OPEN ACCESS

Guideline review

JAG consensus statements for training and certification in colonoscopy

Keith Siau,[1,2] Stavroula Pelitari,[3] Susi Green,[4] Brian McKaig,[5] Arun Rajendran,[6] Mark Feeney,[7] Mo Thoufeeq,[8] John Anderson ,[9] Vathsan Ravindran,[10] Paul Hagan,[11] Neil Cripps,[12] Ian L P Beales,[13,14] Karen Church,[15] Nicholas I Church,[16] Elizabeth Ratcliffe,[17,18] Said Din,[19] Rupert D Pullan,[20] Sharon Powell,[21] Catherine Regan,[21] Wee Sing Ngu,[22] Eleanor Wood ,[23] Sarah Mills,[24,25] Neil Hawkes,[26] Paul Dunckley,[27] Marietta Iacucci,[2,28] Siwan Thomas-Gibson ,[25,29] Christopher Wells,[30] Aravinth Murugananthan,[5,31] On behalf of the Joint Advisory Group on Gastrointestinal Endoscopy (JAG)

For numbered affiliations see end of article.

Correspondence to
Dr Aravinth Murugananthan, Department of Gastroenterology, Royal Wolverhampton Hospitals NHS Trust, Wolverhampton WV10 0QP, UK; a.murugananthan@nhs.net

Received 2 July 2022
Accepted 4 October 2022

To cite: Siau K, Pelitari S, Green S, *et al*. *Frontline Gastroenterology* Epub ahead of print: [please include Day Month Year]. doi:10.1136/flgastro-2022-102260

ABSTRACT

Introduction In the UK, endoscopy certification is awarded when trainees attain minimum competency standards for independent practice. A national evidence-based review was undertaken to update and develop standards and recommendations for colonoscopy training and certification.

Methods Under the oversight of the Joint Advisory Group (JAG), a modified Delphi process was conducted between 2019 and 2020 with multisociety expert representation. Following literature review and Grading of Recommendations, Assessment, Development and Evaluations appraisal, recommendation statements on colonoscopy training and certification were formulated and subjected to anonymous voting to obtain consensus. Accepted statements were peer reviewed by JAG and relevant stakeholders for incorporation into the updated colonoscopy certification pathway.

Results In total, 45 recommendation statements were generated under the domains of: definition of competence (13), acquisition of competence (20), assessment of competence (8) and postcertification support (4). The consensus process led to revised criteria for colonoscopy certification, comprising: (1) achieving key performance indicators defined within British Society of Gastroenterology standards (ie, unassisted caecal intubation rate >90%, rectal retroversion >90%, polyp detection rate >15%+, polyp retrieval rate >90%, patient comfort <10% with moderate–severe discomfort); (2) minimum procedure count 280+; (3) performing 15+ procedures over the preceding 3 months; (4) attendance of the JAG Basic Skills in Colonoscopy course; (5) terminal ileal intubation rates of 60%+ in inflammatory bowel disease; (6) satisfying requirements for formative direct observation of procedure skills (DOPS) and direct observation of polypectomy skills (Size, Morphology, Site, Access (SMSA) level 2); (7) evidence of reflective practice as documented on the JAG Endoscopy Training System reflection tool; (8) successful performance in summative DOPS.

Conclusion The UK standards for training and certification in colonoscopy have been updated, culminating in a single-stage certification process with emphasis on polypectomy competency (SMSA Level 2+). These standards are intended to support training, improve standards of colonoscopy and polypectomy, and provide support to the newly independent practitioner.

INTRODUCTION

Colonoscopy is the gold standard procedure for diagnosis and therapy within the lower gastrointestinal tract. High-quality colonoscopy and polypectomy reduce the incidence of colorectal carcinoma and form the basis for bowel cancer screening. However, it is acknowledged that practice variation exists within colonoscopy, which impacts on patient outcomes.[1 2] Accordingly, national standards and quality assurance (QA) frameworks have been implemented in the UK by the Joint Advisory Group in Gastrointestinal Endoscopy (JAG) and British Society of Gastroenterology (BSG) over the last two decades to maximise the

effectiveness and safety of endoscopy, reduce practice variation and to optimise the patient experience.[3 4]

Training and certification are pivotal to high-quality endoscopy. In the UK, the process is overseen by JAG.[5–7] Certification is a standardised process which formally recognises a trainee as qualified for independent and unsupervised endoscopy nationwide. The JAG colonoscopy certification process was originally formulated in 2011 based on pragmatism and consensus. In the era of technological advances, increasing expectations for high-quality colonoscopy, and the changing shape of UK training,[8] there is a clear need to ensure that these certification pathways remain valid, up-to-date and evidence based. Following consultation with UK Specialist Advisory Committees, a committee was assembled by JAG and stakeholder organisations, including the BSG and the Association of Coloproctology of Great Britain and Ireland (ACPGBI), to develop evidence and consensus-based recommendations relevant to training and certification in colonoscopy and polypectomy in the UK. The aim is to develop a robust set of recommendations to form the framework of colonoscopy certification within the UK and cover the following domains: (1) definition of competence, (2) acquisition of competence, (3) assessment of competence for colonoscopy and polypectomy and (4) postcertification support.

METHODS

Guideline development

A modified DELPHI process was commissioned by the JAG Quality Assurance of Training Working Group, with inclusion of JAG, BSG, ACPGBI, training leads and trainee members, and representation from England, Wales, Scotland and Northern Ireland. Through a series of teleconferences, participants were allocated to seven working groups based on the scope of the guideline. For the domains of 'defining competence', 'acquisition of competence' and 'assessment of competence' working groups were assigned for diagnostic colonoscopy and polypectomy. Each working group was tasked with framing questions relevant to training and certification, using a Population, Intervention, Comparator, Outcome format where possible. Literature searches were then systematically conducted on major databases including Embase, Medline, PubMed and the Cochrane Database of Systematic Reviews. Results were collated and summarised into recommendation statements; these were appraised using the Grading of Recommendations, Assessment, Development and Evaluations framework.[9] The level of evidence and strength of recommendation were provided for each statement. Although it is standard practice to align recommendations with the level of evidence, statements could receive discordant recommendations (eg, strong recommendation for low-quality evidence) if, on balance, the perceived benefit outweighed the paucity of available evidence.

Consensus process

An anonymised, electronic voting process was undertaken during a 2-day face-to-face meeting to measure consensus with recommendation statements. Five Likert scale responses were provided for each statement (Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree and Strongly Agree), with votes for Agree and Strongly Agree indicating agreement with a statement. For each statement, agreement from at least 80% of the group was specified a priori as the threshold for acceptance. For statements that were not accepted, up to three rounds of revisions and revoting were permitted before they were rejected. On collation of the accepted statements, the document was sent to stakeholder groups for review. Accepted statements were then integrated into the final colonoscopy certification pathway.

RECOMMENDATION STATEMENTS

In total, 45 recommendation statements were generated under the domains of: definition of competence (13), acquisition of competence (20), assessment of competence (8) and post-certification support (4). These are summarised in table 1.

Defining competence

1.1: Competence in colonoscopy is defined as the ability to perform colonoscopy, including all relevant peri-procedural and post-procedural aspects consistent with current BSG colonoscopy best practice standards and guidelines

Evidence: **Very low**; Recommendation: **Strong**; Agreement: **100%**

Competence in endoscopy may be defined as the ability to independently carry out procedures in a safe and effective manner, and across a spectrum of case difficulties and case contexts. For colonoscopy, this should cover the necessary periprocedural and post-procedural aspects according to national standards, set by the JAG,[10] the BSG and the ACPGBI.[3] The UK standards for colonoscopy published in 2016 contain guidance on the minimum key performance indicators (KPIs) required for competent colonoscopy.[3] Guidance for tattoo placement and biopsies for chronic diarrhoea should be followed. On review by the working group, KPIs appropriate to reflect trainees' performance summarised in table 2.

1.2: Terminal ileal intubation should be attempted in all cases where indicated. Trainees should attain an unassisted terminal ileal intubation rate of >60% where colonoscopy is indicated for suspected IBD (ie, chronic diarrhoea, iron-deficiency anaemia, abdominal pain, IBD assessment).

Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

Terminal ileum (TI) intubation is indicated in cases of chronic diarrhoea, iron-deficiency anaemia, abnormal

Table 1 Summary of the consensus statements for training and certification in colonoscopy

	Recommendation statement	Level of evidence	Strength
1.1	Competence in colonoscopy is defined as the ability to perform colonoscopy, including all relevant peri-procedural and post-procedural aspects consistent with current BSG colonoscopy best practice standards and guidelines.	Very low	Strong
1.2	Terminal ileal intubation should be attempted in all cases where indicated. Trainees should attain an unassisted terminal ileal intubation rate of >60% where colonoscopy is indicated for suspected IBD (ie, chronic diarrhoea, iron-deficiency anaemia, abdominal pain, IBD assessment).	Low	Strong
1.3	Competence in colonoscopy requires the ability to recognise normal findings, describe and document abnormal findings and take appropriate action.	Very low	Strong
1.4	Competent endoscopists in colonoscopy should be able to demonstrate endoscopic non-technical skills (ENTS) as defined in DOPS and DOPyS.	Low	Strong
1.5	Competence in colonoscopy includes the ability to identify and manage immediate and late complications of the procedure demonstrating effective clinical, endoscopic and Non-Technical Skills (ENTS) to coordinate subsequent action.	Low	Strong
1.6	Competent endoscopists should be able to recognise the adequacy of the endoscopic procedure performed and recommend subsequent action.	Very low	Strong
1.7	Competence in polypectomy should be based on achieving all competencies defined in the DOPyS form rather than a set minimum number of procedures.	Very low	Strong
1.8	Competent endoscopists should be able to define the difficulty level of polypectomy using the SMSA scoring system.	Low	Strong
1.9	Endoscopists should be able to competently document polyps using the Paris classification.	Low	Strong
1.10	Endoscopists should competently use at least one validated optical diagnosis system to classify and document polyps.	Moderate	Strong
1.11	Endoscopists in colonoscopy should be competent to perform safe and effective polypectomy of SMSA level 2 polyps as a minimum.	Low	Strong
1.12	Endoscopists must be able to competently demonstrate safe and appropriate use of diathermy relevant to polypectomy.	Low	Strong
1.13	Endoscopists should be able to competently manage postpolypectomy perforation and bleeding using endoscopic clips and at least one other method of haemostasis while demonstrating relevant ENTS.	Low	Strong
2.1	Lower GI endoscopy training should take place in a unit that maintains its training environment to JAG standards.	Very low	Weak
2.2	Colonoscopy trainers should meet colonoscopy standards as defined by JAG GRS and BSG quality standards.	Low	Strong
2.3	The training programme should include opportunities to gain experience and competencies in ENTS.	Low	Strong
2.4	Trainees in colonoscopy should attend a JAG approved Basic Skills in Colonoscopy course during training.	Low	Strong
2.5	Lower GI endoscopy trainees should apply for a JAG approved basic skills course at the start of LGI endoscopy training and attend this within their first 70 procedures.	Low	Strong
2.6	Virtual reality simulation training for endoscopic technical skills is encouraged in conjunction with conventional endoscopy training to enhance development of early endoscopic technical skills. Trainee simulator-based training should be directly supported by appropriately skilled trainers/supervisors.	Moderate	Strong
2.7	Training in polypectomy should start early during basic colonoscopy training and continue in parallel with this.	Very low	Strong
2.8	Attendance at a hands on (tissue/tissue-like) model endoscopy course with exposure to differing polyp resection techniques, submucosal injection techniques, haemostatic therapy and tattooing is encouraged.	Very low	Strong
2.9	Polypectomy training should include skills acquisition in cold snare, hot snare and basic lift assisted polypectomy to a minimum of SMSA level 2.	Low	Strong
2.10	Trainees should receive training in Paris polyp classification and validated optical diagnosis systems. When available, supportive web-based training tools should be used and any relevant modules completed prior to the basic skills course.	Moderate	Strong
2.11	Appropriate discussion and reflection related to polyp classification and management should occur throughout training.	Very low	Strong
2.12	All parameters described in DOPS/DOPyS should be included during skills training.	Very low	Strong
2.13	Water-assisted insertion techniques may improve patient comfort levels and technical success, and should form part of training in colonoscopy.	Low	Weak
2.14	Where available, magnetic endoscopic imaging should be used for colonoscopy training and should be preferentially used for training lists.	Low	Weak
2.15	A trainee should undertake a minimum of 280 colonoscopy procedures to be eligible for summative assessment in colonoscopy.	Low	Strong
2.16	Trainees who hold JAG certification in flexible sigmoidoscopy should have a minimum of 200 lifetime colonoscopy procedures to be eligible for summative assessment in colonoscopy.	Very low	Strong
2.17	A trainee should have a minimum number of dedicated training lists as defined by the JAG training standards.	Low	Strong

