

# Image-enhanced endoscopy and endoscopic resection practices in the colon among endoscopists in India



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submitted 28.7.2021

accepted after revision 27.12.2021

## Bibliography

Endosc Int Open 2022; 10: E1181–E1187

DOI 10.1055/a-1914-6197

ISSN 2364-3722

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## ABSTRACT

**Background and study aims** Clinical practice patterns for image-enhanced endoscopy (IEE) and colonic endoscopic resection practices vary among endoscopists. We conducted a survey to understand the differences in IEE and colonoscopic resection practices among endoscopists from India.

**Methods** An online cross-sectional survey comprising 40 questions regarding quality control of colonoscopy, IEE, and colonic endoscopic resection practices was circulated through the registry of the Indian Society of Gastroenterology and Association of Colon and Rectal Surgeons of India. Participation was voluntary and response to all questions was compulsory.

**Results** There were 205 respondents to the survey (93.2% gastroenterologists, 90.2% male, 54.6% aged 30 to 40 years, 36.1% working in academic institution, 36.1% working in corporate hospitals). Of the endoscopists, 50.7% had no training in IEE and 10.7% performed endoscopy on systems without any IEE modalities. Endoscopists with more experience were more likely to use IEE modalities in practice routinely ( $P=0.007$ ). Twenty percent never used IEE to classify polyps. Sixty percent of respondents did not use dye-chromoendoscopy. Less experienced endoscopists used viscous solutions as submucosal injectate ( $P=0.036$ ) more often. Of the respondents, 44% never tattooed the site of endoscopic resection. Ablation of edges post-endoscopic mucosal resection was not done by 25.5% respondents. Most respondents used electronic chromoendoscopy (36.1%) or random four-quadrant sampling (35.6%) for surveillance in inflammatory bowel disease. Surveillance post-endoscopic resection was done arbitrarily by 24% respondents at 6 months to 1 year.

**Conclusions** There are several lacunae in the practice of IEE and colonic endoscopic resection among endoscopists, with need for programs for privileging, credentialing and proctoring these endoscopic skills.

## Introduction

Chromoendoscopy using stains and dyes has been used to enhance endoscopic visualization of the gastrointestinal tract, for better delineation of the topography, and to help identify

different pathologies [1]. Techniques with stains were first used in the 1970s in colonoscopy in Japan [2]. Modern day endoscopes produced by different manufacturers are equipped with mechanisms for advanced imaging of the gastrointestinal tract at the push of a button [3]. These techniques of electronic

chromoendoscopy along with magnification have revolutionized endoscopic imaging, and brought about significant changes to practice. Narrow band imaging (NBI, Olympus Inc., Japan) filters the illuminating light at 415 and 540 nm to highlight the mucosal structures and the microvasculature. Blue laser imaging (BLI, Fujifilm, Tokyo, Japan) is similar to NBI with filters at 410 and 450 nm, augmenting mucosal structure and microvascular visualization. On the other hand, iSCAN (Pentax, Tokyo, Japan) and FICE (flexible spectral imaging color enhancement, Fujifilm, Tokyo, Japan) are endoscopic image post-processing techniques in which the image is reconstructed to remove the red wavelength.

Image-enhanced endoscopy (IEE) techniques have been used as an aid to histological diagnosis, especially for colorectal polyps, with sensitivity and specificity close to 90% [4]. IEE has been instrumental in changing the dictum of “resect and analyze” to “resect and discard” in the management of colorectal polyps. IEE techniques also help to assess the depth of invasion of polyps and guide potential therapeutic decisions like endoscopic mucosal resection (EMR) versus endoscopic submucosal dissection (ESD) versus surgical resection of polyps in the colon. However, accuracy of IEE largely depends on the endoscopist’s training. A randomized controlled trial (RCT) from the United States showed that only 25% of endoscopists were able to diagnose colorectal polyps with >90% accuracy [5]. American Society of Gastrointestinal Endoscopy (ASGE) Preservation and Incorporation of Valuable endoscopic Innovations (PIVI) thresholds for real-time assessment of diminutive colorectal polyps require >90% concordance between histology and endoscopic assessment of diminutive polyps, with a >90% negative predictive value for prediction of adenomatous polyps [6]. In a multicenter study, Patel et al were able to demonstrate that with standardized training, most endoscopists were able to meet the performance criteria as defined by the ASGE, with performance improving with time [7]. Despite increased availability of IEE techniques in India, no data on the practice patterns among endoscopists with respect to IEE are available.

