Journal of Pediatric Gastroenterology and Nutrition, Publish Ahead of Print

DOI : 10.1097/MPG.0000000000002496

European Society for Paediatric Gastroenterology, Hepatology and Nutrition Position Paper on Training in Paediatric Endoscopy

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Conflicts of interests:

JAD received grants/research supports from Abbvie, payment/honorarium for lectures from Nestlé, Abbvie, Danone and support to attend meetings from Danone and Falk; PN received payment/honorarium for lectures from Abbvie; MTh received payment/honorarium for lectures from Nestle; CT received payment/honorarium for lectures from Abbvie, Merck, Sanofi; AU received grants/research supports from Nestle Health Science and payment/honorarium for lectures from Shire Mead Johnson Nutrition. HA, IB, HVD, SI, LN, CR, IS, AS, MTa, and FT report no conflict of interest to declare.

Funding sources: none

What is Known?

- Endoscopy Training is becoming an integral part of Paediatric Gastroenterology Training within Europe.
- There is a great degree of variation between European endoscopy training in terms of duration, content, procedural volume, assessment during and at the end of training.

What is New?

- Achievement of milestones in training more accurately assesses competency compared to procedural number.
- 'Train the trainers' courses and educational material such as e-learning and endoscopy simulator training improve a structured approach in endoscopy teaching.
- Cooperation with the National Paediatric Gastroenterology, Hepatology and Nutrition Societies in Europe will facilitate dissemination, discussion and implementation of results of this position paper.

Introduction

Endoscopy Training is an integral part of paediatric gastroenterology training within Europe as mentioned in the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) training syllabus (1). National training programmes are often at least partly based on the ESPGHAN syllabus, however, there are a number of countries where endoscopy training is not included in Paediatric Gastroenterology, Hepatology and Nutrition (PGHN) training. There is increasing evidence that achievement of milestones in training more accurately assesses competency compared to procedural number (2, 3). The updated ESPGHAN Syllabus has been approved by the European Union of Medical Specialists (UEMS), suggesting that countries with National PGHN society should comply with the syllabus. The ESPGHAN syllabus lists the endoscopic procedures to be fulfilled in order to certify for paediatric gastroenterologist and does not specify procedural volume anymore (4). A group of experts within the ESPGHAN was tasked to define milestones of competency in diagnostic and therapeutic endoscopy by the Endoscopy Special Interest Group (SIG). In addition, other areas of possible concern were addressed including the need for 'train the trainers' courses and educational material such as e-learning and endoscopy simulator training. Therefore, this document goes beyond training of PGHN trainees, as it is addressed to training at all stages within PGHN, including training of consultants. Cooperation with the National PGHN Societies in Europe is planned to facilitate implementation and dissemination of results of this position paper.

Methodology

The Endoscopy SIG formulated a position paper on training in paediatric endoscopy. A systematic literature search was carried out using the MEDLINE and Cochrane Database of Systematic Reviews from 1987 to November 2018 applying the terms ‘‘endoscopy, training,

paediatric''. References in these documents were also searched to ensure acquisition of relevant source data. Review of Recommendations, Assessment, Development, and Evaluation was applied to evaluate the outcomes. Levels of evidence for each statement were based on the grading of the literature.

The quality of evidence was graded as follows (5-10).

1. High: Further research is unlikely to change our confidence in the estimate of effect.
2. Moderate: Further research is likely to have impact on our confidence in the estimate of effect and may change the estimate.
3. Low: Further research is likely to have an impact on our confidence in the estimate of effect and likely to change the estimate.
4. Very low: Any estimate of effect is uncertain.

The strength of recommendations was defined as follows:

Strong: when the desirable effects of an intervention clearly outweigh the undesirable effects, or they clearly do not. It should be noted that the expert group can make strong recommendations based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms. Strong recommendations are formulated as ''the working group recommends (...).''

Weak: when the trade-offs are less certain (either because of the low quality of evidence or because the evidence suggests that desirable and undesirable effects are closely balanced). Weak recommendations are formulated as ''the working group suggests(...).''

Each recommendation was anonymously voted on. A 9-point scale was used (1 strongly disagree to 9 fully agree), and votes are reported for each recommendation. It was decided in

advance that consensus was reached if >75% of the WG members voted 6, 7, 8, or 9. Consensus was reached for all questions. In the absence of evidence from randomized controlled trials, the majority of recommendations reflect the expert opinion of the authors. The final draft of this position paper was sent to all the committee members for approval in February 2019, and then critically reviewed by a multidisciplinary panel of the Gastrointestinal (GI) committee and members of the council of ESPGHAN.

Q1. Is there a minimum procedural volume for achieving competency?