Continued

Table 1 Continued

Recommendation statement		Level of evidence	Strength
2.18	It is recommended that a trainee should receive a minimum of one DOPS per training list.	Low	Weak
2.19	It is recommended that a minimum of one DOPyS should be completed for every training list where a polypectomy has been attempted by a trainee.	Low	Weak
2.20	Trainees must complete a reflection tool on JETS every 50 procedures. This forms a framework for meetings with their endoscopy supervisor every 6 months or less.	Low	Strong
3.1	DOPS should be used as the competency assessment tool in lower gastrointestinal endoscopy.	Low	Strong
3.2	Each formative DOPS should be performed on a single pre-selected case.	Low	Strong
3.3	The last 5 DOPS prior to summative assessment must be rated competent without supervision in>90% of all items, with none requiring maximal or significant supervision.	Low	Strong
3.4	DOPyS should be used as the polypectomy competency assessment tool for both technical and non-technical skills.	Low	Strong
3.5	For competence at SMSA Level 1 polypectomy, a minimum of 2 SMSA Level 1 DOPyS should be competently performed using the following methods: cold snare polypectomy, diathermy-assisted resection of stalked polyps and diathermy-assisted EMR. The last 4 DOPyS (Level 1) should score 'competent for independent practice' in all items.	Very low	Strong
3.6	For competence at SMSA Level 2 polypectomy, a minimum of 2 SMSA Level 2 DOPyS should be competently performed for each of the following methods: cold snare polypectomy, diathermy-assisted resection of stalked polyps and diathermy-assisted EMR. The last 4 DOPyS (level 2) should score 'competent for independent practice' in all items.	Very low	Strong
3.7	Eligibility for summative assessment in colonoscopy may be triggered once the following are met: 1. Meeting criteria for BSG standards for competence in colonoscopy relevant to trainees—averaged over a 3-month period (ie, unassisted caecal intubation rate 90%+, rectal retroversion 90%+, polyp detection rate 15%+, polyp retrieval rate 90%+, patient comfort: <10% with moderate–severe discomfort) 2. Attaining minimum colonoscopy procedure count of 280 (200 if certified in flexible sigmoidoscopy) 3. Have performed at least 15 procedures over the last 3-month period 4. Attendance of JAG Basic Skills in Colonoscopy course 5. Terminal Ileum intubation rates (60%+ in suspected IBD) 6. Meeting formative DOPS and DOPyS requirements – Minimum of 25 formative DOPS – Last 5 DOPS rated competent without supervision for 90%+ of all items – Evidence of competency in SMSA level 1 polypectomy – Evidence of competence in SMSA level 2 polypectomy 7. Evidence of engagement with the JETS reflection tool (minimum of 5 reflection entries)	Low	Strong
3.8	For successful completion of the summative DOPS assessment, the trainee should be rated as 'ready for independent practice' in all items within four DOPS by a minimum of two different assessors who are not the trainee's usual trainer.	Low	Strong
4.1	Newly certified endoscopists should have access to a named individual and meet on a regular basis to discuss cases and to review progress.	Very low	Strong
4.2	Endoscopy departments should have systems in place to ensure appropriate list size and caseload selection for newly certified endoscopists.	Very low	Strong
4.3	Certified endoscopists should perform at least 100 procedures a year to maintain competence.	Very low	Strong
4.4	Certified endoscopists should have access to mentored lists.	Very low	Strong

BSG, British Society of Gastroenterology; DOPS, direct observation of procedure skills; DOPyS, direct observation of polypectomy skills; ENTS, endoscopic non-technical skills; IBD, inflammatory bowel disease; JAG, Joint Advisory Group; JETS, JAG Endoscopy Training System; SMSA, Size, Morphology, Site, Access.

radiological imaging of the TI, right iliac fossa pain and suspected inflammatory bowel disease (IBD).[11 12] The manoeuvre is associated with longer procedural times, and when performed in all cases, the benefit on diagnostic yield is unclear.[13] In cases of suspected IBD, performing terminal ileal intubation as a part of colonoscopy is recommended by both European Crohn's and Colitis Organisation and BSG IBD guidance.[14 15] Terminal ileal intubation rates of 80%–85% are feasible in routine practice, although>600 lifetime procedures are required to achieve rates >85%.[16] In order to set a minimum KPI for trainees, the working group proposed a minimum unassisted terminal ileal intubation rate of 60% when indicated for the procedure.

1.3: Competence in colonoscopy requires the ability to recognise normal findings, describe and document abnormal findings and take appropriate action.
Evidence: **Very Low**; Recommendation: **Strong**; Agreement: **100%**

An independent endoscopist should be able to recognise and differentiate between normal and abnormal findings, take appropriate action during the procedure and write a comprehensive report. These cognitive skills are necessary for effective patient management, documentation and handover. Trainees can increase their experience with increasing exposure and case mix during their training lists.

Table 2 Trainee-relevant key performance indicators (KPIs) in colonoscopy (extrapolated from the UK quality standards document by Rees *et al*)[3]

KPIs	*Minimal standards*
Unassisted caecal intubation rate (CIR)	>90%
Rectal retroversion	>90%
Adenoma detection rate*	>15%
Polyp retrieval rate	>90%
Patient's comfort	<10% mod-severe discomfort

This excludes KPIs which may be primarily influenced by the trainer, for example, sedation doses, withdrawal time, adenoma detection rate.
*Polyp detection rate may be used as a substitute.

1.4: Competent endoscopists in colonoscopy should be able to demonstrate endoscopic non-technical skills (ENTS) as defined in DOPS and DOPyS.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

ENTS are complementary to technical skills and are important for a safe and effective procedure.[17] They involve cognitive, interpersonal and social skills and primarily consist of communication and teamwork, situational awareness, leadership, judgement and decision-making.[18] ENTS are essential component of practice with potential positive effects on team performance and clinical outcomes.[19] ENTS training, when delivered to an experienced endoscopy team, demonstrates significant improvements in knowledge and attitudes towards patient safety.[17] In a recent randomised controlled trial (RCT), novice trainees exposed to ENTS training were rated to be more competent during their first hands-on colonoscopy procedures.[20] All JAG direct observation of procedural skills (DOPS) and direct observation of polypectomy skills (DOPyS) assessment forms were updated in July 2016 to emphasise and objectively measure ENTS competencies.[21]

1.5: Competence in colonoscopy includes the ability to identify and manage immediate and late complications of the procedure demonstrating effective clinical, endoscopic and non-technical skills (ENTS) to coordinate subsequent action.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

Although colonoscopy is a relatively safe procedure and severe adverse events are rare, they can be potentially life threatening with a mortality rate of 0.007%–0.07%.[22] Complications can range from minor (eg, vasovagal reaction), moderate (eg, cardiac arrhythmias, side effects of sedation) or severe (eg, bleeding and perforation). They should be measured over the 30-day period after the procedure and may be classified as intraprocedural, postprocedural (<14 days post) or late (>14 days).[23] Larger studies report perforation rates of 0.005%–0.085% and post colonoscopy bleeding at 0.001%–0.687% (depending on the indication), with an overall rate of 0.05% (1 in 2000)[24 25] A competent endoscopist should be able to recognise complications promptly, apply appropriate endoscopic and non-technical skills and initiate appropriate management. In particular competency would include demonstration of immediate leadership of the endoscopy team in managing the complication, appropriate communication with other teams if needed and duty of candour in discussions with patients and their next of kin.

1.6: Competent endoscopists should be able to recognise the adequacy of the endoscopic procedure performed and recommend subsequent action.
Evidence: **Very low**; Recommendation: **Strong**; Agreement: **100%**

The quality of a colonoscopy procedure can be adversely affected by the quality of bowel preparation, patient comfort, technical challenges and other intraprocedural factors (eg, complications). A competent endoscopist should be able to recognise the limitations of the procedure and exercise judgement and decision-making to recommend or arrange subsequent investigations to explain the patient's symptoms (ie, if necessary with a repeat procedure or alternative investigation).

1.7: Competence in polypectomy should be based on achieving all competencies defined in the DOPyS form rather than a set minimum number of procedures.
Evidence: **Very low**; Recommendation: **Strong**; Agreement: **96%**

A recent systematic literature review of polypectomy learning curves showed that polypectomy competence was achieved after completion of 250–400 polypectomies and after 300 colonoscopies.[26] In addition, the rate of competency in polypectomy did not correlate with the established colonoscopy quality metrics (ADR and withdrawal time).[27] Setting a mandatory minimum number of polypectomy procedures would not be achievable within the current shape of training and therefore competency should be driven by performance in DOPyS assessments as validated comprehensive polypectomy assessment tools.

1.8: Competent endoscopists should be able to define the difficulty level of polypectomy using the SMSA scoring system.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **96%**

The SMSA scoring system comprises four factors which determine the complexity of a polypectomy; (S) Size, (M) Morphology, (S) Site and (A) Access.[28] Application of SMSA divides complexity of polypectomy into four levels: level 1 (4–5), level 2 (6–8), level 3 (9–12), and level 4 (>12). Defining

the difficulty level of polypectomy aids therapeutic decision-making, correlates with adverse events and can avoid unnecessary repeat procedures.[29 30] For larger polyps, the SMSA level can determine the appropriate colonoscopist and time slot allocation for a future polypectomy.

Polyp size is an important predictor of polypectomy difficulty, postprocedural outcome and surveillance intervals.[28] However, estimates of polyp size during colonoscopy often exceed those measured from histology samples. Anderson *et al* compared endoscopic and histological size from 1528 polyps. Of all 222 polyps estimated as ≥1 cm on endoscopy, 46% were <1 cm on pathology, while of 1306 polyps estimated as <1 cm, 3.9% were ≥1 cm on pathology.[31] Eichenseer *et al* found that in 63% of their polyp cohort, a size difference of at least 33% was detected between in situ and postfixation measurements, leading to inappropriate surveillance recommendations in over a third of the cases, regardless of histology and the number of detected polyps.[32] The use of an instrument (eg, open biopsy forceps) to calibrate size might increase accuracy in both experts and novices.[33 34]

In combination with size, polypectomy site (right vs left) can influence outcome, due to different anatomy characteristics and complication profiles. Different access scenarios (proximity to appendix, TI or diverticular segments, over a fold) could also make smaller lesions more challenging to resect. Additionally complete endoscopic resection is more challenging in lesions that have been resected previously or have advanced changes on optical diagnosis suggesting early cancerous change.

1.9: Endoscopists should be able to competently document polyps using the Paris classification.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

In vivo assessment of colorectal polyp morphology enables decision-making with regard to the appropriateness and mode of endoscopic therapy.[28] The Paris classification provides standardised nomenclature for polyp morphology, classifying lesions to protruding (sessile, pedunculated, subpedunculated), flat (flat elevated or depressed) or depressed, although mixed morphology may be also present.[35] Risk factors for submucosal invasion include Paris classification 0-IIa+c morphology, non-granular surface and Kudo pit pattern type V.[36] The Paris classification can be predictive of submucosal invasion, with rates ranging from 1.4% for the most commonly observed lesions (Paris IIa granular), 7.5% (Paris 1s) to 31% for Paris IIc or IIa+IIc lesions.[36] Paris classification aids decision-making with polypectomy and should be used for the documentation of polyp morphology and be included in the endoscopy report.

1.10: Endoscopists should competently use at least one validated optical diagnosis system to classify and document polyps.
Evidence: **Moderate**; Recommendation: **Strong**; Agreement: **100%**

Advancement of imaging techniques, new classification systems and the use of artificial intelligence have allowed for increased viability of optical diagnosis.[37] To date, many classification systems have emerged (eg, Sano, Narrow-band imaging International Colorectal Endoscopic Classification (NICE), Japan NBI Expert Team (JNET), Simplified Identification Method for Polyp Labelling During Endoscopy (SIMPLE), Kudo, Workgroup serrAted polypS and Polyposis (WASP), BLI Adenoma Serrated International Classification (BASIC)) with some more widely used than others. Competency in validated optical diagnosis systems is critical in assessing the realtime malignant potential of polyps.

Kudo *et al* first described five different 'pit patterns' according to mucosal surface seen by magnifying endoscopy, as a helpful tool to predict histology.[38] Specific analysis of lesions with Kudo type V pit pattern found a vastly higher incidence of malignancy than with other pit pattern types (56% vs 4.4% (pit pattern III) vs 5% (pit pattern IV) vs 0% (pit patterns I+II), n=479, p<0.001).[38] The Sano classification was described in 2006 using NBI and was based on vascular patterns.[39] In an attempt to simplify the process and make use of a more universal system, the NICE classification was created in 2009 and was based in colour, vessel and surface pattern, and has been widely implemented.[40]

Although using the validated NICE classification for real-time prediction of polyp histology for small lesions (<10 mm) was not superior to high definition white light endoscopy in a German RCT,[41] data appraising the 'resect and discard' strategy showed that the use of NICE classification might be able to prevent leaving in situ high-grade adenomas or small invasive colorectal cancers[42] and a further Japanese study supports NICE being a valid tool for predicting deep submucosal invasive carcinomas (SMIC) with overall sensitivity and negative predictive value of 92%.[43] One RCT found the modified Sano classification (MS) to outperform NICE for differentiating neoplastic polyps and predicting resectability.[44]

In order to address differences in surface patterns in elevated and superficial lesions, the JNET classification was developed and validated as a tool for hyperplastic polyps, sessile serrated lesions (SSL), adenomas and SMIC but was less applicable for shallow submucosal cancers.[45 46] In a further attempt to create a classification inclusive of SSLs, the WASP classification was developed which led to a sustained increased in accurate diagnosis especially for SSLs.[47]

The BASIC is based on Blue Light Imaging and takes into account polyp morphology, crypt and vessel

characteristics. It has high interobserver concordance and has been validated for diminutive colorectal polyps,[48] with lesion recognition accuracy improving with training.[49]

1.11: Endoscopists in colonoscopy should be competent to perform safe and effective polypectomy of SMSA level 2 polyps as a minimum.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

The SMSA scoring system has been shown to predict critical outcomes of endoscopic mucosal resection (EMR), thereby validating its application for identifying high-risk lesions.[29] In the Munich Polypectomy study,[50] size and right side location were associated with major complications and specifically right sided lesions >10 mm and left sided lesions >20 mm. Lower levels of endoscopic clearance were also shown for more complex (SMSA level 4) compared with less complex lesions (SMSA levels 2 and 3) (87.5% vs 97.5%, p=0.009).[51] Following Delphi group consensus, the SMSA system has replaced the previous system of assessing polyp complexity based on size alone (ie, where level 1: <10 mm; level 2: 10–20 mm), with competency in colonoscopy to include competency in at least SMSA level 2 polypectomy.