Colorectal cancer incidence is on the rise in India [8]. Colonoscopy for diagnosis and resection of polyps remains a major intervention for prevention of progression of colon cancer [9]. Because structured training programs for endoscopic polypectomy and resection are not available in many countries, practice varies among endoscopists with regard to quality standards and also surveillance. There is an unmet need to understand the endoscopic resection practices among endoscopists in India. Hence, we designed a survey to assess practice patterns and to identify lacunae to improve IEE skills and improve colonic endoscopic resection practices among endoscopists in India.

## Methods

This study was a cross-sectional questionnaire-based survey for practicing endoscopists in India. A survey questionnaire comprising 40 questions relating to demography, quality control practices for colonoscopy, clinical practices of IEE and endoscopic resection in the colon was developed. The survey was in-

ternally validated for relevance, clarity, simplicity, and ambiguity. The survey was administered to practicing endoscopists through the registry of the Indian Society of Gastroenterology and Association of Colon and Rectal Surgeons of India. Emails were sent through the respective societies to approximately 1000 members total across both societies. The survey was entered online through Google Forms and the responses were automatically recorded. The time taken to complete the questionnaire was 3 to 4 minutes. The initial email was sent in April 2020 and a reminder mail was sent 2 weeks later. Participation was voluntary with no incentive for participation and all responses were anonymized. Response to all questions was compulsory.

## Statistical considerations

Data were collated from the survey forms and analyzed using SPSS version 26 (IBM, Armonk, New York, United States). Frequencies were used to describe demographic variables. Data comparisons based on age, experience, practice setting with regard to various IEE and resection practices was done using Chi square or Fisher Exact test with  $P < 0.05$  considered statistically significant.

## Results

### Demographics and use of image-enhanced endoscopy

Two-hundred and five endoscopists participated in the survey (response rate approximately 20%), of whom 185 (90.2%) were male. Most of the respondents were gastroenterologists (93.2%). Also, most respondents were aged 30 to 40 years (54.6%). Nearly two-thirds of the respondents had experience of up to 10 years as endoscopists. Details of the demographics of the respondents are presented in ► **Table 1**. Of the respondents, 50.7% (104/205) had no training in IEE. Of those who received training (101/205), most respondents (59, 58.1%) had attended a conference workshop as part of training. Twelve respondents (11.8%) had done a short certificate course, while 14 respondents (13.9%) had received long-term training (more than 3 months) in advanced endoscopy with IEE. Only 22 respondents (10.7%) performed endoscopy with systems not having any IEE technology. Also, nine respondents (4.4%) used systems with IEE technologies without magnification. Of the respondents, 59% (122/205) were confident about using IEE to some extent; however, they felt they needed more training. Of the respondents, 21% (43/205) felt they were not confident at all. No significant difference was seen among endoscopists based on experience with respect to IEE training. Endoscopists with more experience were more likely to use IEE in practice more frequently ( $P = 0.007$ ).