Recommendation 1. The ESPGHAN Endoscopy SIG suggests that competence be assessed based on paediatric specific competence thresholds on technical and non-technical endoscopic skills and not solely based on number of procedures. Level of evidence (LoE): low Strength of recommendation (SoR): weak Vote: 100% of agreement

"Competence threshold" numbers have been issued by several scientific Societies and have long been used as indicators of competency (Table 1) (11, 12). Indeed, they represent the minimum number of supervised procedures required before the technical competence can be assessed reliably. Adult learning curves have recommended 100-200 oesophagogastroduodenoscopies (OGDs) and 200-300 ileocolonoscopies (ICs) as minimum threshold numbers for achieving competence (2, 3, 13-17) and recent studies could show that there is a correlation between adult and paediatric competency and procedural volume in IC (18). Some Societies (e.g. ESPGHAN, British Society for Paediatric Gastroenterology, Hepatology and Nutrition (BSPGHAN)) have stated that not all trainees will require this number (19). Moreover, most of these numbers were based on expert opinion. Actual studies,

available in adult trainees only, have found that they were underestimated, so this position on competence thresholds looks, at first sight, untenable and against available evidence (13). Despite this, the recommended "competence threshold" numbers were shown to be difficult to attain for a significant proportion of paediatric endoscopy trainees in North American paediatric centres (20, 21). Therefore, perhaps a possible solution might be that paediatric GI fellowships could be supplemented using all possible options, including rotations in large paediatric accredited centres as well as in adult endoscopy units - especially for advanced endoscopy skills. In a recent survey of ESPGHAN trainee members across Europe it was reported that 26% of the paediatric trainees had received endoscopy training by adult endoscopists during their training. In Europe there is a great diversity of training in paediatric endoscopy proving again the need to timely develop a locally achievable system to gain endoscopic competence with the aim to homogenise paediatric endoscopy training across Europe (22). Apart from this survey of 125 young ESPGHAN members, no assessment of actual numbers of endoscopies performed by paediatric trainees has been published.

For OGD, the largest study to date analysing the learning curve for competency in adult endoscopy trainees is described by Ward et al. (3) They assessed the Joint Advisory Group for Endoscopy (JAG) National training database from 1255 trainees in their early stages of training. By using the moving average method and learning curve cumulative summation, trainees attained 95% completion rate (intubation of second part of the duodenum) after 187 and 200 procedures respectively.

The only published data in paediatric OGD assessment tool validity is described in an analysis of JAG national training database of 157 direct observation of procedural skills (DOPS) submitted by 20 trainers for 17 trainees (23). Overall competence scores and mean DOPS scores were compared by trainee seniority and procedure count (discriminative

validity). Receiver operating characteristic curve (ROC) analysis was performed to explore if DOPS scores could be used to delineate procedural competency (consequential validity). In this analysis it was observed that the region of 75+ procedures count, trainees were nearing full competence in diagnostic procedures, which is in keeping with the current UK JAG paediatric gastroscopy certification requirement of 100 procedures (19). Again, the only published data in paediatric IC assessment tool validity is described in an analysis of JAG national training database of 203 DOPS submitted by 11 UK training centres for 29 trainees. Competency acquisition followed the order of: 'pre-procedure', 'post-procedure', generic 'endoscopic non-technical skills', 'management', 'procedure' domains, followed by the global competency, which was achieved in 81% of the cohort after 125-149 procedures (34).

For IC, a systematic adult review included 18 studies (15 prospective studies, 288 trainees) that provided gastroenterology or surgery trainee-specific data (i.e. excluding training of family practice or nurse endoscopists as reported by Ward et al (2, 13). Two studies incorporated simulator training at least for some trainees and four different criteria were used to assess competency for caecal intubation rate. Among these 18 studies, 10 studies used independent caecal intubation rate (ICIR) ≥90% only as indicative of competency, the threshold of ICIR ≥90% was reached by all trainees in 4 studies only (across a range of 141 to 305 IC). Of course, ileal intubation rate is the gold standard in paediatrics (24). Among 6 studies that used ICIR ≥90% in conjunction with a caecal intubation time limit (15-30 minutes depending on studies), competency was achieved in 5 studies in a range of 101 and 300 ICs, however, the definition of time for procedure depends very much on the local settings and that should be taken with caution and not be strictly used as a criterion for competence. In the study that used ICIR in conjunction with a total procedural time limit (35 minutes), competence was not achieved by any of the 6 trainees but three (50%) of them exceeded the ≥90% ICIR threshold by study end and had completed 203-263 ICs.

Two studies used comprehensive competency assessment tools. Using the Mayo IC skills assessment tool, validated in a previous study (25) scoring averages surpassed the minimal competency criteria for the assessment tool components after the completion of 275 ICs. Competency was achieved across all trainees at approximately 400 ICs. A definition of completely independent IC that incorporated multiple aspects of IC, including caecal intubation, polypectomy, and haemostasis: 90% independent IC completion was achieved at 467 ICs. Ileal intubation is particularly important in paediatric IC due to the more frequent indication of Crohn's disease/bleeding for IC in children vs. adults (24).

The available evidence suggests that the number of procedures needed to attain competency is likely significantly higher than current recommended guidelines. Due to a very large diversity of available settings, it is difficult to impossible for many/ most programmes to achieve even the cited numbers. The conundrum posed by these two opposing pieces of evidence suggests that it is sensible that "competency" be assessed using metrics taking suggested numbers as a guide but not as a fixed rule. Therefore, minimum number of procedures should be kept in mind but competence-based teaching may provide adequate experience without the formal definition of minimum numbers, if desired goals are achieved.

Q2. How can endoscopic competence during and at the end of training be assessed?

Recommendation 2. The ESPGHAN Endoscopy SIG suggests that internal and external assessors evaluate trainees' endoscopic competence during and at the end of training using formative and summative assessments with review of the collection of assessments as well as of the log book which must fulfil the specific paediatric curriculum competences and certification criteria. Therefore, the current DOPS concept is endorsed.

