Mu, G., Wan, X., Lv, X., Gao, J., Cui, N., Hu, S., Chen, Y., Hu, X., Li, J., Chen, D., Gong, D., ... Yu, H. G. (2019). Randomised controlled trial of WISENSE, a real-time quality improving system for monitoring blind spots during esophagogastroduodenoscopy. *Gut*, 68(12), 2161–2169. <https://doi.org/10.1136/gutjnl-2018-317366>
21. Cho, B.-J., Bang, C. S., Lee, J. J., Seo, C. W., & Kim, J. H. (2020). Prediction of submucosal invasion for gastric neoplasms in endoscopic images using deep-learning. *Journal of Clinical Medicine*, 9(6), Article 1858. <https://doi.org/10.3390/jcm9061858>
22. Goto, A., Kubota, N., Nishikawa, J., Ogawa, R., Hamabe, K., Hashimoto, S., Ogihara, H., Hamamoto, Y., Yanai, H., Miura, O., & Takami, T. (2023). Cooperation between artificial intelligence and endoscopists for diagnosing invasion depth of early gastric cancer. *Gastric Cancer*, 26(1), 116–122. <https://doi.org/10.1007/s10120-022-01330-9>
23. Chen, T. H., Kuo, C. F., Lee, C., Yeh, T. S., Lan, J., & Huang, S. C. (2024). Artificial intelligence model for a distinction between early-stage gastric cancer invasive depth T1a and T1b. *Journal of Cancer*, 15(10), 3085–3094. <https://doi.org/10.7150/jca.94772>
24. Zhu, Y., Wang, Q.-C., Xu, M.-D., Zhang, Z., Cheng, J., Zhong, Y.-S., Zhang, Y.-Q., Chen, W.-F., Yao, L.-Q., Zhou, P.-H., & Li, Q.-L. (2019). Application of convolutional neural network in the diagnosis of the invasion depth of gastric cancer based on conventional endoscopy. *Gastrointestinal Endoscopy*, 89(4), 806–815.e1. <https://doi.org/10.1016/j.gie.2018.11.011>

25. Yoon, H. J., Kim, S., Kim, J.-H., Keum, J.-S., Oh, S.-I., Jo, J., Chun, J., Youn, Y. H., Park, H., & Kwon, I. G. (2019). A lesion-based convolutional neural network improves endoscopic detection and depth prediction of early gastric cancer. *Journal of Clinical Medicine*, 8(9), Article 1310. <https://doi.org/10.3390/jcm8091310>
26. Kim, J.-H., Oh, S.-I., Han, S.-Y., Keum, J.-S., Kim, K.-N., Chun, J.-Y., Youn, Y.-H., & Park, H. (2022). An optimal artificial intelligence system for real-time endoscopic prediction of invasion depth in early gastric cancer. *Cancers*, 14(23), Article 6000. <https://doi.org/10.3390/cancers14236000>
27. Chen, K., Wang, Y., Lang, Y., Yang, L., Guo, Z., Wu, W., Zhang, J., & Ding, S. (2024). Machine learning models to predict submucosal invasion in early gastric cancer based on endoscopy features and standardized color metrics. *Scientific Reports*, 14, Article 10445. <https://doi.org/10.1038/s41598-024-61258-1>
28. Li, J., Zhu, Y., Dong, Z., He, X., Xu, M., Liu, J., Zhang, M., Tao, X., Du, H., Chen, D., Huang, L., Shang, R., Zhang, L., Luo, R., Zhou, W., Deng, Y., Huang, X., Li, Y., Chen, B., ... Yu, H. (2022). Development and validation of a feature extraction-based logical anthropomorphic diagnostic system for early gastric cancer: A case-control study. *eClinicalMedicine*, 46, Article 101366. <https://doi.org/10.1016/j.eclinm.2022.101366>
29. Dong, Z., Wang, J., Li, Y., Deng, Y., Zhou, W., Zeng, X., Gong, D., Liu, J., Pan, J., Shang, R., Xu, Y., Xu, M., Zhang, L., Zhang, M., Tao, X., Zhu, Y., Du, H., Lu, Z., Yao, L., ... Yu, H. (2023). Explainable artificial intelligence incorporated with domain knowledge diagnosing early gastric neoplasms under white light endoscopy. *npj Digital Medicine*, 6, Article 64. <https://doi.org/10.1038/s41746-023-00813-y>
30. Ebigbo, A., Messmann, H., & Lee, S. H. (2025). Artificial intelligence applications in image-based diagnosis of early esophageal and gastric neoplasms. *Gastroenterology*, 169(3), 396–415. <https://doi.org/10.1053/j.gastro.2025.01.253>
31. Shi, Y., Fan, H., Li, L., Hou, Y., Qian, F., Zhuang, M., Miao, B., & Fei, S. (2024). The value of machine learning approaches in the diagnosis of early gastric cancer: A systematic review and meta-analysis. *World Journal of Surgical Oncology*, 22, Article 40. <https://doi.org/10.1186/s12957-024-03321-9>
32. Jin, Z., Gan, T., Wang, P., Fu, Z., Zhang, C., Yan, Q., Zheng, X., Liang, X., & Ye, X. (2022). Deep learning for gastroscopic images: Computer-aided techniques for clinicians. *BioMedical Engineering OnLine*, 21, Article 12. <https://doi.org/10.1186/s12938-022-00979-8>