### Quality of colonoscopy

Fifty-three percent of respondents recorded images and videos of the colonoscopy, while another 42% recorded only images. Three percent of respondents kept no documentation for the procedure. Images of fewer than eight sites were taken by 39.8% of respondents as part of documentation of the procedure. No significant difference was seen in objective bowel

► **Table 1** Demographics of respondents

Question	Responses	Numbers (%)
Primary specialty	Gastroenterology	191 (93.2)
	General surgeon	5 (2.4)
	Gastrointestinal surgeon	7 (3.4)
	Internist	2 (1)
Experience	<5 years	65 (31.7)
	5–10 years	62 (30.2)
	10–15 years	29 (14.1)
	> 15 years	49 (23.9)
Area of practice	Academic institution	74 (36.1)
	Corporate hospital	74 (36.1)
	Private practice – solo	42 (20.5)
	Private practice – group	15 (7.3)
Number of colonoscopies per week	<5	33 (16.1)
	5–15	90 (43.9)
	> 15	82 (40)
Number of endoscopic resection procedures performed per month	<5	122 (59.5)
	5–10	55 (26.8)
	10–20	18 (8.8)
	> 20	10 (4.9)
Training in image-enhanced endoscopy	Yes	101 (49.3)
	No	104 (50.7)
Use of IEE in practice	In all cases	31 (15.1)
	Select procedures with suspicion (To find something abnormal)	100 (48.8)
	Select procedures with findings (After something abnormal is found)	47 (22.9)
	Not used	27 (13.2)
Confidence in using IEE techniques routinely	Confident and able to use classification with ease	37 (18)
	Confident to some extent, however need more training	122 (59)
	Not confident at all	43 (21)
	Don't think it adds much information over white light endoscopy (WLE)	4 (2)

IEE, image-enhanced endoscopy.

preparation reporting, use of simethicone, and antimotility agents in relation to endoscopist experience.

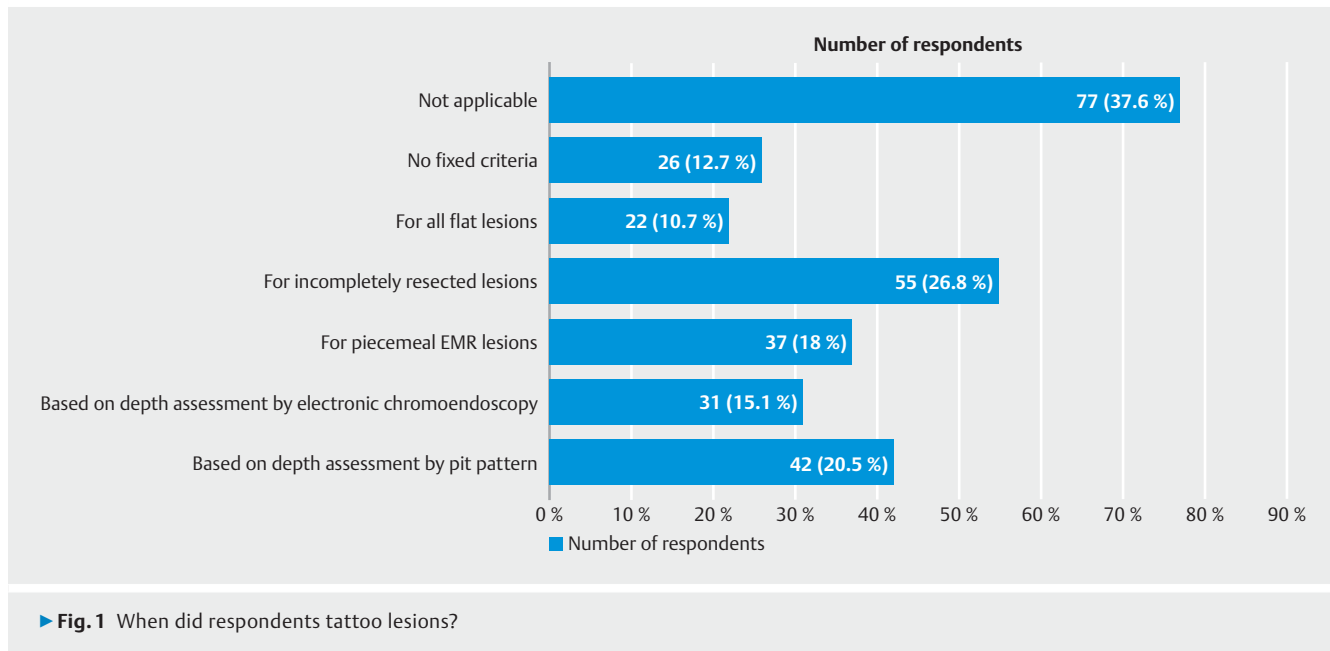
### Colonic polyps and endoscopic resection practices