LoE: low

SoR: weak

Vote: 100% of agreement

Endoscopic competence has been defined as the minimum level of knowledge, skills, and expertise required to perform endoscopy safely and proficiently as an independent practitioner (26). At the beginning of the training we suggest a basic skills course which treats core knowledge about endoscopy in children (e.g. indication for endoscopy, complications, equipment specifics) as per ESPGHAN syllabus (4, 16, 17). Various skills are required to perform endoscopy independently, including technical, cognitive and communication skills.

Communication skills have recently been recognized as essential non-technical skills (NTS) and have now been included in assessment tools. They are deemed an essential component of practice - although a recent review in adult training suggested that a future validation tool will be required to identify and quantify the effect of NTS on outcomes (27). A recent study also looked whether or not paediatric endoscopists can accurately assess their clinical competency and found that novices were inaccurate in assessing their own endoscopic competence and were prone to overestimate their performances (18). Furthermore, external assessors assure objective and credible assessment of endoscopic skills of the trainees.

Table 2 summarizes the assessment levels of the Miller's pyramid and how these can be applied in the field of GI endoscopy (28). The assessment process in clinical competence can also be divided into 'formative' (process focused) at the beginning of training and 'summative' (outcome focused) towards the end of the training process (29). The various types of assessment tools available have been described in a recent review (11):

1. Quality metrics: These have been integrated in several guidelines because optimizing quality has become a major focus in the performance of endoscopic procedures (Table 1). Such metrics may assess technical skills (e.g. ICIR), interpretive/diagnostic skills (e.g. adenoma detection rate in adults), completion and withdrawal times and adverse event rates.

Logbooks, used by endoscopists to record their clinical experiences are a common assessment method. However, the objectivity and accuracy of these records have been questioned (30). The independent success rates of paediatric trainees at various stages of training have not been reported.

2. Simulators: performance during a simulated endoscopy is generally assessed by one of three means: automated simulator measurements; observational tools; and motion analysis. Some of these metrics have been shown to discriminate between novice, intermediate and "expert" endoscopists (the latter category having performed >200 procedures) in adults (31). Only one study in paediatric endoscopy has been reported and this showed a wide variability in skill acquisition but a significant uplift in the velocity of the training curve for the group who had received simulator training prior to starting procedures on actual patients (24).

3. Knowledge tests: although knowledge is necessary to perform safe endoscopy and may easily be tested in written or oral tests, validated assessments would be desirable but have not yet been reported for paediatric endoscopy.

4. Direct observation assessment tools:

The only direct observation assessment tool specifically validated in paediatric IC is the "Gastrointestinal Endoscopy Competency Assessment Tool for Paediatric Colonoscopy" (GiECATkids) (32). This tool consists of a 7-item global rating scale and 18-item checklist. It assesses technical as well as non-technical skills required for IC before, during and after the procedure (e.g. if the endoscopist acts in response to patient history, administers adequate sedation or communicates adequately with the anaesthesiologist, recognizes loop formation, educates the patient and/or caregiver about the colonoscopic findings). The validation study included 104 ICs performed by 56 endoscopists. It disclosed high inter-rater and test-retest reliabilities as well as a good discriminative power between novice, intermediate and advanced endoscopists. A recently published validation study of this tool demonstrated strong

reliability and validity as a measure of performance of paediatric IC. A recommendation would be that wide utilisation of this tool and similar validated tools should be employed to support training and assessment in paediatric endoscopy training (32, 33). E.g. summative DOPS assessments could consist of 10 OGDs and ICs each, with an attainment of at least 3 out of 4 in every domain (34, 35). A similar, but more technically-focused, assessment tool has been validated for OGD and IC in adults (36).

Non-validated assessment score sheets are also available from the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) (37). BSPGHAN and the JAG have developed paediatric formative and summative DOPS for OGD and IC available at http://www.thejag.org.uk/AboutUs/DownloadCentre.aspx. The first validation analysis for paediatric OGD and IC DOPS were recently published (23, 34). As competency test for endoscopy training we suggest formative and summative DOPS.

The authors of the present position paper think that it is important to asses competence on an appropriate case mix of patients' age/weight, including infants below 10 kg as this increases the procedure difficulty (38).

Q3. What is the role of web-based teaching?

Recommendation 3. The ESPGHAN Endoscopy SIG suggests that web-based learning allows for rapid dissemination of quality training material and best practice to a wide audience but does not replace face-to-face teaching of endoscopic skills.

LoE: moderate

SoR: weak

Vote: 100% of agreement

Web-based learning tools and social media are some of the most engaging and easy applications to use which facilitate learning across borders. The web-based learning tools allow access to the latest evidence-based literature, undertaking online learning modules, updating e-portfolio for on-the-job recording of progression and assessment and simulation for replication of acute scenarios. Social media has created a host of mobile-device applications such as YouTube, Facebook, Twitter and WhatsApp applicable to this area including the new excellent NASPGHAN Toolbox App (40).

A multicentre trial, assessing the learning curve and reproducibility of a simplified version of a classification for gastric magnification chromoendoscopy using a hybrid approach of CD-ROM/DVD and internet was evaluated (41). Three endoscopists prospectively and independently classified 10 of 20 selected non-consecutive endoscopic videos with at least 3 days apart. A web-based survey showed a substantial, although non-statistically significant, increase in intra- and inter-observer agreement and improved agreement with reference. A learning program based on visualisation of YouTube videos allowed 6 endoscopists to improve their accuracy in classifying gastric lesions using narrow band imaging. This programme, which took over 200 days, only showed an improvement in accuracy from 60 to 70% (42). Learning curves are considered efficient tools in monitoring workers' performance in repetitive tasks and were assessed in several studies in GI endoscopy (41, 43-48).