1.12: Endoscopists must be able to competently demonstrate safe and appropriate use of diathermy relevant to polypectomy.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

There is significant variation in the use of diathermy for polypectomy among endoscopists, with variable usage of current (blended or forced coagulation) by polyp morphology.[52 53] Pure coagulation current is favoured by some due to its efficient haemostatic properties but delayed bleeding can occur and prolonged use might cause deep thermal injury. Blended current alters the current and blend delivered according to tissue resistance and was thought safer due to the rationale that it provides adequate cutting with effective haemostasis although immediate bleeding is observed.[54] A recent RCT comparing the two diathermy modalities found no difference in risk of serious adverse events, complete resection rate or polyp recurrence.[55] Pure cutting current should be avoided due to its high risk for immediate post polypectomy bleeding.[56]

Trainees should have a basic understanding of the electrosurgical unit and diathermy settings needed for safe polypectomy. A recent UK survey identified practice variations and knowledge gaps on the diathermy use which may not only affect safety in doing polypectomy but also quality of training delivered to subsequent generations of trainees.[52] Understanding of diathermy should be supported through the Colonoscopy Basic Skills Course and teaching should also be delivered during polypectomy hands on simulation, enabling assessment and development of trainees' skills in a protected and safe environment.[57]

1.13: Endoscopists should be able to competently manage post-polypectomy perforation and bleeding using endoscopic clips and at least one other method of haemostasis while **demonstrating relevant ENTS.**
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

Bleeding and perforation are the most common and serious complications of polypectomy. Endoscopists should be able to mitigate, recognise and manage such complications.[58] Careful examination of the polypectomy resection site is important to check for deep mural injury (ideally with a recognised scoring system), bleeding or residual polyp.

For post polypectomy bleeding, haemostasis can be achieved in most cases with the use of through the scope (TTS) clips,[59] direct thermal therapy with coagulation forceps or snare tip coagulation, or alternatively, coagulation therapy with argon plasma coagulation. There are no direct comparative trials between clips and thermal methods and they should be applied as required in an individual case-by-case basis, although caution should be taken to avoid prolonged thermal therapy in the resection site for risk of delayed perforation.[60] Over the scope clips,[61] haemostatic powders[62] and self-assembling matrix forming gels[63] may also be considered, with interventional radiology or surgical back up should endoscopic management fail.

For intraprocedural perforation, endoscopic closure is a safe and effective alternative to surgery and is thus the treatment of choice for select cases. In a systematic review of 24 cohort studies, successful closure was achieved in 90% of intraprocedural perforations using endoscopic methods.[64]

Although some skills might be acquired later with further experience and exposure, independent endoscopists should be competent with TTS clip placement and at least one other form of haemostasis. In addition to technical skills, demonstration of ENTS is also crucial to coordinate subsequent patient management.

Acquiring competence

2.1: Lower GI endoscopy training should take place in a unit that maintains its training environment to JAG standards.
Evidence: **Very low**; Recommendation: **Weak**; Agreement: **100%**

The JAG accreditation standards for endoscopy services have set quality standards to ensure that all

training centres deliver safe and effective training.[65] Herein, each trainee should have a nominated trainer who performs to BSG standards, has received appropriate training as an endoscopy trainer (Train the Colonoscopy Trainer course) and is assessed regularly by trainees and peers (trainee feedback and through Direct Observation of Training Skills—DOTS). Training should be supplemented by access to recommended JAG courses, assessment and certification tools (JETS access) and appropriate supervision precertification and post certification. Finally, each certified endoscopy unit should maintain a suitable environment and have policies in place to support training opportunities in line with a trainee's personal development plan.

2.2: Colonoscopy trainers should meet colonoscopy standards as defined by JAG and BSG quality standards.

Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

Colonoscopy trainers should maintain their own competencies and safety standards as defined by the BSG.[3] All trainers will have attended a JAG approved Train the Endoscopy Trainer for example, Train the Colonoscopy Trainer course before they are assigned to a trainee, with ongoing peer assessments to ensure these training skills are maintained as per current JAG standards.

2.3: The training programme should include opportunities to gain experience and competencies in ENTS.

Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

The acquisition of higher ENTS competencies can lag behind the development of the technical skills of scope control and may be addressed through focused and structured ENTS training. In the RCT by Grover *et al*, structured simulation-based curriculum covering ENTS improved colonoscopy and integrative (ENTS) performance in novice trainees compared with self-directed simulator based training.[66] More recently, an assessor-blinded RCT by the same group found that novice trainees exposed to a comprehensive non-technical skills curriculum (covering didactic teaching and case base scenario, virtual reality (VR) simulation, scenario training and specific non-technical skills feedback) had superior overall colonoscopy performance and non-technical skills ratings in their hands-on cases compared with the control group.[67] Additionally, didactic teaching and multiprofessional in situ simulation training can be used to improve ENTS.[17 68 69]

2.4: Trainees in colonoscopy should attend a JAG approved Basic Skills in Colonoscopy course during training.

Evidence: **Low**; Recommendation: **Strong**; Agreement:**100%**

2.5: Lower GI endoscopy trainees should apply for a JAG approved basic skills course at the start of LGI endoscopy training and attend this within their first 70 procedures.

Evidence: **Low**; Recommendation: **Strong**; Agreement: **91%**

The Basic Skills in Colonoscopy course was implemented by JAG in response to poor performance demonstrated in the 2004 UK wide colonoscopy audit.[45] The main objective of a JAG approved training course is to standardise the delivery of endoscopy theory and hands-on techniques to all trainees. This allows trainees to build on the knowledge acquired and improve their skills until certification.

A 1-week hands-on colonoscopy course showed positive, sustained improvement on key areas of skills acquisition.[70] An interrupted time series analysis found that attendance of the Basic Skills in Colonoscopy course results in a step-change improvement in performance when measured using the composite PICI endpoint in all trainees regardless of procedural experience.[71] However, the greatest benefit was found in trainees at earlier stages training (in the <70 lifetime procedure count group). We therefore advise that the course should be undertaken early in the individual's training journey and preferably within their first 70 colonoscopies.

2.6: Virtual reality simulation training for endoscopic technical skills is encouraged in conjunction with conventional endoscopy training to enhance development of early endoscopic technical skills. Trainee simulator-based training should be directly supported by appropriately skilled trainers/supervisors.

Evidence: **Moderate**; Recommendation: **Strong**; Agreement: **91%**

The use of simulators for diagnostic colonoscopy training has been well studied, as in theory it reduces risk exposure to patients and allows development of basic techniques. The current literature includes 5 meta-analyses and a total of 10 RCTs for colonoscopy, although the quality of evidence is limited by the risk of bias.[72–76] Overall, simulators show good validity, can distinguish between competency levels and can improve endoscopic procedure completion and mucosal visualisation compared with those who receive no training.[77] Within individual RCTs, VR simulation training has been shown to improve CIR in the first 10 colonoscopies,[78] increase competency during the first 100 cases with higher completion rates.[79] However, a meta-analysis of seven studies found no improvement in patient-based CIR in trainees exposed to VR training.[76] While VR simulators are effective as a precursor to patient-based training, there is insufficient evidence for VR to

replace early hands-on training or to count towards a trainee's lifetime procedure count.

The ASGE Preservation and Incorporation of Valuable Endoscopic Innovations committee felt that the threshold for benefit to recommend widespread simulator use would be a >25% reduction in median number of clinical cases to attain competency.[80] This has not been tested in an RCT.

Regarding polypectomy, the optimal simulator approach has not yet been established. Interim results of a randomised trainee cohort study have failed to show a significant increase in DOPyS performance in the group that received specific augmented reality training in addition to conventional simulator-based training.[81] At present, it is unclear what proportion of polypectomy training should consist of cognitive didactics, use of simulation/ex vivo models, observation of experts or supervised hands-on polypectomy. There is a lack of robust data on the efficacy and effectiveness of training interventions which increase trainees' competencies and this has led to practice variation in different institutions and countries.[82] In a study of eight gastroenterology trainees who underwent a lecture-based training which included basic principles of polyp characterisation, polypectomy technique, outcome and management of complications, the training did not result in improvement in overall competencies assessed by DOPyS.[83] Different training methods such as educational videos are increasingly used and have demonstrated effect on the learning curve of polypectomy skills.[84] Studies supporting the use of simulators for polypectomy are limited. The Welsh Institute for Minimal Access Therapy colonoscopy suitcase is an ex vivo porcine simulator for polypectomy that has shown content validity for training in polypectomy skills. The simulator was validated for snare polypectomy and correlated with the real-life level of expertise of the user.[85]

Training with GI simulators can increase early clinical performance but the optimal manner to deliver training is still under review. Feedback appears to be essential to derive benefit from simulation training.[66 86 87] As such, simulation-based training should be directly supported with coaching and feedback from appropriately skilled trainers to maximise efficacy.[88 89]

2.7: Training in polypectomy should start early during basic colonoscopy training and continue in parallel with this.
Evidence: **Very low**; Recommendation: **Strong**; Agreement: **100%**

Only 50% of UK trainees achieve competency in polypectomy of lesions between 1 and 2 cm within 3 years of their first DOPyS.[90] Additionally, more recent data suggest that the polypectomy learning curve requires 250–400 polypectomies or 300 procedures to achieve competency.[26] Colonoscopy trainees should be competent in the resection of SMSA level 2 polyps. Thus to allow sufficient time for that and shorten the learning curve, training in polypectomy should start early in colonoscopy training, once basic handling and tip control are mastered, and continue in parallel to ongoing diagnostic colonoscopy skills training

2.8: Attendance at a hands on (tissue/tissue-like) model endoscopy course with exposure to differing polyp resection techniques, submucosal injection techniques, haemostatic therapy and tattooing is encouraged.
Evidence: **Very low**; Recommendation: **Strong**; Agreement: **96%**

Endoscopic training in therapeutics should start when the trainee has developed some early essential skills (basic tip control) and continue throughout their training. Procedures can harbour life-threatening complications or be part of a high-risk clinical scenario, and prove challenging even in experienced hands.

One way to increase confidence of the trainee and to make the task safer is to deconstruct and learn the different steps of a new technique in a more controlled, less stressful environment of a hands on model course with expert trainer support and clear learning objectives appropriate to endoscopy training. The existing JAG accredited model courses, Hands-on Polypectomy Skills Course and the pilot Upper Gastrointestinal Haemostasis course apply these principles.

Supportive evidence for improvement in task competency is lacking although one RCT reported significant improvements in the performance of polypectomy, control of upper GI bleeding and oesophageal dilatation following a hands-on course.[91] Additionally, a recent evaluation study of the 1 day BSG-JAG developed pilot haemostasis course in two centres showed that trainee confidence increased in both in their understanding and delivery of main therapeutic techniques in the management of upper gastrointestinal bleeding.[92]

2.9: Polypectomy training should include skills acquisition incold snare, hot snare and basic lift-assisted polypectomy to a minimum of SMSA level 2.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

As SMSA level 2 competency is the minimum requirement for competency in colonoscopy, trainees should be familiar with all the different techniques that might be used in endoscopy to safely and effectively remove all such polyps. Cold biopsy polypectomy (CBP) is a technique used for diminutive polyps (≤5 mm) but has been associated with high rates of incomplete resection, with only 39% of polyps being completely resected using CBP.[93] The use of jumbo biopsy forceps is superior to standard CBP for small, sessile polyps although

the efficacy remains questionable (78.8% vs 50.7%).[94] When CBP was compared with cold snare polypectomy (CSP), the rate of complete resection was significantly higher in the CSP group for diminutive and small colorectal polyps, although for those polyps <4 mm complete resection rates were similar.[95 96]

CSP is favoured for small sessile lesions due to its safety profile, speed of resection and effectiveness. The CRESCENT study (A comparison of the resection rate for cold and hot snare polypectomy for 4-9mm colorectal polyps: a multicentre randomised controlled trial) and a recent meta-analysis comparing CSP with hot snare polypectomy (HSP) for polyps <10 mm reported similar complete resection rates of 92%–98%, but lower delayed bleeding rates and shorter procedure times for the CSP groups.[97–99] CSP is unable to achieve en-bloc resection for lesions >10 mm,[100 101] although lower residual polyp rates are seen with SSLs compared with adenomas (1.1% vs 11%) indicating a selective role for piecemeal CSP.[102 103]

HSP is the preferred technique for pedunculated polyps but also for larger lesions (>10 mm) and especially adenomas as part of lift-assisted polypectomy (EMR). It is associated with higher risk of perforation and also delayed bleeding depending on the current/setting used and type of polyp removed.

Trainees should be aware of the strengths and weaknesses of each method and be trained to apply these appropriately.