One hundred and two respondents (49.8%) felt the polyp detection rate was 1% to 5% for colonoscopies in high-risk individuals (>50 years of age). One hundred and eight respondents (52.7%) felt the left colon was the most common site of colorectal cancer they encountered in practice. Ninety-one respondents (44.4%) felt synchronous polyps were seen in 1% to 5% of patients with colorectal cancer and 70 (34.1%) felt that synchronous polyps were seen in <1%. In patients with polyps, 41 respondents (20%) never used IEE to classify polyps. Twenty-four respondents (11.7%) always biopsied prior to polypectomy. Eighty-six respondents (42%) would never resect during the insertion phase, while 101 participants (49%) would consider resection occasionally during the insertion phase. Paris classification was used to describe polyps by 66 respondents (32.2%) in all cases, sometimes by 91 respondents (44.4%), and never by 48 respondents (23.4%). One hundred twenty-three of the respondents (60%) never used dye-chromoendoscopy.

The preferred solution for ESD was normal saline by 123 respondents (60%) whereas 60 respondents (29.3%) preferred gelofusine. Less experienced endoscopists (<10 years) were more likely to use viscous solutions like gelofusine as submucosal injectate ( $P=0.036$ ). Preferred methods for hemostasis in large pedunculated polyps were hemostatic clips (93 respondents, 45.4%) and endo-loop (91 respondents, 44.4%). For large sessile polyps, 66 respondents (32.2%) did not perform piecemeal EMR, while 139 (67.8%) went ahead with piecemeal resection. Fifty-one respondents (25.5%) never ablated the edges of the lesion after EMR. On the other hand, 110 (55%) ablated the edges of the lesion after piecemeal EMR, while 39 respondents (19.5%) ablated after resecting all flat lesions. Ninety-one respondents (44.4%) never tattooed the site of EMR (► **Fig. 1**). Post-resection surveillance was done arbitrarily at 6 months to 1 year by 49 respondents (24%). Seventy-five percent of respondents based surveillance on histopathology and high-risk criteria like size. For surveillance for lesions in inflammatory bowel disease (IBD), only 23 respondents (11.2%) preferred dye-based chromoendoscopy. Seventy-four respondents (36.1%) used electronic chromoendoscopy and 73 respondents (35.6%) preferred random four-quadrant sampling at every 10 cm. Less experienced endoscopists used random four-quadrant sampling for surveillance in IBD rather than IEE modalities ( $P=0.01$ ). No significant difference was seen in IEE and endoscopic resection practices between gastroenterologists and other practitioners. Quality criteria for colonoscopy, IEE practices, and endoscopic resection in the colon are summarized in ► **Table 2**.

### Discussion

This is the first survey performed among endoscopists in India to assess practice of IEE and endoscopic resection in the colon. The survey found lacunae in practice of IEE among endos-



copists. There were significant differences in practice of endoscopic colonic resection among endoscopists as well. The study was aimed at developing structured programs in India for IEE and also for endoscopic colonic resection practices.