A recent study investigated the training efficacy of a computer-aided learning programme of capsule endoscopy lesion recognition skills. A full result was available for 27 out of 99 individuals and showed significant improvement in test performance after training ($p=0.037$) and positive feedback from trainees for training, test modules and usefulness (49, 50).

A randomised clinical trial was carried out assessing knowledge of endoscopy-related quality indicators (QIs) and the impact of web-based tutorial intervention among US American

trainees (51). 347 of 1220 trainees undertook the initial assessment with further 208 of 347 trainees taking the survey after randomisation. The baseline scores were similar in both groups (56.4% for tutorial and 56.9% for no tutorial) but showed improvement after intervention (65.4% for tutorial and 56.9% for no tutorial, P=0.003).

A systematic review assessing the effectiveness of an e-learning platform for teaching any surgical skill, compared to no intervention or another method of teaching showed e-learning as effective at least to other methods of training (52).

A randomised controlled trial evaluated the effectiveness of the e-learning system for improving the detection rate of early gastric cancer among endoscopists worldwide (53). The medical practitioners whose pre-test score was 80% or more were excluded as e-learning was aimed to provide training in the endoscopic diagnosis of early gastric cancer. 332 of 515 endoscopists were enrolled from various countries, 151 participants in e-learning and 181 in the non-e-learning group. There was a clinically significant improvement rate in the e-learning group. Also, e-learning was effective irrespective of pre-test score, the endoscopists' experience or geographical area.

e-learning platforms are increasingly being used by many national societies. e-learning for Healthcare (LfH) is a Health Education England programme in partnership with the NHS and professional bodies to support patient care by providing free, high quality e-learning for training and education of healthcare workers across the UK. It records user activity and builds a learning portfolio. The e-Endoscopy project is overseen by the JAG in GI Endoscopy and aligned with existing recommendations for endoscopy training in the UK.

Scientific PGHN societies have already provided several resources for web based learning and e.g. one of the main focuses of ESPGHAN is education in paediatric endoscopy with the

aim to further strengthen the cooperation with sister societies such as NASPGHAN and United European Gastroenterology (UEG).

The American Society of Gastrointestinal Endoscopy (ASGE) has introduced GI Leap, a new online learning platform with comprehensive access to clinical education videos, self-assessment tools, on-demand webinars and courses. The American Gastrointestinal Association (AGA) Institute Journals have a wide array of podcasts and video abstracts that allow learners to download journal content at any time. ESPGHAN collaborates with UEG for an educational e-learning program. It is difficult to measure or quantify the impact of UEG e-learning material but it has helped disseminating material to the GI community at large. There has been increase in page views, online users, awareness and engagement with the GI community (54).

Web-based materials have consistently demonstrated their efficacy with learner satisfaction with easy to access interactive multi-media. They also help to bring a change in knowledge or skills and practice performance. However, assessment of patient health outcomes is difficult, with only a few studies having examined these outcomes (55). In addition, experience and data from the American Board of Internal Medicine's Web-based Performance Improvement Modules and other activities have demonstrated participant satisfaction and improvements in knowledge and care processes (56, 57).

The only paediatric study assessing web-based teaching and patient health outcomes was sponsored by NASPGHAN. The NASPGHAN enlisted experts who developed maintenance of certification (MOC) web-based quality improvement modules for upper GI endoscopy, IC and informed consent for the American Board of Pediatrics MOC Part 4 credit. 134 participating paediatric gastroenterologists reported data from 6300 procedures, engaged in 3 data collection periods over a period of at least 4 months and self-reported their performance

and/or obtained parental survey responses on specified quality measures. Participants implemented individual behaviour changes and demonstrated significant improvements on most targeted processes and quality care outcomes (58).

Despite a widely recognised and evidence-based ability to enhance both teaching and learning, full web-based teaching potential is yet to be realised. There is anticipation of wider application of learning technologies to enhance training in endoscopy to benefit both trainees and educators (40). Medical knowledge is expanding and problem-based learning, often on web-based platform, is becoming an essential part of practice and should be encouraged (37).

Training programs may benefit from complementing practice-based learning with a more didactic curriculum for endoscopic performance and skills (58), however more evidence is required. Web-based educational supplements, but does not replace, face-to-face teaching of endoscopic skills. Web-based learning allows rapid dissemination of quality training material and best practice to a wide audience.

Q4. What is the role of simulator-based training?

Recommendation 4. The ESPGHAN Endoscopy SIG suggests that simulator-based training may be combined with conventional patient-based endoscopy training in the early phases of training and in therapeutic procedures.

LoE: moderate

SoR: weak

Vote: 100% of agreement

The use of simulators augments the technical and cognitive skills required to perform safe, high-quality endoscopy in a controlled, risk-free environment. Simulators comprise of mechanical models, explanted animal organ simulators, live animal models and more recently, virtual reality simulators. There are limited opportunities in paediatric endoscopic training programs to meet "competence threshold" numbers issued by scientific societies. Therefore, simulators could be a good addition to the individual endoscopy training program.