2.10: Trainees should receive training in Paris polyp classification and validated optical diagnosis systems. When available, supportive web-based training tools should be utilised and any relevant modules completed prior to the basic skills course.
Evidence: **Moderate**; Recommendation: **Strong**; Agreement: **96%**

Trainees should receive a structured training approach to gain competency in use of the Paris polyp classification and at least one validated optical diagnosis system to classify and document polyps (*statements 1.9 and 1.10*). These could include NBI International Colorectal Endoscopic (NICE),[41–43 104] JNET,[45 104] BASIC[48 105] and the WASP classification[47] to improve diagnostic accuracy of hyperplastic and adenomatous histology and to predict serrated histology. Other proposed classifications such as ICE and SIMPLE for i-scan platform but they have not been fully validated in clinical practice yet.[106] Ideally, training should consider encompassing multiple endoscopic platforms

Training modules can be didactic or web based and should take into account all commonly encountered lesions including hyperplastic polyps, SSLs, adenomas and cancer to allow effective implementation in clinical practice. Recently, Smith *et al* found no difference in diagnostic accuracy for the prediction of diminutive/small polyps between trainees assigned to didactic training and computer based training.[107] The optimum mode of optical diagnosis training is therefore unclear.

Analysis of post colonoscopy colorectal cancers (PCCRC) highlight that 89% of these can be avoided with 8% of cases being attributed to detected polyps in the area of subsequent cancer not being removed. This would suggest inadequate lesion assessment (and subsequent decision not to proceed with resection) at the index procedure has an important role in development of these cancers.[108]

Optical diagnosis training should be incorporated into the Basic Skills in Colonoscopy course with a combination of precourse self-study material and in-course discussions to enhance understanding. Systematic, feedback-based training programmes have helped endoscopists with different levels of experience to develop high accuracy and good intraobserver agreement using NICE classification,[109] while in-class teaching and self-directed learning using a standardised educational tool for these had similar results in accuracy of comparing adenomatous versus hyperplastic colonic polyps in a recent RCT.[110]

2.11: Appropriate discussion and reflection related to polyp classification and management should occur throughout training.
Evidence: **Very low**; Recommendation: **Strong**; Agreement: **100%**

Polypectomy is a complex skill that requires significant training time. Lesion recognition and description with appropriate application of Paris classification and optical diagnosis platforms is an important first step and requires continuous practice, case variation and adequate exposure. Management planning and decision-making on optimal therapeutic approach for a lesion using SMSA score along with all other non-technical skills around polypectomy are also critical for a safe and effective resection technique. These discussions could precede hands-on technical skills experience and will aid future development. Regular feedback, use of DOPyS and reflective tools can facilitate these discussions.

2.12: All parameters described in DOPS/DOPyS should be included during skills training.
Evidence: **Very low**; Recommendation: **Strong**; Agreement: **100%**

The colonoscopy DOPS and DOPyS are formative assessment tools for diagnostic colonoscopy and polypectomy respectively which itemise specific competencies in sequential order.[111 112] Each competency item is grouped within a domain, for example, preprocedure, procedural, management of findings, postprocedure and ENTS.[111] All items covered within DOPS and DOPyS should be covered during colonoscopy and polypectomy training.

2.13: Water-assisted insertion techniques may improve patient comfort levels and technical success, and should form part of training in colonoscopy.
Evidence: **Low**; Recommendation: **Weak**; Agreement: **87%**

Water-assisted insertion techniques are now routinely used by many endoscopists around the world with notable benefits on patient comfort, increasing patient acceptance of repeat procedures, higher adenoma detection rates and procedural simplification.[113–119] Colonoscopy trainees rated water-assisted colonoscopy (WAC) as easier to learn compared with air insufflation colonoscopy in a randomised crossover study involving three trainees.[120] Lower rates of loop formation, as supported by magnetic endoscopic imaging (MEI) studies,[121] may explain these benefits. WAC should be considered part of training in colonoscopy where expertise is available.

2.14: Where available, magnetic endoscopic imaging should be used for colonoscopy training and should be preferentially used for training lists.
Evidence: **Low**; Recommendation: **Weak**; Agreement: **82%**

Scope tracking technologies such as MEI provides real-time three dimensional views of colonoscope configuration within the abdomen.[122] MEI allows for direct visualisation of loop formation as well as the direction and degree of rotational manoeuvres required for directly observed withdrawal or precise external abdominal pressure.[123] In training, use of MEI can facilitate discussion between the trainee and trainer to resolve issues with scope advancement or patient discomfort and explain decision making without taking over the scope.[124] A meta-analysis of eight RCTs showed that MEI is beneficial in training and can improve performance with higher CIRs in inexperienced endoscopists and in experts in technically difficult cases.[125] Some studies show improvement in caecal intubation times and patients comfort scores although data are conflicting.[126 127] MEI can also improve the accuracy of preoperative localisation of colonic tumours, which is important when planning laparoscopic resection.[128 129] Although MEI is a useful tool in colonoscopy and training, it is recognised that MEI is not universally available due to cost or compatibility with some endoscope manufacturers, and may be contraindicated in some patients. We therefore advise its use in training if available.

2.15: A trainee should undertake a minimum of 280 colonoscopy procedures to be eligible for summative assessment in colonoscopy.
Evidence: ***Low***; Recommendation: ***Strong***; Agreement: **87%**

Although the learning curve to competency in colonoscopy has been studied, the findings are heterogenous and vary according to the endpoints by which competency is defined. Most studies apply an unassisted CIR of 90% as an indicator of competency in colonoscopy with no caecal intubation time limit. This was achieved after 233 procedures in the UK study by Ward *et al*[130] and in>90% of trainees after 500 procedures in the US study by Spier *et al*.[131] The UK study by Siau *et al* based on DOPS assessments (N=1199 trainees) found that 250–299 procedures were required to attain competency in>90% of assessable skills within the procedural domain of DOPS, although skills such as 'pace and progress', 'proactive problem solving' required>300 procedures.[111]

When factoring in caecal intubation time limits, the time to competency is potentially longer. In a study of colorectal surgery trainees, >400 procedures was required to achieve this CIR>90%and caecal intubation time of≤10min).[132] In the study by Sedlack *et al*, the endpoint of CIR>90%, caecal intubation time<15min and competent assessment scores (>3.5) was achieved in 90% of trainees after 300 procedures.[133] When taking data from polypectomy learning curves into account, competency was achieved after 300 procedures.[26]

As it is likely that>300 colonoscopies will be required for competency in diagnostic colonoscopy and SMSA level 2 polypectomy, it is important to note that previously, in certain cohorts of trainees, undertaking this number of procedures has not been achievable during specialty training.[134]

Previously, JAG colonoscopy certification consisted of two stages—provisional and full. Based on JETS data, trainees apply for provisional certification after a median of 269 procedures (IQR 226–342) and for full certification after 403 (IQR 339–509).[7] However, not all endoscopists applied for full certification once provisional certification was granted, and as such, competencies in higher level polypectomy could not be assured. Therefore, a simple single-stage colonoscopy certification process was preferable providing a uniform practice standard to patients and this has now been adopted with a minimum of 280 colonoscopies (based on Siau data)[111] required before application.

2.16: Trainees who hold JAG certification in flexible sigmoidoscopy should have a minimum of 200 lifetime colonoscopy procedures to be eligible for summative assessment in colonoscopy.
Evidence: **Very Low**; Recommendation: **Strong**; Agreement: **91%**

JAG certification in flexible sigmoidoscopy is awarded when trainees meet competency standards evidenced in KPIs and DOPS,[135] and are competent in the resection of small polyps (up to 10mm). Some of the technical and ENTS skills in colonoscopy are generic to flexible sigmoidoscopy, although additional training is required for aspects such as sedation, loop management, terminal ileal intubation, postprocedure planning and the resection of lesions up to SMSA Level 2.

Development of earlier competence in colonoscopy in trainees in this cohort is supported by the finding that trainees with flexible sigmoidoscopy experience (>100 procedures) were more likely to achieve caecal intubation (OR 2.4, p<0.01).[130] Additionally, a further study found that trainees who achieved splenic flexure intubation rates>90% also achieved the target of CIR>90% within a significantly lower number of procedures (mean of 208 vs 352 procedures, p=0.03).[136] In trainees who have been awarded JAG flexible sigmoidoscopy certification, the working group recommended a minimum procedure threshold of 200 lifetime colonoscopy as an eligibility criterion to trigger summative assessment in colonoscopy.

2.17: A trainee should have a minimum number of dedicated training lists as defined by the JAG training standards.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

Skills can decay over time. Jorgensen *et al* reported decrease in CIR after 6-week break for endoscopy trainees[137] and this was confirmed in recent retrospective analysis looking at the impact of a 2-week break from colonoscopy practice on performance in independent endoscopists, which showed a small but significant drop in CIR and the composite score, performance indicator of colonic intubation.[138]

Current JAG training standards state that each trainee should have a minimum of 20 dedicated training lists a year in addition to access to ad-hoc training opportunities.[65] With impending changes to structure of medical training, on-call rotations, dual accreditation commitments and the minimum procedure count of>280 procedures (*statement 2.15*) for certification, ensuring adequate training opportunity is important for trainees to achieve their certification during training. Increased availability and attendance of endoscopy training opportunities will be required to achieve this goal during specialty training.

2.18: It is recommended that a trainee should receive a minimum of one DOPS per training list.
Evidence: **Low**; Recommendation: **Weak**; Agreement: **96%**

DOPS assessments were developed to standardise skills assessment in a structured approach, to facilitate feedback provision and to support the certification process. They provide formal objective evidence of skills acquisition for both technical and non-technical skills.[139 140] Accurate regular assessment of a trainees' performance when learning a new skill can help them reach their full potential,[141] while delivering constructive feedback after a procedure can stimulate reflection and and enhance learning.[142] For training programmes, DOPS help to identify areas for improvement and when performed at regular intervals can be used to chart competency development. Indeed, the lifetime colonoscopy DOPS count is an independent predictor of procedural competency, while DOPS assessment scores strongly correlate with the CIR.[111] The updates to DOPS forms in 2016, which incorporated ENTS and a change in scoring format from a performance-based scale to a supervision-based scale has also improved the validity of assessments.[21]

The updated requirements for certification include a minimum of 25 mandatory formative DOPS. While other training systems have recommended assessment blocks, for example, five consecutive assessments at intervals of 25 procedures, this was not found to affect competency development. For pragmatism, we advise a minimum of one DOPS per training list.

2.19: It is recommended that a minimum of one DOPyS should be completed for every training list where a polypectomy has been attempted by a trainee.
Evidence: **Low**; Recommendation: **Weak**; Agreement: **96%**

Similar to DOPS (*statement 2.18*), DOPyS should be performed regularly to chart competency development in polypectomy. Although DOPyS assessments should ideally be completed after every polypectomy performed to enhance performance, this may not always be feasible due to time constraints. We advise at least one DOPyS per training list where applicable.

2.20: Trainees must complete a reflection tool on JETS every 50 procedures. This forms a framework for meetings with their endoscopy supervisor every 6 months or less.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

Reflective practice is an important aspect of endoscopy and is encouraged in the General Medical Council standards for good practice. It empowers practitioners to develop self-awareness and insights on their strengths and weaknesses, optimises the learning process, consolidates practice and identifies opportunities for improvement.[143] Trainees are encouraged to reflect on their clinical practice, endoscopic skills, interesting cases, ENTS, complications and so on, using the JETS 'Reflection Tool' at least once every 50 procedures. In line with GMC recommendations, this is one of the new requirements for endoscopy certification which should be reviewed by the endoscopy trainer during appraisal meetings.

Assessment of competence

3.1: DOPS should be used as the competency assessment tool in lower gastrointestinal endoscopy.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

The colonoscopy DOPS assesses 24 individual competencies under five broad domains (seven preprocedure; eight procedure; three management of findings; two post procedure; four ENTS).[111] The current DOPS integrates a supervision-based scoring scale and an ENTS section which provides greater validity compared with the previous iteration.[144]

It is recognised that other competency assessment tools have been developed internationally which have undergone validation.[77 140 145] The Assessment of Competency in Endoscopy (ACE) tool,[146] which superseded the Mayo Colonoscopy Skills Assessment Tool, is currently used in North America.[147] ACE measures 14 competency items and awards overall scores for technical and cognitive skills on a performance-based scale ranging from 1 (novice) to 4 (highly skilled). Following the analysis of 1061 ACE assessments for 93 fellows, an overall score of 3.5 was reported as the optimal competency threshold; this was attained for cognitive endpoints before technical skills, with competency achieved in nearly all items after 250 procedures. The Gastrointestinal Endoscopy Competency Assessment Tool,[148] and (Skill Assessment in Fellow Endoscopy Training) SAFE-T,[149] have also been introduced and supported by validity and reliability data, but not have been incorporated into national endoscopy training systems as with the DOPS. The Resident Practice Audit in Gastroenterology instrument assesses professionalism, interpretation of data, patient safety, knowledge, independence and technical skills, in addition to an overall score, and is being evaluated in Canada.[150]

As endoscopy trainees and trainers in the UK are familiar with DOPS, we recommend the continued use of DOPS as the default formative and summative assessment tool during colonoscopy training.

3.2: Each formative DOPS should be performed on a single pre-selected case.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **91%**

Endoscopy skills should be demonstrated across a breadth of different scenarios and with different case difficulties to ensure competency across a range of case contexts.[140] DOPS assessments can be initiated by either the trainee or trainer but should be prospectively selected to minimise selection bias.

3.3: The last 5 DOPS prior to summative assessment must be rated competent without supervision in >90% of all items, with none requiring maximal or significant supervision.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **96%**

DOPS performance can be used to gauge when an individual is ready for summative assessment. Competent performance in colonoscopy DOPS should be demonstrated in more experienced trainees who have met or are approaching eligibility requirements for summative assessment. Prior to summative assessment, therefore, trainees should be competent in >90% of items assessed in DOPS,[111] with up to 10% of items scoring 'minimal supervision' and no items rated as requiring 'maximum supervision' or 'significant supervision'.