Almost 90% of respondents were using endoscopes with IEE facilities. However, only 49% of respondents received any training in IEE. This discordance represents an opportunity to improve training and outreach at these facilities to nearly all endoscopists. While different images produced by various in-built IEE methods has been a hindrance to proper training, structured programs will help address this issue. Also, only 18% of respondents felt they were confident in using IEE modalities routinely. Most of the other respondents (80%) felt they needed more training, some of whom were not confident at all with respect to use of IEE modalities. This shows a large unmet need, which should be addressed using formal teaching programs. Also, India being a country with limited resources, the benefit in terms of time and money saved over pathology need not be emphasized further.

Quality indicators of colonoscopy as defined by the American College of Gastroenterology, ASGE, and Japanese Gastroenterological Endoscopy Society include adequacy of bowel preparation, cecal intubation rate, colonoscope withdrawal time, and adenoma detection rate [10, 11]. A previous study found a polyp detection rate of 14% among the high-risk group (>40 years) in the Indian population, of which 40% were adenomatous polyps [12]. Although the rate of colonic adenomas is lower in the Indian population than the West, cecal intubation rate, withdrawal time, and adequacy of bowel preparation impact detection of colorectal polyps. Photo-documentation of the colonoscopy is integral to quality control. As per European Society of Gastrointestinal Endoscopy (ESGE) guidelines for quality control, eight sites are required to be photographed for an adequate examination. An additional ninth photograph with forward view of the rectum can be considered an addition to the

► **Table 2** Quality criteria for colonoscopy, IEE practices, and endoscopic resection in the colon.

Question	Responses	Numbers (%)
Reporting bowel preparation objectively as part of standard reporting protocol	Yes	171 (83.4)
	No	34 (16.6)
Preferred bowel preparation	High-dose (4L) PEG	66 (32.2)
	Low-dose (2L) PEG	114 (55.6)
	Exelyte	6 (2.9)
	Others	19 (9.3)
Use of antimotility agents during colonoscopy	No	152 (74.1)
	Yes, always	14 (6.8)
	Yes, sometimes	39 (19)
Use of simethicone to reduce bubbling to improve visualization	Yes	173 (84.4)
	No	32 (15.6)
Average withdrawal time during colonoscopy	<5 minutes	33 (16.1)
	5–10 minutes	142 (69.3)
	>10 minutes	30 (14.6)
Use of IEE during colonoscopy for classifying colorectal polyps	Sometimes	99
	Always	65
	Never	41

► **Table 2** (Continuation)

Question	Responses	Numbers (%)
Polyp detection rate in high-risk population (> 50 years of age)	< 1%	32 (15.6)
	1%-5%	102 (49.8)
	5%-10%	43 (21)
	> 10%	28 (13.7)
In patients with colonic polyps, do you biopsy prior to polypectomy?	Yes, always	24 (11.7)
	Yes, most of the time	77 (37.6)
	Yes, rarely	56 (27.3)
	Never	48 (23.4)
Do you use Paris classification for reporting colonic polyps?	Always	66 (32.2)
	Sometimes	91 (44.4)
	Never	48 (23.4)
What is your preference for dye chromoendoscopy?	Do not use dye chromoendoscopy	123 (60)
	Methylene blue	53 (25.9)
	Indigo carmine	23 (11.2)
	Other	6 (2.9)
Preferred classification for IEE of colonic polyps	NICE classification	84 (41)
	Kudo's pit pattern	61 (29.8)
	JNET classification	32 (15.6)
	Other	28 (13.7)

IEE, image-enhanced endoscopy; PEG, polyethylene glycol; NICE, narrow-band imaging international colorectal endoscopic classification; JNET, Japanese NBI expert team.