Two studies in paediatric endoscopy report on the use of a simulator during endoscopy training of trainees (59, 60). One study compares a group of trainees with virtual reality simulator training (Simbionix GI Mentor VR simulator) prior to IC training with a historic cohort without prior virtual reality simulator training (59). Comparison of rates of skill acquisition and lesion recognition revealed an acceleration of achievement of endoscopic goals in the group with prior exposure to virtual endoscopy. Another study demonstrated that computer-based endoscopy simulators may offer trainees the benefit of facilitating training while posing no additional risk to patients (60). The sessions on the simulator were perceived useful for endoscopic skills acquisition and were associated with reported improvement of colonoscopic skill and confidence.

In adult endoscopy training the additional value of virtual reality simulators is extensively investigated. The extensive systematic reviews have concluded that the use of validated virtual-reality simulators in the early training setting accelerates the learning of practical skills in trainees with limited or no prior endoscopic experience (61-64). Despite this recommendation the authors stated that the quality of the current evidence was low due to inadequate randomization, allocation concealment, and/or blinding of outcome assessment in several trials and that more studies are needed to examine the extent to which simulator training should be carried out (61-64).

Several virtual-reality simulators for IC in adults have been shown to have good validity (the AccuTouch Immersion Medical VR computer simulator, Simbionix GI Mentor VR simulator and Olympus Endo TS-1 colonoscopy simulator) and are recommended for use in initial training, preferably in a prepatient setting (63). Every training model has its advantages and disadvantages and is best suited to training specific tasks and levels of learners. However, we cannot formally recommend specific virtual reality simulators for endoscopy training, since there is not a comparative study between virtual reality simulators and the studies are too heterogeneous in methodology and endpoints measured to make a reliable head-to-head comparison of individual virtual reality simulators (63). There may be a role for simulators in complex procedures with low numbers (e.g. ERCP (endoscopic retrograde cholangiopancreatography) and other therapeutic endoscopic procedures) since there are validated models for these procedures. However, evidence is scarce on these topics. The diagnostic and therapeutic GI endoscopy skills learned within simulated setting have been shown to transfer to patient care (61-63, 65). There is little evidence on clinical outcomes of patients treated by simulator-trained endoscopists with regards to factors such as adverse events or satisfaction. Additionally, it is unclear whether the use of simulators can be used to maintain competence in endoscopy training (63). Simulation can be integrated into training and assessment in a thoughtful and purposeful manner to maximize its benefit. If the advantage of simulators could be consistently demonstrated, a cost-benefit analysis considering various scenarios (e.g., simulator renting) would be useful, given that the initial investment is considerable (66).

Q5. What are quality indicators for paediatric endoscopy?

Recommendation 5. The ESPGHAN Endoscopy SIG recommends to adopt standardisation and agreement of paediatric endoscopy quality indicators (QIs). LoE: low SoR: strong Vote: 100% of agreement

QIs allow comparison of actual performance against a standard defined by ideal performance or benchmarking thus enabling potential improvement in quality of care (67). These should correlate with clinically relevant end-points, be evidence based, able to demonstrate gaps in performance and be amenable to both measurement and improvement (67).

QIs in adult endoscopy are well established and involve measures of structure, process and outcome (68, 69). Recently, paediatric scientific societies (ESPGHAN and NASPGHAN) have worked on standardisation and agreement of paediatric QIs.

QIs relating to structure assess characteristics of the health care environment and for paediatric endoscopy and can include access to age appropriate equipment, endoscopy reporting systems, supportive anaesthetic, pathology and radiology services with paediatric expertise etc. QIs relating to process assess performance during the delivery of care and can include agreed policies such as those needed for managing patients with diabetes, adherence to guidelines for endoscope decontamination, use of time-out or WHO checklists pre-procedure coordinated by an endoscopy user group that meets regularly etc. QIs relating to

outcome assess the results of the care provided and can include completion rates, adverse events etc.

QIs may also be divided into three time periods: pre-procedure, intra-procedure and post-procedure (70). Pre-procedure QIs include appropriate indication of procedure, informed consent, risk assessment, timeliness etc. Intra-procedure QIs include all the technical aspects of the procedure including completion rates and safe use of sedation or anaesthesia with patient monitoring. Post-procedure QIs include procedural documentation with standardised reporting, appropriate post-procedure advice, appropriate follow up, patient satisfaction etc. (70). The standardised report should include an explicit indication for the procedure and in an IC report an assessment of the adequacy of bowel preparation – these represent two auditable QIs. Pain and anxiety management with basic monitoring and recording of patient comfort and pain levels before, during and after the procedure especially for procedures performed under sedation is important (71).

QIs may be flexible as evidence and practice evolves. Identified quality and safety indicators have been used to underpin the respective items of the Paediatric Endoscopy Global Rating Scale (P-GRS) in the UK. P-GRS is a QI tool launched in 2017, which amongst other measures also assesses the extent to which the audit cycle has been applied to the quality and safety indicators (72). Suggested paediatric procedural QIs include procedure completion rates such as caecal intubation and terminal ileal intubation rates, appropriate diagnostic biopsies based on best evidence, adequate bowel preparation for ICs and safety indicators that relate to complication rates. These are auditable outcomes for which there is some evidence base to help recommend a minimum standard, for example, ileal intubation rates in paediatric IC. As confirmation or exclusion of Inflammatory Bowel Disease is one of the main reasons for paediatric IC, ileal intubation is a clinically important and meaningful paediatric QI as compared to only using caecal intubation rates that are more relevant for adult endoscopists

in the context of bowel cancer screening. Caecal intubation rates are generally recommended to be >90% (69). Reported ileal intubation rates in recent paediatric literature vary from 84% to 98% (73-75).