3.4: DOPyS should be used as the polypectomy competency assessment tool for both technical and non-technical skills.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

DOPyS is a validated polypectomy assessment tool for colonoscopy and flexible sigmoidoscopy[112] which has been endorsed by the US Multi-Society Task Force on colorectal cancer.[151] The use of DOPyS improves trainees documented exposure to therapeutic endoscopy, provides formal evidence of polypectomy skills acquisition and serves as an effective tool for assessing and certifying polypectomy in the UK.[139] DOPyS was also used by Patel *et al* in the validation of Cold Snare Polypectomy Assessment Tool (CSPAT) which was developed specifically for CSP.[152]

3.5: For competence at SMSA Level 1 polypectomy, a minimum of 2 SMSA Level 1 DOPyS should be competently performed in each of the following methods: cold snare polypectomy, diathermy-assisted resection of stalked polyps and diathermy-assisted EMR. The last 4 DOPyS (Level 1) should score 'competent for independent practice' in all items.
Evidence: **Very low**; Recommendation: **Strong**; Agreement: **100%**

Statement 2.9 highlighted the importance of applying the correct method for polypectomy according to the size and type of the polyp to reduce risk and improve outcomes. These techniques might be required to remove an SMSA level 1 polyp and thus trainees need to demonstrate competence in each modality. A systematic review on the learning curve for polypectomy based on 'independent *en bloc* resection' and delayed post polypectomy bleeding rate suggests that 250–400 polypectomies are required.[26] The I-DOPyS study suggested a median of 15 polypectomies to achieve competence in CSP.[153]

We recommend a minimum of two assessments for SMSA level 1 polyps at the standard of 'competent for independent practice' for each modality (CSP, diathermy assisted resection of stalked polyps and diathermy assisted EMR). In total, this constitutes a minimum of six competent DOPyS for SMSA Level 1 polyps with the four most recent SMSA Level 1 DOPyS scoring 'competent for independent practice' in all items.

3.6: For competence at SMSA Level 2 polypectomy, a minimum of 2 SMSA Level 2 DOPyS should be competently performed in each of the following methods: cold snare polypectomy, diathermy-assisted resection of stalked polyps and diathermy-assisted EMR. The last 4 DOPyS (Level 2) should score 'competent for independent practice' in all items.
Evidence: **Very low**; Recommendation: **Strong**; Agreement: **100%**

For independent practice in colonoscopy, competency in SMSA Level 2 polypectomy is required. This replaces the previous competency requirement of being expected to resect polyps up to 20 mm in size. Studies on the polypectomy learning curve recommend that trainees perform 50 EMRs with mentorship to prevent unacceptably high polyp recurrence rates.[26]

As per *statement 3.5*, trainees will need to have achieved competence in SMSA Level 1 polypectomy. In addition to this, trainees should complete a minimum of two DOPyS for each polypectomy technique (CSP, diathermy-assisted resection of stalked polyps and diathermy assisted EMR), all performed for SMSA Level 2 polyps. This constitutes a minimum of six competent DOPyS for SMSA Level 2 polyps with the four most recent SMSA Level 2 DOPyS scoring 'competent for independent practice' in all items.

Inadequacy of initial polyp resection contributes to PCCRC rates and analysis of these cases highlights that 7% of PCCRC cases may be attributed to this cause.[108 154]

3.7: Eligibility for summative assessment in colonoscopy may be triggered once the following are met:

1. Meeting criteria for BSG standards for competence in colonoscopy relevant to trainees—averaged over a 3-month period (ie, unassisted caecal intubation rate 90%+, rectal retroversion 90%+, polyp detection rate 15%+, polyp retrieval rate 90%+, patient comfort: <10% with moderate–severe discomfort).
2. Attaining a minimum colonoscopy procedure count of 280 (200 if certified in flexible sigmoidoscopy).
3. Have performed at least 15 procedures over the last 3-month period.
4. Attendance of JAG Basic Skills in Colonoscopy course.
5. Terminal Ileum intubation rates (≥60% in suspected IBD).
6. Meeting formative DOPS and DOPyS requirements.
   - Minimum of 25 formative DOPS.
   - Last 5 DOPS rated competent without supervision for ≥90% of all items.
   - Evidence of competency in SMSA Level 1 polypectomy.
   - Evidence of competence in SMSA Level 2 polypectomy.
7. Evidence of engagement with the JETS reflection tool (minimum of five reflection entries).

Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

In addition to DOPS, JAG certification adopts the use of minimum procedural numbers and KPIs from self-reporting methods to inform readiness for summative assessment. The KPIs for competent practice are aligned with trainee-relevant metrics featured within the UK colonoscopy quality standards (*Statement 1.1*). In line with previous JAG certification criteria,[155] KPIs will continue to be measured over the last 3 months with a minimum of 15 procedures to enable sufficient practice volume to gauge performance. The eligibility criteria for summative assessment reflect the requirements described within this document.

3.8: For successful completion of the summative DOPS assessment, the trainee should be rated as 'ready for independent practice' in all items within four DOPS by a minimum of two different assessors who are not the trainee's usual trainer.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **100%**

To ensure objectivity of summative assessment, JAG had traditionally mandated DOPS to be scored by assessors who are not the trainee's usual trainer (defined as the dedicated named trainer allocated to the trainee during their attachment who supervises the majority of training lists), involving a total of four summative DOPS performed within a 1 month window. This could involve different permutations, that is, as a 2+2 process simultaneously (2 assessors over 2 cases), as a 2+2 process sequentially (2 assessors over 4 cases), as a 2+1 + 1 process (3 assessors over 4 cases), as a 1+1 + 1 + 1 process (4 assessors over 4 cases), or as a 3+1 process sequentially (2 assessors over 3 cases).

Although there are data suggestive of the role for distant supervision, that is, through magnetic endoscopic imager configurations,[156] video recordings,[70 157] or live video transmissions on tablet devices,[158] these are currently insufficient to be recommended as alternatives to directly observed assessments within the same room due to their limitations with ENTS assessments. Further research should be centred on these distant methods in conjunction with DOPS to facilitate external formative/summative assessments in colonoscopy.

Postcertification support

4.1: Newly certified endoscopists should have access to a named individual and meet on a regular basis to discuss cases and to review progress.
Evidence: **Very Low**; Recommendation: **Strong**; Agreement: **96%**

The transition between supervised training and newly independent practice can be a challenging period and may be the first opportunity to perform colonoscopy without an in-room trainer. Most newly certified practitioners will require a defined period of supervision (eg,

1 year) and ongoing endoscopy exposure to achieve the outcomes of an experienced practitioner.[159] Assigning a named individual to meet regularly with a newly certified endoscopist to review progress and to discuss any clinical and non-clinical challenges faced during this period offers support and allows a relationship of trust and rapport to develop. Instances where such support may be beneficial may include: review of photodocumentation (and indeterminate lesions), postprocedural management plans, therapeutic decision-making. Such meetings should be conducted on a regular basis, to safeguard patient management and to facilitate skills development for the newly independent practitioner. The supervisor should possess valid credentials (appropriately experienced with competent KPIs) and have attended a Train-the-Trainers course.

The recent implementation of the UK National Endoscopy Database enables procedural data to be uploaded to a centralised server to benchmark an endoscopist's KPIs against national quality standards.[160] In accordance with JAG QA standards,[65] performance data of all independent endoscopists should be reviewed at regular intervals to enable practitioners to discuss queries, concerns, raise issues with caseload or time management, and to receive support and further skills training where necessary. This should also include plans for support if underperformance is self-reported or observed during the newly independent period, in line with JAG guidance.[161]

As part of professional development, training requirements of newly certified endoscopists should be identified, discussed and recorded on an individualised personal development plan. For colonoscopy, this could include mentored lists (*Statement 4.4*) to improve specific technical or non-technical skills, or further skills training in therapeutics, or the attendance of multidisciplinary team meetings.

4.2: Endoscopy departments should have systems in place to ensure appropriate list size and case load selection for newly certified endoscopists.
Evidence: **Very Low**; Recommendation: **Strong**; Agreement: **96%**

The path from competent to high-quality practice involves an ongoing learning curve post certification. Newly certified endoscopists need to be able to demonstrate all the appropriate technical and non-technical skills without a trainer in the room which can increase their mental workload and might lead to longer times to complete a test safely. Data from Siau *et al* showed that after colonoscopy certification, 18% of trainees had a dip in performance (CIR<90%) in their first 50 procedures, which decreased after 100 additional independent procedures.[159] Endoscopy departments should allow for adjustments on the lists of the newly independent colonoscopists with reduced caseload if applicable, for example, for the first 6 months, to encourage familiarisation with independent practice and as confidence develops. It is advisable for progress to be reviewed by the named individual assigned to the newly certified endoscopist (*Statement 4.1*) and if applicable, to review caseload after the transition period.

4.3: Certified endoscopists should perform at least 100 procedures a year to maintain competence.
Evidence: **Very Low**; Recommendation: **Strong**; Agreement: **100%**

Performing a minimum annual volume of colonoscopy procedures helps to maintain competency and is independently associated with improved patient outcomes including CIR,[162] PICI and lower rates of adverse events.[163–165] Harewood *et al* analysed performance of junior faculty members (<5 year experience) and reported significantly higher completion rates in those performing>200 colonoscopies per year than those who do not (92.5% vs 88.5%).[162] The BSG guidance on KPIs recommend a minimum of 100 colonoscopies per year with an aspirational standard of 150 procedures per year to be undertaken by the endoscopist or directly supervising a trainee in the room.[3]

4.4: Certified endoscopists should have access to mentored lists.
Evidence: **Low**; Recommendation: **Strong**; Agreement: **91%**

Within the Bowel Cancer Screening Programme framework on mentorship and QA, a mentor is defined as 'a trusted counsellor or guide'. It is important for new certified endoscopists to feel supported by their department and be given access to mentored lists for a defined period, for example, first 6 months, after certification. A mentored list may involve a colleague with expertise either observing the newly independent endoscopist or vice versa. This can be useful to facilitate ongoing training, upskilling (eg, to SMSA 3+polyps), reflective practice and upskilling during this transition period, for supporting underperformance, or for imparting Train-the-Trainers skills to those who wish to eventually train others. Such an approach can also improve career satisfaction and mitigate burnout.[166]

DISCUSSION

The 2022 JAG guidance for training and certification in colonoscopy and polypectomy provides a robust evidence-based framework and replaces previous certification criteria in colonoscopy (summarised in figure 1). The two-stage colonoscopy certification process has now been replaced with a single-stage sign-off process. This document covers recommendations for training, assessment and certification in colonoscopy, in addition to measures during the early postcertification period to support the transition

from trainees into independent practitioners. Where evidence has been sparse, statements integral to training and certification have been sourced from expert consensus.

Competency endpoints will continue to be measured through a combination of KPIs (via NED/JETS e-portfolio), DOPS assessments, and with a minimum procedural number of 280 colonoscopies as a competency safeguard. The pathway integrates diagnostic colonoscopy with polypectomy training and is intrinsically aligned with KPI criteria from UK quality standards which forms the benchmark for competent colonoscopy.

The eligibility criteria for summative assessments have now been updated in line with latest evidence and with an emphasis towards competence in polypectomy. These include the following: (1) competence in SMSA Level 2 polypectomy has replaced the previous requirement of polypectomy of lesions larger than 10 mm; (2) additional emphasis on DOPyS for SMSA Level 1 and Level 2 polyps. With the increasing evidence on the value of feedback through formative assessments, DOPS and DOPyS are now recommended for each dedicated training list. Active reflection is encouraged and included within the certification criteria. The JAG pathway for training and certification in colonoscopy is summarised in figure 1.

We acknowledge that additional training and support may be required for trainers with the introduction of this curriculum. Some of the standards, for example, characterising lesions by SMSA classification, use of at least one validated optical diagnosis system, undertaking DOPS and DOPyS assessments may be a challenge for existing trainers. While these are already covered in JAG Train-the-Trainers courses, trainers should familiarise themselves with this document and identify trainer development needs that may be bridged through self or peer-assisted learning.

The recommendations for training and competency acquisition have been laid out to include evidence-based interventions which have been shown to benefit competency development in colonoscopy and polypectomy. The challenges for trainees to achieve competence can be complex and adversely affected by factors such as central directives which lead to a change in approach to postgraduate training, or external events (eg, COVID-19 pandemic).[167] Specialty training programmes in the UK should ensure adequate endoscopy training provision, including the availability of fellowships, or if required, the continued access to training during the post-CCT period. Meeting the updated standards outlined in this document will inevitably be a challenge for trainees, trainers and training programmes, and may require innovative solutions such as simulation-based induction and accelerated (immersion) training. A reconfiguration to the structure of endoscopy training via a centrally agreed and regionally coordinated approach may be required to achieve certification during specialty training. It is hoped that this updated certification pathway will ensure that patients can expect to receive high-quality care from the newly certified independent colonoscopist.