existing eight for quality assessment [13]. Almost 40% of the respondents in our survey performed inadequate image documentation. Considering most endoscopists who participated in the survey kept either photo or video documentation, we presume that most practitioners give patients printed reports, which would be the standard. A recent meta-analysis suggested that low-volume, split-dose preparation is as good as high-volume, split-dose regimens for bowel preparation. Low-dose split regimen also was found to be more tolerable and likely to be completed, and patients were more likely to be willing to complete the preparation [14]. 2L PEG was the preferred bowel preparation for 55.6% of the respondents. Use of antimotility agents and antispasmodics during colonoscopy is recommended as part of the bowel cancer screening program in the United Kingdom [15]. Although evidence for benefit in terms of polyp detection, completion of colonoscopy, and cecal intuba-

tion time is equivocal, certain patients such as those with significant colonic spasm benefit from use of antimotility agents [16]. In our survey, 74% of respondents never used antispasmodics. Adjuvants like simethicone are useful in improving quality of bowel visualization during colonoscopy, with improved tolerability and fewer adverse reactions [17]. Only 15.6% of respondents in our survey used simethicone. Change in practice to consider use of adjuvants like antispasmodics and simethicone will help improve quality of colonoscopy. Cap-assisted colonoscopy has been shown to reduce bowel discomfort and improve adenoma detection rates (ADRs) during colonoscopy as compared to conventional colonoscopy [18]. Only 3.4% always used a distal attachment while 62% never used a distal cap.

In terms of incidence, rectal cancer remains the most common site of colorectal cancer in India as per previous data [19]. However, in the survey, 52% of respondents felt they encountered malignancies most commonly in the left colon. Almost 50% of the respondents also felt that the ADR was 1% to 5% in a high-risk population (>50 years of age). Although the quality criteria for adenoma detection suggest rates of more than 25% being appropriate in the West, in India, rates are much lower [12]. A previous study from Southern India found the prevalence of colorectal polyps to be 10.6% with adenomatous representing 4.3% in a cohort of 36,426 patients who underwent colonoscopy. This rate is much lower than the rates reported in Western literature. However, the number of polyps in the high-risk population (>50 years of age) is unclear [20]. Forty-four percent also felt that the rate of synchronous polyps was between 1% to 5% in the population with colorectal cancer while another 34% felt the rate of synchronous polyps was <1%. A previous abstract from India suggested a rate of synchronous colorectal cancer of 2% and of adenomatous synchronous polyps of 7.3% in a cohort of 800 patients of colorectal cancer [21]. Validation of both the NICE and JNET classification has been done for use for diagnosing colorectal polyps based on NBI [22, 23], with high accuracy for histopathologic prediction. A recent study tried to evaluate the diagnostic yield of JNET classification in clinical practice across multiple institutions. Both experts and non-experts were able to use the classification with comfort [24]. Of all the respondents, 31% always used IEE to classify all polyps, while 20% never used IEE. Despite the widespread availability of IEE, 11% of respondents in our survey always performed biopsy prior to polypectomy, while another 37% of respondents mostly performed biopsy.

The recently published PRESECT trial showed that cold snare polypectomy during insertion in the left colon and rectum significantly shortened procedure time during withdrawal (18.9 vs 22.3 minutes). In the control group with 107 patients, seven polyps were completely missed during withdrawal [25]. Forty-two percent of respondents in our survey never resect polyps during the insertion phase. The Paris classification is used to describe superficial tumors of the gastrointestinal tract [26] to denote submucosal invasion and endoscopic resectability. Thirty-two percent of respondents always use Paris classification for reporting polyps. Dye-based chromoendoscopy with cresol-violet was first demonstrated by Kudo et al for prediction of histopathology using the pit pattern in colorectal polyps



[27]. Methylene Blue and Indigo carmine are used commonly for targeted and pan-chromoendoscopy now [28]. The SCENIC consensus recommended use of dye-based chromoendoscopy for surveillance for malignancies in IBD [29]. Sixty percent of respondents in the survey never used dye-based chromoendoscopy. Only 11.2% of respondents used dye-based chromoendoscopy in IBD for surveillance. Less experienced endoscopists were more likely to use random four-quadrant sampling at every 10 cm in the colon, suggesting likely lesser experience with dye-based chromoendoscopy. Among the classifications for IEE, 41% of respondents preferred using the NICE classification, while 29.8% used the Kudo's pit pattern. Of the respondents, 15.6% preferred using the JNET classification. No comparative study assessing predictive value of these classifications for colorectal polyps has been done so far.