A recent North American endoscopy clinical report proposed >90% ileal intubation rate as a quality metric for paediatric IC (76).

The paediatric IC certification criteria in the UK uses terminal ileal intubation rates of ≥60% and caecal intubation rates of ≥90% amongst other criteria for certifying paediatric gastroenterology trainees to perform independent IC (69).

A pre-procedure auditable outcome is the rate of adequate bowel preparation with a minimum standard of ≥90% and a target of ≥95% (77). The bowel preparation quality, assessed using an appropriate validated scale should be included in every IC report (77).

Standardisation and agreement of paediatric endoscopic QIs will allow a standard means of assessing quality, safety and patient centeredness of paediatric endoscopy services. NASPGHAN and ESPGHAN have contemporaneously produced a guideline on paediatric endoscopy QIs.

Q6. How can quality of endoscopy training be assured?

Recommendation 6. The ESPGHAN Endoscopy SIG suggests access to dedicated training lists, adoption of standardized tools for formative and summative assessments of trainees, a structured training curriculum and certification pathways, consistent endoscopy training practices and regular engagement with QI tools in order to ensure high quality endoscopy training.

LoE: low

SoR: weak

Vote: 100% of agreement

Endoscopy units should provide continuing high-quality training and assessment of training provision against appropriate standards. Recent reports suggest that numbers of procedures performed and the resulting competency of practitioners vary considerably between different endoscopy training programs (78-82). The evaluation of training and the assessment of trainees are therefore fundamental to ensure high quality training so that trainees progress appropriately in the development of their specific procedure-related competencies culminating in readiness for unsupervised independent practice. Both formative (process focused; at the beginning of training) and summative (outcome focused; towards the end of training) assessments may be used to monitor progression of trainees against training objectives and to provide an overall judgement of competence and readiness for independent practice (29).

In the UK, quality assurance of endoscopy services and training fall under the remit of the JAG in GI Endoscopy, which oversees adult and paediatric endoscopy services (69). The JAG DOPS are competence assessment tools, which are well established in adult endoscopy training (83) and more recently validity evidence supporting the paediatric gastroscopy DOPS has been published (34). DOPS are typically completed by one or more assessors observing the performance of a trainee with scores being recorded on the JAG Electronic Training System (JETS) e-portfolio (84). This feeds into the structured paediatric endoscopy certification pathway developed for paediatric gastroenterology trainees in the UK and requires attendance at JAG approved basic endoscopy skills courses in addition to achieving the certification criteria (69). An increasing uptake of JAG approved paediatric training the trainer courses helps trainers provide consistent and structured endoscopy training.

Other paediatric assessment tools developed include the GiECATKIDS tool, used for direct observational assessment of paediatric IC in North America (32).

Quality assurance in endoscopy training aims to assess the processes, which can help ensure trainees have access to training lists and receive appropriate training (85). The schedule with the endoscopy procedures in the theatre/ endoscopy suite performed by trainees should be dedicated, with an increased amount of time allocated to each patient to allow for training, and with a suitable number of cases and case mix. There should also be processes in place to maximize trainee exposure to emergency and urgent endoscopic procedures.

QI tools such as the endoscopy Global Rating Scale (GRS), a web based self- assessment QI tool, that enables units to assess how well they provide a patient-centred service, track their progress during QI and drive changes, was initially developed and implemented in the adult endoscopy services in England in 2004 (86). This also allowed units to develop action plans for improvement if gaps between current quality standards for training and the training provided were identified. The GRS has been adapted for use in the Dutch and Canadian adult endoscopy units. A P-GRS was piloted nationally successfully and launched in the UK in 2017 (35, 72, 87). The training domain in the P-GRS provides quality standards for the structure of training and enables endoscopy units in the UK to self-assess against those standards. It also tests whether endoscopy trainers have been appropriately trained and processes are in place to seek, review and act on trainee feedback (69).

National organizations such as the ASGE (14), the JAG (69), the Conjoint Committee for Recognition of Training in Gastrointestinal Endoscopy (88) and NASPGHAN (37) have proposed recommendations for endoscopy training. However, no homogeneity of training in paediatric gastroenterology, hepatology and nutrition currently exists across Europe.

Q7. What is the role of 'Train the Trainer' courses?

Recommendation 7. The ESPGHAN Endoscopy SIG suggests that trainers follow "train the trainer" courses to encourage a uniform approach to the teaching of endoscopy. LoE: low SoR: weak Vote: 100% of agreement

Endoscopy education has progressed significantly in recent years, evolving from the traditional model of 'see one, do one' to the current skilful application of sound educational principles (89). International 'train the trainer' courses encourage a uniform approach to the teaching of endoscopy (90). There is a lack of formal training for clinicians in teaching. Although it is a common assumption that competence in endoscopy confers an ability to teach it, experience in endoscopy is not an automatic surrogate marker for skill in teaching (91). Trainees are also often exposed to multiple teachers, which can limit the development of longitudinal relationships with endoscopy trainers, who themselves are under increasing time-efficiency demands (91). A single original study in adult GI endoscopy with 62 participants ("experts", trainers, nurse endoscopists and trainees) using the Delphi process proposed a list of attributes that describe good endoscopy trainers and an evaluation toolkit by which trainers could gain formative feedback on their performance (69). This study used as a starting point a proposed list of attributes that described the high quality trainer (92).