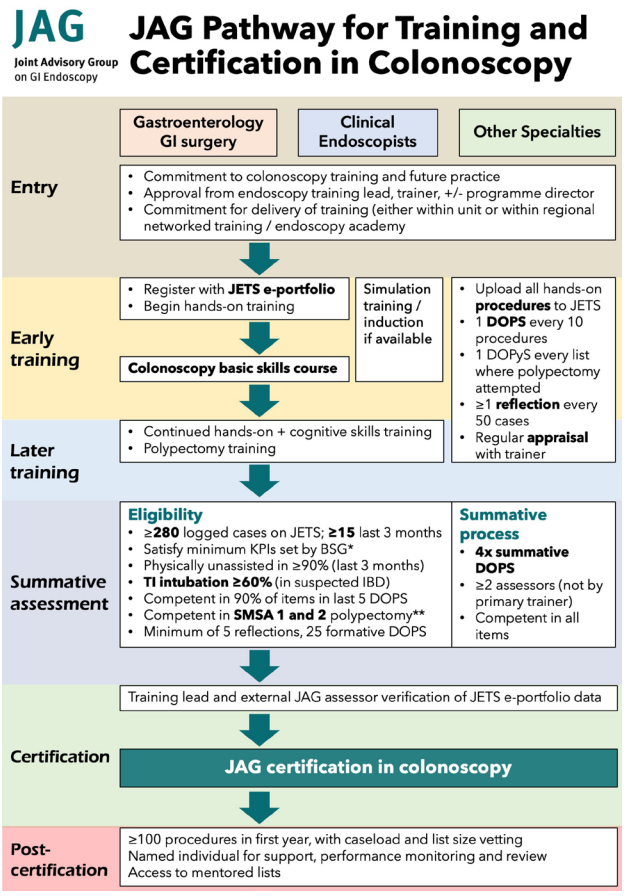

Figure 1 Pathway for JAG training and certification in colonoscopy. * ≥90% unassisted caecal intubation rate, rectal retroflexion and polyp retrieval, ≤10% moderate/severe pain; ** Minimum of two direct observation of polypectomy skills (DOPyS) demonstrating competency for each of: cold snare polypectomy, diathermy-assisted resection of stalked polyps and diathermy-assisted endoscopic mucosal resection for both Size, Morphology, Site, Access (SMSA) Level 1 and Level 2 polyps. JETS, JAG Endoscopy Training System.

Author affiliations
[1]Department of Gastroenterology, Royal Cornwall Hospitals NHS Trust, Truro, UK
[2]University of Birmingham College of Medical and Dental Sciences, Birmingham, UK
[3]Department of Gastroenterology, Royal Free London NHS Foundation Trust, London, UK
[4]Department of Gastroenterology, University Hospitals Sussex NHS Foundation Trust, Worthing, UK
[5]Department of Gastroenterology, Royal Wolverhampton Hospitals NHS Trust, Wolverhampton, UK
[6]Department of Gastroenterology, Hillingdon Hospitals NHS Foundation Trust, Uxbridge, UK
[7]Department of Gastroenterology, Torbay and South Devon NHS Foundation Trust, Torquay, UK
[8]Department of Gastroenterology, Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, UK
[9]Gastroenterology, Gloucestershire Hospitals NHS Foundation Trust, Cheltenham, UK
[10]Gastroenterology, St Mark's Hospital and Academic Institute Wolfson Unit for Endoscopy, Harrow, UK
[11]Endoscopy, Royal Derby Hospital, Derby, UK

[12]Colorectal Surgery, University Hospitals Sussex NHS Foundation Trust, Worthing, UK
[13]Department of Gastroenterology, Norfolk and Norwich University Hospitals NHS Foundation Trust, Norwich, UK
[14]University of East Anglia, Norwich, UK
[15]Gastroenterology, NHS Lothian, Edinburgh, UK
[16]Department of Gastroenterology, NHS Lothian, Edinburgh, UK
[17]Faculty of Medical and Human Sciences, The University of Manchester, Manchester, UK
[18]Wrightington Wigan and Leigh NHS Foundation Trust, Wigan, UK
[19]Department of Gastroenterology, University Hospitals of Derby and Burton NHS Foundation Trust, Derby, UK
[20]Colorectal Surgery, Torbay and South Devon NHS Foundation Trust, Torquay, UK
[21]Endoscopy, Royal Wolverhampton Hospitals NHS Trust, Wolverhampton, UK
[22]Colorectal Surgery, City Hospitals Sunderland NHS Foundation Trust, South Shields, UK
[23]Department of Gastroenterology, Homerton University Hospital NHS Foundation Trust, London, UK
[24]Colorectal Surgery, Chelsea and Westminster Hospital, London, UK
[25]Imperial College London, London, UK
[26]Department of Gastroenterology, Royal Glamorgan Hospital, Llantrisant, UK
[27]Department of Gastroenterology, Gloucestershire Hospitals NHS Foundation Trust, Gloucester, UK
[28]Department of Gastroenterology, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK
[29]St Mark's Hospital and Academic Institute Wolfson Unit for Endoscopy, Harrow, UK
[30]Department of Gastroenterology, North Tees and Hartlepool NHS Foundation Trust, Hartlepool, UK
[31]Faculty of Health, Education and Life Sciences, Birmingham City University, Birmingham, UK

Twitter Keith Siau @drkeithsiau, Susi Green @susi_green, Arun Rajendran @pelicanhere and Siwan Thomas-Gibson @SiwanTG

Contributors Conception: KS and AM. DELPHI design: KS and AM. Literature searches, electronic voting, manuscript draft, critical review and approval of final version: all authors.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests ER has received research funding from Medtronic Ltd.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

ORCID iDs
John Anderson http://orcid.org/0000-0002-7053-197X
Eleanor Wood http://orcid.org/0000-0002-7467-5698
Siwan Thomas-Gibson http://orcid.org/0000-0001-8922-6249

REFERENCES

1 Gavin DR, Valori RM, Anderson JT, *et al*. The National colonoscopy audit: a nationwide assessment of the quality and safety of colonoscopy in the UK. *Gut* 2013;62:242–9.
2 Burr NE, Derbyshire E, Taylor J, *et al*. Variation in post-colonoscopy colorectal cancer across colonoscopy providers in English National health service: population based cohort study. *BMJ* 2019;367:l6090.
3 Rees CJ, Thomas Gibson S, Rutter MD, *et al*. Uk key performance indicators and quality assurance standards for colonoscopy. *Gut* 2016;65:1923–9.
4 Rees CJ, Koo S, Anderson J, *et al*. British Society of gastroenterology endoscopy quality improvement programme (EQIP): overview and progress. *Frontline Gastroenterol* 2019;10:148–53.
5 Siau K, Green JT, Hawkes ND, *et al*. Impact of the joint Advisory group on gastrointestinal endoscopy (JAG) on endoscopy services in the UK and beyond. *Frontline Gastroenterol* 2019;10:93–106.
6 Anderson JT. Assessments and skills improvement for endoscopists. *Best Pract Res Clin Gastroenterol* 2016;30:453–71.
7 Siau K, Anderson JT, Valori R, *et al*. Certification of UK gastrointestinal endoscopists and variations between trainee specialties: results from the jets e-portfolio. *Endosc Int Open* 2019;7:E551–60.
8 Clough J, FitzPatrick M, Harvey P, *et al*. Shape of training review: an impact assessment for UK gastroenterology trainees. *Frontline Gastroenterol* 2019;10:356–63.
9 Balshem H, Helfand M, Schünemann HJ, *et al*. Grade guidelines: 3. rating the quality of evidence. *J Clin Epidemiol* 2011;64:401–6.
10 Joint Advisory Group. JAG accreditation programme: guide to meeting the quality and safety standards. JAG, 2019. Available: https://www.thejag.org.uk/CMS/UploadedDocuments/Scheme/Scheme5/Guidance/191107%20-%20guidance%20-%20JAG%20quality%20and%20safety%201.0%20final.pdf [Accessed 10 Jan 2022].
11 Neilson LJ, Bevan R, Panter S, *et al*. Terminal ileal intubation and biopsy in routine colonoscopy practice. *Expert Rev Gastroenterol Hepatol* 2015;9:567–74.
12 Jeong SH, Lee KJ, Kim YB, *et al*. Diagnostic value of terminal ileum intubation during colonoscopy. *J Gastroenterol Hepatol* 2008;23:51–5.
13 Leiman DA, Jawitz NG, Lin L, *et al*. Terminal ileum intubation is not associated with colonoscopy quality measures. *J Gastroenterol Hepatol* 2020;35:1503–8.
14 Maaser C, Sturm A, Vavricka SR, *et al*. ECCO-ESGAR guideline for diagnostic assessment in IBD Part 1: initial diagnosis, monitoring of known IBD, detection of complications. *J Crohns Colitis* 2019;13:144–64.
15 Lamb CA, Kennedy NA, Raine T, *et al*. British Society of gastroenterology consensus guidelines on the management of inflammatory bowel disease in adults. *Gut* 2019;68:s1–106.
16 Cherian S, Singh P. Is routine ileoscopy useful? An observational study of procedure times, diagnostic yield, and learning curve. *Am J Gastroenterol*, 2004. Available: https://journals.lww.com/ajg/Fulltext/2004/12000/Is_Routine_Ileoscopy_Useful__An_Observational.9.aspx
17 Matharoo M, Haycock A, Sevdalis N, *et al*. Endoscopic non-technical skills team training: the next step in quality assurance of endoscopy training. *World J Gastroenterol* 2014;20:17507–15.
18 Ravindran S, Haycock A, Woolf K, *et al*. Development and impact of an endoscopic non-technical skills (ENTS) behavioural marker system. *BMJ Simul Technol Enhanc Learn* 2021;7:17-25.
19 Hitchins CR, Metzner M, Edworthy J, *et al*. Non-Technical skills and gastrointestinal endoscopy: a review of the literature. *Frontline Gastroenterol* 2018;9:129–34.
20 Walsh CM, Scaffidi MA, Khan R, *et al*. Non-technical skills curriculum incorporating simulation-based training improves performance in colonoscopy among novice endoscopists: randomized controlled trial. *Digestive Endoscopy* 2020;32:940–8.
21 Siau K, Dunckley P, Valori R, *et al*. Changes in scoring of direct observation of procedural skills (DOPS) forms and the

impact on competence assessment. *Endoscopy* 2018;50:770–8.
22 Levy I, Gralnek IM. Complications of diagnostic colonoscopy, upper endoscopy, and enteroscopy. *Best Pract Res Clin Gastroenterol* 2016;30:705–18.
23 Cotton PB, Eisen GM, Aabakken L, *et al*. A lexicon for endoscopic adverse events: report of an ASGE workshop. *Gastrointest Endosc* 2010;71:446–54.
24 Kim SY, Kim H-S, Park HJ. Adverse events related to colonoscopy: global trends and future challenges. *World J Gastroenterol* 2019;25:190–204.
25 Reumkens A, Rondagh EJA, Bakker CM, *et al*. Post-Colonoscopy complications: a systematic review, time trends, and meta-analysis of population-based studies. *Am J Gastroenterol* 2016;111:1092–101.
26 Rajendran A, Pannick S, Thomas-Gibson S, *et al*. Systematic literature review of learning curves for colorectal polyp resection techniques in lower gastrointestinal endoscopy. *Colorectal Dis* 2020;22:1085–100.
27 Subramaniam S, Bhandari P. Competency in polypectomy: when desirable becomes essential. *Gastrointest Endosc* 2018;87:645–7.
28 Gupta S, Miskovic D, Bhandari P, *et al*. A novel method for determining the difficulty of colonoscopic polypectomy. *Frontline Gastroenterol* 2013;4:244–8.
29 Sidhu M, Tate DJ, Desomer L, *et al*. The size, morphology, site, and access score predicts critical outcomes of endoscopic mucosal resection in the colon. *Endoscopy* 2018;50:684–92.
30 Currie AC, Merriman H, Nadia Shah Gilani S, *et al*. Validation of the size morphology site access score in endoscopic mucosal resection of large polyps in a district general Hospital. *Ann R Coll Surg Engl* 2019;101:558–62.
31 Anderson BW, Smyrk TC, Anderson KS, *et al*. Endoscopic overestimation of colorectal polyp size. *Gastrointest Endosc* 2016;83:201–8.
32 Eichenseer PJ, Dhanekula R, Jakate S, *et al*. Endoscopic mis-sizing of polyps changes colorectal cancer surveillance recommendations. *Dis Colon Rectum* 2013;56:315–21.
33 Jin H-Y, Leng Q. Use of disposable graduated biopsy forceps improves accuracy of polyp size measurements during endoscopy. *World J Gastroenterol* 2015;21:623–8.
34 Kim JH, Park SJ, Lee JH, *et al*. Is forceps more useful than visualization for measurement of colon polyp size? *World J Gastroenterol* 2016;22:3220–6.
35 The Paris endoscopic classification of superficial neoplastic lesions: esophagus, stomach, and colon: November 30 to December 1, 2002. *Gastrointest Endosc* 2003;58:S3–43.
36 Moss A, Bourke MJ, Williams SJ, *et al*. Endoscopic mucosal resection outcomes and prediction of submucosal cancer from advanced colonic mucosal neoplasia. *Gastroenterology* 2011;140:1909–18.
37 Djinbachian R, Dubé A-J, von Renteln D. Optical diagnosis of colorectal polyps: recent developments. *Curr Treat Options Gastroenterol* 2019;17:99–114.
38 Kudo S, Tamura S, Nakajima T, *et al*. Diagnosis of colorectal tumorous lesions by magnifying endoscopy. *Gastrointest Endosc* 1996;44:8–14.
39 Sano Y, Horimatsu T, Fu KI, *et al*. Magnified observation of microvascular architecture using narrow band imaging (NBI) for the differential diagnosis between non-neoplastic and neoplastic colorectal lesion. A prospective study. *Gastrointest Endosc* 2006;63:AB102.
40 Hewett DG, Kaltenbach T, Sano Y, *et al*. Validation of a simple classification system for endoscopic diagnosis of small colorectal polyps using narrow-band imaging. *Gastroenterology* 2012;143:599–607.
41 Klare P, Haller B, Wormbt S, *et al*. Narrow-Band imaging vs. high definition white light for optical diagnosis of small colorectal polyps: a randomized multicenter trial. *Endoscopy* 2016;48:909–15.
42 Hattori S, Iwatate M, Sano W, *et al*. Narrow-Band imaging observation of colorectal lesions using NICE classification to avoid discarding significant lesions. *World J Gastrointest Endosc* 2014;6:600–5.
43 Hayashi N, Tanaka S, Hewett DG, *et al*. Endoscopic prediction of deep submucosal invasive carcinoma: validation of the narrow-band imaging international colorectal endoscopic (NICE) classification. *Gastrointest Endosc* 2013;78:625–32.
44 Pu LZCT, Cheong KL, Koay DSC, *et al*. Randomised controlled trial comparing modified Sano's and narrow band imaging international colorectal endoscopic classifications for colorectal lesions. *World J Gastrointest Endosc* 2018;10:210–8.
45 Komeda Y, Kashida H, Sakurai T, *et al*. Magnifying narrow band imaging (NBI) for the diagnosis of localized colorectal lesions using the Japan NBI expert team (JNET) classification. *Oncology* 2017;93 Suppl 1:49–54.
46 Kobayashi S, Yamada M, Takamaru H, *et al*. Diagnostic yield of the Japan NBI expert team (JNET) classification for endoscopic diagnosis of superficial colorectal neoplasms in a large-scale clinical practice database. *United European Gastroenterol J* 2019;7:914–23.
47 IJspeert JEG, Bastiaansen BAJ, van Leerdam ME, *et al*. Development and validation of the wasp classification system for optical diagnosis of adenomas, hyperplastic polyps and sessile serrated adenomas/polyps. *Gut* 2016;65:963–70.
48 Bisschops R, Hassan C, Bhandari P, *et al*. Basic (BLI adenoma serrated International classification) classification for colorectal polyp characterization with blue light imaging. *Endoscopy* 2018;50:211–20.
49 Subramaniam S, Hayee B, Aepli P, *et al*. Optical diagnosis of colorectal polyps with blue light imaging using a new International classification. *United European Gastroenterol J* 2019;7:316–25.
50 Heldwein W, Dollhopf M, Rösch T, *et al*. The Munich polypectomy study (MUPS): prospective analysis of complications and risk factors in 4000 colonic SNARE polypectomies. *Endoscopy* 2005;37:1116–22.
51 Tholoor S, Tsagkournis O, Basford P, *et al*. Managing difficult polyps: techniques and pitfalls. *Ann Gastroenterol* 2013;26:114–21.
52 Verma AM, Chilton AP. National survey of UK endoscopists showing variation in diathermy practice for colonic polypectomy. *Frontline Gastroenterol* 2019;10:120–7.
53 Singh N, Harrison M, Rex DK. A survey of colonoscopic polypectomy practices among clinical Gastroenterologists. *Gastrointest Endosc* 2004;60:414–8.
54 Rutter MD, Chattree A, Barbour JA, *et al*. British Society of Gastroenterology/Association of Coloproctologists of great britain and ireland guidelines for the management of large non-pedunculated colorectal polyps. *Gut* 2015;64:1847–73.
55 Pohl H, Grimm IS, Moyer MT, *et al*. Effects of blended (yellow) vs forced coagulation (blue) currents on adverse events, complete resection, or polyp recurrence after polypectomy in a large randomized trial. *Gastroenterology* 2020;159:119–28.
56 Ferlitsch M, Moss A, Hassan C, *et al*. Colorectal polypectomy and endoscopic mucosal resection (EMR): European Society of gastrointestinal endoscopy (ESGE) clinical guideline. *Endoscopy* 2017;49:270–97.
57 Siau K, Murugananthan A, Dunckley P, *et al*. National survey of UK endoscopists showing variation in diathermy practice for colonic polypectomy: a JAG perspective. *Frontline Gastroenterol* 2019;10:444–5.