Submucosal injection with viscous solutions like gelofusine led to higher rates of en bloc resections during EMR with lower rates of residual lesions, without any difference in adverse events [30]. Most respondents (60%) in our survey preferred using normal saline, followed by 29.3% preferring gelofusine. Less experienced endoscopists were more likely to use viscous solutions. This may represent an increasing trend toward better training and change in practices among trainers. Prophylactic clip placement is considered as effective as endoloop placement for hemostasis in large pedunculated polyps, with rates of bleeding being approximately 5% [31]. In our survey, 45% of respondents preferred clips, while 44% preferred endoloop application. While piecemeal EMR is the preferred treatment for large sessile colonic polyps, recurrence rates range from 10% to 30% in various reports [32]. In patients with large sessile polyps, 32% of respondents in our survey never performed piecemeal EMR. Thermal ablation of edges of resection after EMR of laterally spreading tumors  $\geq 20$  mm is associated with decreased recurrence rates in a previous RCT of 390 patients [33]. One-quarter of respondents in our survey never performed thermal ablation post EMR. ESD is an advanced technique used for laterally spreading tumors in the colorectal region. ESD requires significant training and expertise and is currently practiced by only a few experts across India [34]. To ensure generalizability of the survey, we did not include questions related to ESD in the survey.

Tattooing is done for patients with flat lesions of the colon, after piecemeal resection and also with residual lesions for easy identification during surgery. Tumor site estimation is imprecise in up to 14% of cases and may need localization during surgery using tattooing [35]. Of the respondents, 44% never tattooed the site of EMR. While tattooing may be necessary, its use at the site of EMR may result in fibrosis and difficulty visualizing the submucosal layer, making repeat endoscopic resection difficult [36]. Post-polypectomy surveillance of colorectal polyps depends on factors like size, number, and histopathology of polyps [11,37]. Surveillance post-endoscopic resection was done arbitrarily at 6 months to 1 year by almost one-quarter of respondents to the survey.

ESGE recently came up with guidelines for training in optical diagnosis during endoscopy [38]. General competence to commence training includes performing at least 300 colonoscopies

while meeting the ESGE quality criteria. For training to classify colonic lesions, attending a validated course using externally validated classifications like NICE and BASIC and incorporating other classifications as well is needed for diminutive polyps. For early colorectal cancer, a validated on-site course of at least 1 week with an expert, with training in the NICE classification without magnification, and JNET, Sano, and Kudo classification when magnification is used is needed. To achieve competence, classifying 120 diminutive lesions and 20 colorectal lesions  $\geq 20$  mm with histologic feedback is required.

The Japanese Endoscopic Database Project recently published their preliminary findings about data-sharing among institutes between 2015 and 2017, showing a high proportion of therapeutic colonoscopic procedures (~20%) [39]. The project is an effort to develop a data repository, which will help all practitioners as a quality improvement initiative. This survey was an effort in a similar direction, aimed at understanding the lacunae in colorectal endoscopic resection and IEE practice and improving on them. This was the first survey to assess IEE and endoscopic resection practices in the colon among endoscopists from India. The limitations of this study are those related to survey studies, wherein the population surveyed may not reflect the actual practices in the population. Also, the study may have self-selection bias as practitioners who are motivated and aware are the ones more likely to respond.

## Conclusions

To conclude, this study helped us to identify the lacunae in IEE practice as well as the wide variability in colonoscopic resection practices in comparison with the standard recommendations. This, in turn, has identified a large, unmet need to develop local guidelines, training programs, and proctoring the practice of advanced endoscopy and colonic endoscopic resection.

## Competing interests

The authors declare that they have no conflict of interest.

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