Development of 'Train the Trainer' courses enables a consistent and structured approach in teaching skill acquisition in endoscopic techniques and may help trainees in achieving competence efficiently and effectively. A core concept of this course is to be able to deconstruct the endoscopy technique and the development of 'conscious competence' both

for the procedure and training, enabling the endoscopy trainer to give performance enhancing instructions effectively and explicitly without always having to take over the endoscope, using common, consistent and concise language (91, 93). The 'Train the Trainer' course emphasises the importance of establishing a clear educational contract that includes specific, measurable, achievable, realistic and timely objectives within a training framework such as 'set-dialogue-closure' during a teaching episode and supports the delivery of performance enhancing feedback (91). Optimally, a trainer's ability in teaching endoscopy will be assessed by trainers, which is termed direct observation of trainer skills (DOTS).

Several years after the implementation of various measures including 'train the trainer' courses, a substantial improvement in the IC quality in adult gastroenterology was noted in the UK (94). Adoption of these courses can therefore improve endoscopic training skills, which ultimately may lead to significant improvements in quality outcomes (91). These courses have been essential for adult GI endoscopy trainers in the UK and are being implemented in other countries. A paediatric endoscopy 'Train the Trainer' course has also been developed and recommended for paediatric GI endoscopy trainers in the UK with increasing uptake since 2013 (95).

Excellent teaching is a fundamental component to ensure a high quality, motivated endoscopy workforce (92). Endoscopy trainers must learn how to perform trainee assessments looking at the key technical aspects for any endoscopic procedure systematically and consistently (96).

Q8. What is the role of training for therapeutic endoscopy?

Diagnostic competence in paediatric endoscopy is defined as the ability to recognize abnormalities and pathological features in the GI tract. Therapeutic competence is defined as the ability to manage and actively care for GI disorders with the endoscopic approach. This

part of the document will address the following issues, namely who/ when/ how to train for advanced endoscopy (level 3); which techniques can be learned; and how to assume cognitive competencies. Inclusive in this will be indications/contra-indications; equipment selection; risks; and management of adverse events.

The main challenge for training in these techniques is the number of patients encountered for therapy compared to diagnostic numbers in any one centre. Hence for a trainee to gain competency in these techniques inevitably will involve a number of possible avenues which may include: hands-on courses; e-learning modules; live endoscopy courses; virtual simulator models; learning in adult centres; and learning in large paediatric endoscopy centres identified by ESPGHAN as training centres.

Techniques and therapies such as not significant acute GI bleeding will not be in performed during the training of a 'level 1' endoscopist, except polypectomy. A 'level 2' endoscopist will, in addition, be trained to competently perform percutaneous endoscopic gastrostomy (PEG) insertion, stricture dilation, and variceal and non-variceal bleeding therapy. Other more sophisticated techniques will only be learned by a minority of trainees designated to attain 'level 3' training - aiming to practice in large centres once trained (e.g. ERCP, endoscopic ultrasound (EUS), PEJ placement, single balloon enteroscopy (SBE) or double-balloon enteroscopy (DBE), perforation closure, pancreatic cyst drainage, endo-mucosal resection, etc.). A trainee's competence should be measured by trainers at the end of their training using specific DOPS assessment tools – these have been developed for each therapeutic activity performed at endoscopy and can be accessed at https://www.thejag.org.uk. Clearly this competency-based assessment is better than stipulating a particular number of procedures required during training. In addition, a trained individual's skills should be regularly re-assessed especially if the procedure is infrequently performed in their day to day practice. Who and how often such assessments would be

performed is still a matter for debate. This is one of the main QIs in the very recent NASPGHAN-ESPGHAN Quality in Endoscopy Guideline.

The specific case of ERCP training deserves further critique as competency does require significant and regular exposure and a case can be made for this occurring in specialised centres with high throughput – potentially therefore this may only occur in one or just a handful of centres in each country.

Recommendation 8. The ESPGHAN Endoscopy SIG recommends that ERCPs and EUS as well as other sophisticated endo-therapeutic procedures in children be performed by skilled and experienced endoscopists in a limited number of tertiary care centres and with paediatric involvement. Learning curves in these advanced endoscopic techniques significantly vary between operators.

LoE: moderate

SoR: strong

Vote: 100% of agreement

ERCP is one of the most advanced therapeutic procedures in GI endoscopy in adults and children. ERCP is an operator-dependent procedure and training requires the development of technical, cognitive, and integrative skills well beyond those needed for standard endoscopic procedures. To perform ERCP independently, a period of dedicated training in a recognized training centre is required until technical competency is achieved. There are several ERCP training pathways. The duration of these pathways differs within and across countries.

EUS is another challenging level 3 endoscopic technique requiring advanced technical (choosing adequate equipment for age/weight; linear *vs.* curve scopes; blind scope intubation; positioning; structure recognition by ultrasound; therapeutic manoeuvres) and cognitive skills

(interpretation of findings; differential diagnosis; etc.), as well as expertise with ultrasonography. On top of these challenges, specific paediatric equipment is needed especially in infants (limited access, specific scopes only available as prototypes). EUS only has a few indications in paediatric GI pathologies, which significantly limit exposure to this modality outside large and very specialized units.

Recent evaluation in adults has shown a significant disparity in learning curves for ERCP and EUS amongst skilled endoscopists (97). Furthermore, ERCP and EUS procedures carry higher risk for adverse events compared to conventional endoscopy (87, 98). Training pathways may thus include familiarization with ultrasound appearance of paediatric GI pathologies by eg. learning to recognise normal organ structures by transabdominal ultrasound with paediatric radiologists or hands-on training in adults as well as paediatric patients and cognitive/interpretative courses.