58 Ma MX, Bourke MJ. Complications of endoscopic polypectomy, endoscopic mucosal resection and endoscopic submucosal dissection in the colon. *Best Pract Res Clin Gastroenterol* 2016;30:749–67.
59 Parra-Blanco A, Kaminaga N, Kojima T, *et al*. Hemoclipping for postpolypectomy and postbiopsy colonic bleeding. *Gastrointest Endosc* 2000;51:37–41.
60 Gutta A, Gromski MA. Endoscopic management of Post-Polypectomy bleeding. *Clin Endosc* 2020;53:302–10.
61 Alcaide N, Peñas-Herrero I, Sancho-del-Val L, *et al*. Ovesco system for treatment of postpolypectomy bleeding after failure of conventional treatment. *Rev Esp Enferm Dig* 2014;106:55–8.
62 Ivekovic H, Bilic B, Markos P, *et al*. Successful use of Hemospray to control refractory post-polypectomy bleeding. *Endoscopy* 2015;47 Suppl 1 UCTN:E466–7.
63 Subramaniam S, Kandiah K, Thayalasekaran S, *et al*. Haemostasis and prevention of bleeding related to ER: the role of a novel self-assembling peptide. *United European Gastroenterol J* 2019;7:155–62.
64 Verlaan T, Voermans RP. Endoscopic closure of acute perforations of the GI tract: a systematic review of the literature. *Gastrointestinal*, 2015. Available: https://www.sciencedirect.com/science/article/pii/S0016510715022889?casa_token=cJxxYdOk-u0AAAAA:yh4hIZym4Z5V4jDg1nK6azv1O_RlL85sKk4d36Gk4zXcYJJytOjaKmhGtdycVtNIrn0GRFR4McvJ
65 JAG. Joint Advisory group on gastrointestinal endoscopy (JAG) accreditation standards for endoscopy services. Available: https://www.thejag.org.uk/Downloads/JAG/Accreditation/JAG%20accreditation%20standards%20for%20endoscopy%20services.pdf [Accessed 1 Aug 2020].
66 Grover SC, Garg A, Scaffidi MA, *et al*. Impact of a simulation training curriculum on technical and nontechnical skills in colonoscopy: a randomized trial. *Gastrointest Endosc* 2015;82:1072–9.
67 Walsh CM, Scaffidi MA, Khan R, *et al*. Non-Technical skills curriculum incorporating simulation-based training improves performance in colonoscopy among novice endoscopists: randomized controlled trial. *Dig Endosc* 2020;32:CD008237.
68 Heard LA, Fredette ME, Atmadja ML, *et al*. Perceptions of simulation-based training in crisis resource management in the endoscopy unit. *Gastroenterol Nurs* 2011;34:42–8.
69 Uttley E, Suggitt D, Baxter D, *et al*. Multiprofessional in situ simulation is an effective method of identifying latent patient safety threats on the gastroenterology ward. *Frontline Gastroenterol* 2020;11:351–7.
70 Thomas-Gibson S, Bassett P, Suzuki N, *et al*. Intensive training over 5 days improves colonoscopy skills long-term. *Endoscopy* 2007;39:818–24.
71 Siau K, Hodson J, Anderson JT, *et al*. Impact of a national basic skills in colonoscopy course on trainee performance: an interrupted time series analysis. *World J Gastroenterol* 2020;26:3283–92.
72 Khan R, Plahouras J, Johnston BC, *et al*. Virtual reality simulation training for health professions trainees in gastrointestinal endoscopy. *Cochrane Database Syst Rev* 2018;8:CD008237.
73 Singh S, Sedlack RE, Cook DA. Effects of simulation-based training in gastrointestinal endoscopy: a systematic review and meta-analysis. *Clin Gastroenterol Hepatol* 2014;12:1611–23.
74 Khan R, Plahouras J, Johnston BC, *et al*. Virtual reality simulation training in endoscopy: a cochrane review and meta-analysis. *Endoscopy* 2019;51:653–64.
75 Khan R, Plahouras J, Johnston BC, Scaffidi MA, Grover SC, Walsh CM, *et al*. Virtual reality simulation training for health professions trainees in gastrointestinal endoscopy. *Cochrane Database Syst Rev* 2018;8:CD008237.
76 Qiao W, Bai Y, Lv R, *et al*. The effect of virtual endoscopy simulator training on novices: a systematic review. *PLoS One* 2014;9:e89224.
77 Ekkelenkamp VE, Koch AD, de Man RA, *et al*. Training and competence assessment in Gi endoscopy: a systematic review. *Gut* 2016;65:607–15.
78 Ahlberg G, Hultcrantz R, Jaramillo E, *et al*. Virtual reality colonoscopy simulation: a compulsory practice for the future colonoscopist? *Endoscopy* 2005;37:1198–204.
79 Cohen J, Cohen SA, Vora KC, *et al*. Multicenter, randomized, controlled trial of virtual-reality simulator training in acquisition of competency in colonoscopy. *Gastrointest Endosc* 2006;64:361–8.
80 Cohen J, Bosworth BP, Chak A, *et al*. Preservation and incorporation of valuable endoscopic innovations (PIVI) on the use of endoscopy simulators for training and assessing skill. *Gastrointest Endosc* 2012;76:471–5.
81 Khan R, Scaffidi MA, Gimpaya N, *et al*. A143 impact of a simulation-based augmented reality curriculum on polypectomy skills among novice endoscopists: a randomized controlled trial. *J Can Assoc Gastroenterol* 2020;3:5–7.
82 Patel K, Rajendran A, Faiz O, *et al*. An international survey of polypectomy training and assessment. *Endosc Int Open* 2017;5:E190–7.
83 van Doorn SC, Bastiaansen BAJ, Thomas-Gibson S, *et al*. Polypectomy skills of gastroenterology fellows: can we improve them? *Endosc Int Open* 2016;4:E182–9.
84 Duloy AM, Kaltenbach TR, Wood M, *et al*. Colon polypectomy report card improves polypectomy competency: results of a prospective quality improvement study (with video). *Gastrointest Endosc* 2019;89:1212–21.
85 Ansell J, Hurley JJ, Horwood J, *et al*. The Welsh Institute for minimal access therapy colonoscopy suitcase has construct and concurrent validity for colonoscopic polypectomy skills training: a prospective, cross-sectional study. *Gastrointest Endosc* 2014;79:490–7.
86 Mahmood T, Darzi A. The learning curve for a colonoscopy simulator in the absence of any feedback: no feedback, no learning. *Surg Endosc* 2004;18:1224–30.
87 Kruglikova I, Grantcharov TP, Drewes AM, *et al*. The impact of constructive feedback on training in gastrointestinal endoscopy using high-fidelity Virtual-Reality simulation: a randomised controlled trial. *Gut* 2010;59:181–5.
88 Ansell J, Hurley JJ, Horwood J, *et al*. Can endoscopists accurately self-assess performance during simulated colonoscopic polypectomy? A prospective, cross-sectional study. *Am J Surg* 2014;207:32–8.
89 Scaffidi MA, Grover SC, Carnahan H, *et al*. Impact of experience on self-assessment accuracy of clinical colonoscopy competence. *Gastrointest Endosc* 2018;87:827–36.
90 Rajendran A, Thomas-Gibson S, Bassett P. PTU-006 time to polypectomy competency in the UK: retrospective analysis of 1633 dopys from 131 trainees. *Gut* 2017;66:A53.
91 Haycock AV, Youd P, Bassett P, *et al*. Simulator training improves practical skills in therapeutic Gi endoscopy: results from a randomized, blinded, controlled study. *Gastrointest Endosc* 2009;70:835–45.
92 Siau K, Fazal W, Thoufeeq M. PWE-114 upper Gi haemostasis course improves delegate confidence in theoretical and practical aspects of haemostasis management 2019;68:A257.
93 Efthymiou M, Taylor AC, Desmond PV, *et al*. Biopsy forceps is inadequate for the resection of diminutive polyps. *Endoscopy* 2011;43:312–6.
94 Draganov PV, Chang MN, Alkhasawneh A, *et al*. Randomized, controlled trial of standard, large-capacity versus jumbo biopsy forceps for polypectomy of small, sessile, colorectal polyps. *Gastrointest Endosc* 2012;75:118–26.

95 Kim JS, Lee B-I, Choi H, *et al*. Cold SNARE polypectomy versus cold forceps polypectomy for diminutive and small colorectal polyps: a randomized controlled trial. *Gastrointest Endosc* 2015;81:741–7.
96 Raad D, Tripathi P, Cooper G, *et al*. Role of the cold biopsy technique in diminutive and small colonic polyp removal: a systematic review and meta-analysis. *Gastrointest Endosc* 2016;83:508–15.
97 Kawamura T, Takeuchi Y, Asai S, *et al*. A comparison of the resection rate for cold and hot SNARE polypectomy for 4-9 MM colorectal polyps: a multicentre randomised controlled trial (crescent study). *Gut* 2018;67:1950–7.
98 Iwashita H, Takedatsu H, Murao H, *et al*. Safety and efficacy of cold polypectomy compared to endoscopic mucosal resection and hot biopsy polypectomy. *Scand J Gastroenterol* 2019;54:678–83.
99 Shinozaki S, Kobayashi Y, Hayashi Y, *et al*. Efficacy and safety of cold versus hot SNARE polypectomy for resecting small colorectal polyps: systematic review and meta-analysis. *Dig Endosc* 2018;30:592–9.
100 Van Overbeke L, Ilegems S, Mertens G, *et al*. Cold SNARE endoscopic resection of nonpedunculated colorectal polyps larger than 10 mm. A retrospective series. *Acta Gastroenterol Belg* 2019;82:475–8.
101 Murakami T, Yoshida N, Yasuda R, *et al*. Local recurrence and its risk factors after cold SNARE polypectomy of colorectal polyps. *Surg Endosc* 2020;34:2918–25.
102 Thoguluva Chandrasekar V, Spadaccini M, Aziz M, *et al*. Cold snare endoscopic resection of nonpedunculated colorectal polyps larger than 10 mm: a systematic review and pooled-analysis. *Gastrointest Endosc* 2019;89:929–36.
103 Tutticci NJ, Hewett DG. Cold EMR of large sessile serrated polyps at colonoscopy (with video). *Gastrointest Endosc* 2018;87:837–42.
104 Sano Y, Tanaka S, Kudo S-E, *et al*. Narrow-Band imaging (NBI) magnifying endoscopic classification of colorectal tumors proposed by the Japan NBI expert team. *Dig Endosc* 2016;28:526–33.
105 Rondonotti E, Hassan C, Andrealli A, *et al*. Clinical validation of basic classification for the Resect and discard strategy for diminutive colorectal polyps. *Clin Gastroenterol Hepatol* 2020;18:2357–65.
106 Iacucci M, Trovato C, Daperno M, *et al*. Development and validation of the simple endoscopic classification of diminutive and small colorectal polyps. *Endoscopy* 2018;50:779–89.
107 Smith SCL, Saltzman J, Shivaji UN, *et al*. Randomized controlled study of the prediction of diminutive/small colorectal polyp histology using didactic versus computer-based self-learning module in gastroenterology trainees. *Dig Endosc* 2019;31:535–43.
108 Anderson R, Burr NE, Valori R. Causes of Post-Colonoscopy colorectal cancers based on world endoscopy organization system of analysis. *Gastroenterology* 2020;158:1287–99.
109 Sikong Y, Lin X, Liu K, *et al*. Effectiveness of systematic training in the application of narrow-band imaging international colorectal endoscopic (NICE) classification for optical diagnosis of colorectal polyps: experience from a single center in China. *Dig Endosc* 2016;28:583–91.
110 Allen JE, Vennalaganti P, Gupta N, *et al*. Randomized controlled trial of Self-directed versus In-Classroom education of narrow band imaging in diagnosing colorectal polyps using the NICE criteria. *J Clin Gastroenterol* 2018;52:413–7.
111 Siau K, Crossley J, Dunckley P, *et al*. Colonoscopy direct observation of procedural skills assessment tool for evaluating competency development during training. *Am J Gastroenterol* 2020;115:234–43.
112 Gupta S, Anderson J, Bhandari P, *et al*. Development and validation of a novel method for assessing competency in polypectomy: direct observation of polypectomy skills. *Gastrointest Endosc* 2011;73:1232–9.
113 Hafner S, Zolk K, Radaelli F, *et al*. Water infusion versus air insufflation for colonoscopy. *Cochrane Database Syst Rev* 2015:CD009863.
114 Siau K, Beintaris I. My approach to water-assisted colonoscopy. *Frontline Gastroenterol* 2019;10:194–7.
115 Vemulapalli KC, Rex DK. Water immersion simplifies cecal intubation in patients with redundant colons and previous incomplete colonoscopies. *Gastrointest Endosc* 2012;76:812–7.
116 Chen Z, Li Z, Yu X, *et al*. Is water exchange superior to water immersion for colonoscopy? A systematic review and meta-analysis. *Saudi J Gastroenterol* 2018;24:259.
117 Fuccio L, Frazzoni L, Hassan C, *et al*. Water exchange colonoscopy increases adenoma detection rate: a systematic review with network meta-analysis of randomized controlled studies. *Gastrointest Endosc* 2018;88:589–97.
118 Garborg K, Kaminski MF, Lindenburger W, *et al*. Water exchange versus carbon dioxide insufflation in unsedated colonoscopy: a multicenter randomized controlled trial. *Endoscopy* 2015;47:192–9.
119 Cadoni S, Ishaq S, Hassan C, *et al*. Water-assisted colonoscopy: an international modified Delphi review on definitions and practice recommendations. *Gastrointest Endosc* 2021;93:1411–20.
120 Ngo C, Leung JW, Mann SK, *et al*. Interim report of a randomized cross-over study comparing clinical performance of novice trainee endoscopists using conventional air insufflation versus warm water infusion colonoscopy. *J Interv Gastroenterol* 2012;2:135–9.
121 Leung JW, Thai A, Yen A, *et al*. Magnetic endoscope imaging (ScopeGuide) elucidates the mechanism of action of the pain-alleviating impact of water exchange colonoscopy - attenuation of loop formation. *J Interv Gastroenterol* 2012;2:142–6.
122 Bladen JS, Anderson AP, Bell GD, *et al*. Non-radiological technique for three-dimensional imaging of endoscopes. *Lancet* 1993;341:719–22.
123 Von Delius S, Classen M. Magnetic endoscopic imaging as a guide to smart colonoscopy. *J Dig Dis* 2011;12:317–8.
124 Rahman I, Pelitari S, Boger P. Magnetic endoscopic imaging: a useful ally in colonoscopy. *J Gastrointest Dig Syst* 2015;5:1–3.
125 Chen Y, Duan Y-T, Xie Q, *et al*. Magnetic endoscopic imaging vs standard colonoscopy: meta-analysis of randomized controlled trials. *World J Gastroenterol* 2013;19:7197–204.
126 Hoff G, Bretthauer M, Dahler S, *et al*. Improvement in caecal intubation rate and pain reduction by using 3-dimensional magnetic imaging for unsedated colonoscopy: a randomized trial of patients referred for colonoscopy. *Scand J Gastroenterol* 2007;42:885–9.
127 Jelsness-Jørgensen L-P, Lerang F, Sandvei P, *et al*. Magnetic endoscopic imaging during colonoscopy is associated with less pain and decreased need of analgesia and sedation--results from a randomized controlled trial. *Scand J Gastroenterol* 2013;48:890–5.
128 Szura M, Pasternak A, Solecki R, *et al*. Accuracy of preoperative tumor localization in large bowel using 3D magnetic endoscopic imaging: randomized clinical trial. *Surg Endosc* 2017;31:2089–95.
129 Szura M, Bucki K, Matyja A, *et al*. Evaluation of magnetic scope navigation in screening endoscopic examination of colorectal cancer. *Surg Endosc* 2012;26:632–8.
130 Ward ST, Mohammed MA, Walt R, *et al*. An analysis of the learning curve to achieve competency at colonoscopy using the jets database. *Gut* 2014;63:1746–54.

131 Spier BJ, Benson M, Pfau PR, *et al*. Colonoscopy training in gastroenterology fellowships: determining competence. *Gastrointest Endosc* 2010;71:319–24.
132 Oh JR, Han KS, Hong CW, *et al*. Colonoscopy learning curves for colorectal surgery fellow trainees: experiences with the 15-year colonoscopy training program. *Ann Surg Treat Res* 2018;95:169–74.
133 Sedlack RE, Coyle WJ, ACE Research Group. Assessment of competency in endoscopy: establishing and validating generalizable competency benchmarks for colonoscopy. *Gastrointest Endosc* 2016;83:516–23.
134 Malik KI, Siau K, Dunckley P, *et al*. Colorectal trainees in the UK struggle to meet JAG certification standards in colonoscopy by the end of their training. *Colorectal Dis* 2019;21:715–22.
135 Siau K, Crossley J, Dunckley P, *et al*. Training and assessment in flexible sigmoidoscopy: using a novel direct observation of procedural skills (DOPS) assessment tool. *J Gastrointestin Liver Dis* 2019;28:33–40.
136 McCarthy ST, Jorgensen J, Elta GH, *et al*. Early splenic flexure intubation competency predicts early cecal intubation competency in gastroenterology fellows. *Dig Dis Sci* 2016;61:3155–60.
137 Jorgensen JE, Elta GH, Stalburg CM, *et al*. Do breaks in gastroenterology fellow endoscopy training result in a decrement in competency in colonoscopy? *Gastrointest Endosc* 2013;78:503–9.
138 Siau K, Disney B, Cheung D. PTU-111 does a 2 week break from colonoscopy practice impact on performance? *Gut* 2019;68:A49–50.
139 Patel K, Faiz O, Rutter M, *et al*. The impact of the introduction of formalised polypectomy assessment on training in the UK. *Frontline Gastroenterol* 2017;8:104–9.
140 Siau K, Hawkes ND, Dunckley P. Training in endoscopy. *Curr Treat Options Gastroenterol* 2018;16:345–61.
141 Dilly CK, Sewell JL. How to give feedback during endoscopy training. *Gastroenterology* 2017;153:632–6.
142 Walsh CM, Ling SC, Wang CS, *et al*. Concurrent versus terminal feedback: it may be better to wait. *Acad Med* 2009;84:S54–7.
143 The reflective practitioner - guidance for doctors and medical students. Available: https://www.gmc-uk.org/education/standards-guidance-and-curricula/guidance/reflective-practice/the-reflective-practitioner-guidance-for-doctors-and-medical-students [Accessed 10 Sep 2020].
144 Siau K, Dunckley P, Valori R, *et al*. Correction: changes in scoring of direct observation of procedural skills (DOPS) forms and the impact on competence assessment. *Endoscopy* 2018;50:C9.
145 Leung FW. Assessment of trainees' performance in colonoscopy. *Gastrointest Endosc* 2018;87:270–1.
146 Fried GM, Marks JM, Mellinger JD, *et al*. ASGE's assessment of competency in endoscopy evaluation tools for colonoscopy and EGD. *Gastrointest Endosc* 2014;80:366–7.
147 Sedlack RE. The Mayo colonoscopy skills assessment tool: validation of a unique instrument to assess colonoscopy skills in trainees. *Gastrointest Endosc* 2010;72:1125–33.
148 Walsh CM, Ling SC, Khanna N, *et al*. Gastrointestinal endoscopy competency assessment tool: reliability and validity evidence. *Gastrointest Endosc* 2015;81:1417–24.
149 Kumar NL, Kugener G, Perencevich ML, *et al*. The SAFE-T assessment tool: derivation and validation of a web-based application for point-of-care evaluation of gastroenterology fellow performance in colonoscopy. *Gastrointest Endosc* 2018;87:262–9.
150 Monteiro S, Xenodemetropoulos T. Resident practice audit in gastroenterology (RPAGE): an innovative approach to trainee evaluation and professional development in medicine. *Can Med Educ J* 2019;10:e72–7.
151 Kaltenbach T, Anderson JC, Burke CA, *et al*. Endoscopic removal of colorectal Lesions-Recommendations by the US Multi-Society Task force on colorectal cancer. *Gastroenterology* 2020;158:1095–129.
152 Patel SG, Duloy A, Kaltenbach T, *et al*. Development and validation of a video-based cold SNARE polypectomy assessment tool (with videos). *Gastrointest Endosc* 2019;89:1222–30.
153 Rajendran A, Haycock A, Sevdalis N. The primary aim was to assess the average number of polypectomies required to achieve competency for polyps ≤2cm. *Endoscopy* 2020;52:S66.
154 Rutter MD, Beintaris I, Valori R, *et al*. World endoscopy organization consensus statements on Post-Colonoscopy and Post-Imaging colorectal cancer. *Gastroenterology* 2018;155:909–25.
155 Siau K, Hodson J, Ravindran S, *et al*. Variability in cecal intubation rate by calculation method: a call for standardization of key performance indicators in endoscopy. *Gastrointest Endosc* 2019;89:1026–36.
156 Nerup N, Preisler L, Svendsen MBS, *et al*. Assessment of colonoscopy by use of magnetic endoscopic imaging: design and validation of an automated tool. *Gastrointest Endosc* 2015;81:548–54.
157 Scaffidi MA, Grover SC, Carnahan H, *et al*. A prospective comparison of live and video-based assessments of colonoscopy performance. *Gastrointest Endosc* 2018;87:766–75.
158 Laborde CJ, Bell CS, Slaughter JC, *et al*. Evaluation of a novel tablet application for improvement in colonoscopy training and mentoring (with video). *Gastrointest Endosc* 2017;85:559–65.
159 Siau K, Hodson J, Valori RM, *et al*. Performance indicators in colonoscopy after certification for independent practice: outcomes and predictors of competence. *Gastrointest Endosc* 2019;89:482–92.
160 Lee TJ, Siau K, Esmaily S, *et al*. Development of a national automated endoscopy database: the United Kingdom national endoscopy database (NED). *United European Gastroenterol J* 2019;7:798–806.
161 JAG. Available: https://www.thejag.org.uk/news/publication-of-managing-underperformance-in-endoscopists-guidance [Accessed 10 Sep 2020].
162 Harewood GC. Relationship of colonoscopy completion rates and endoscopist features. *Dig Dis Sci* 2005;50:47–51.
163 Pace D, Borgaonkar M, Lougheed M, *et al*. Effect of colonoscopy volume on quality indicators. *Can J Gastroenterol Hepatol* 2016;2016:1–7.
164 Valori RM, Damery S, Gavin DR, *et al*. A new composite measure of colonoscopy: the performance indicator of colonic intubation (PICI). *Endoscopy* 2018;50:40–51.
165 Wexner SD, Garbus JE, Singh JJ, *et al*. A prospective analysis of 13,580 colonoscopies. reevaluation of credentialing guidelines. *Surg Endosc* 2001;15:251–61.
166 Travis AC, Katz PO, Kane SV. Mentoring in gastroenterology. *Am J Gastroenterol* 2010;105:970–2.
167 Siau K, Iacucci M, Dunckley P, *et al*. The impact of COVID-19 on gastrointestinal endoscopy training in the United Kingdom. *Gastroenterology* 2020;159:1582–5.