Q9. Who provides paediatric endoscopies?

Recommendation 9. The ESPGHAN Endoscopy SIG suggests that endoscopic procedures in children be performed by endoscopists trained in paediatric gastroenterology with demonstrated procedure-specific competency. If not possible, endoscopy *could* be performed by a paediatric surgeon after they reached the minimum levels of competency required for a paediatric endoscopist (Table 1). If endoscopy is performed by an adult gastroenterologist/GI surgeon the procedure *must* be supervised and coordinated by a paediatrician/paediatric gastroenterologist.

LoE: moderate

SoR: weak

Vote: 93% of agreement

Three categories of paediatric endoscopy providers have been identified:

• Paediatricians with a sub-specialty training or special interest in paediatric gastroenterology, hepatology and nutrition (PGHN);

• Paediatric surgeons;

• Adult gastroenterologists/surgeons.

Paediatric and adult endoscopy are not one and the same. The size of the patient, procedural indications/contraindications, informed consent, psychological and emotional burden for children and parents/carers, bowel preparation, anaesthesia and sedation practices, adequately tailored equipment and importance of routine tissue sampling are just some of the unique characteristics that differentiate paediatric from adult endoscopy (99). For all these reasons, paediatric endoscopy should be an essential part of PGHN training as suggested by NASPGHAN guidelines for training in paediatric endoscopy (37).

Inspired by the NASPGHAN guidelines a consortium of paediatric gastroenterologists designed some valuable research in order to assess outcomes, complications and QIs of paediatric endoscopy performed by paediatric gastroenterologists (73, 100, 101).

Reports of endoscopy performed by paediatric surgeons (102, 103) are scarce and outcome or quality studies haven't been produced.

Two retrospective studies reported on the performance of paediatric endoscopy by adult gastroenterologists (104, 105). They included a total of 225 procedures, which accounted for <0.5% of endoscopic procedures performed in these centres. Satisfactory results were reported by the authors, who insisted on the necessity of close collaboration between paediatric and adult gastroenterologists performing paediatric endoscopy.

The quality of endoscopies performed by surgeons has been questioned in adults mainly for colon cancer screening (106, 107). No comparative study between paediatric surgeons and paediatric endoscopists can be found in the available literature.

Q10. Which levels of training competency exist?

Recommendation 10. The ESPGHAN Endoscopy SIG suggests three levels of competency to be acquired by the corresponding appropriate curriculum. All fully trained paediatric gastroenterologists should have at least completed level 1 training. LoE: low SoR: weak Vote: 100% of agreement

The 2013 NASPGHAN training guidelines define three levels of endoscopic competency (37):

All fully trained paediatric gastroenterologists should have at least completed level 1 training. Paediatric gastroenterologists who intend to perform advanced procedures should have fulfilled level 2 and/or level 3 training as recommended in Table 3.

Level 1 PGHN trainees should be capable to perform mainly diagnostic endoscopic procedures independently, including polypectomy. Level 2 training includes straightforward therapeutic techniques procedures such as endoscopic control of variceal and non- variceal bleeding, endoscopic dilations, endoscopic deployment of a video capsule endoscopy (VCE), and transpyloric feeding tube insertion. Level 3 training is considered advanced training for specialized endoscopic procedures such as ERCP, endoluminal stent placement, DBE and

EUS, etc. In addition to performing the procedures, competency also includes understanding the indications, interpretation and integration of findings or therapy into the management plan and awareness of potential complications and their treatment.

The procedural volume of some procedures recommended to achieve competency is noted in Table 1.

The majority of level 1 and level 2 training should be performed in paediatric patients. In centres with a low procedural volume it may be necessary for the trainee to gain additional experience in adult patients or in more specialized centres. Initial level 3 training may be done in adult patients but paediatric experience is necessary to achieve the required competency.

Q11. What is the role of a paediatric endoscopy curriculum?

Recommendation 11. The ESPGHAN Endoscopy SIG recommends that the endoscopy training programme, which must be an integral part of PGHN training, must include evidence of ability to perform diagnostic and therapeutic endoscopy independently.

LoE: low

SoR: strong

Vote: 93% of agreement

Endoscopic procedures are an integral part of the practice in paediatric gastroenterology and training occurs during a formalized paediatric gastroenterology traineeship. The duration of the training programs varies from 18 months to 4 years. The aims of formal paediatric

endoscopy training are based on the principles and practice of safe endoscopy. There are differences between adult and paediatric practice.

Paediatric endoscopy training programs are obliged to ensure that trainers are competent to deliver high-quality endoscopic care at completion of training. The endoscopy skills curriculum consists of cognitive, associative and autonomous stages. Competence also includes the acknowledgment of the complexity of paediatric gastroenterology disease (pancreatic and biliary disorders, motility disorders, inflammatory bowel disease, short bowel syndrome and intestinal failure). An important aspect of paediatric gastroenterology practice is the ability to perform endoscopy procedures safely, effectively, and efficiently (13, 37, 108).

Paediatric GI fellowship should be financially supported using all possible options in large paediatric centres as well as in adult units. In a recent survey of ESPGHAN trainee members across Europe it was reported that 26% of PGHN trainees received endoscopy training by adult endoscopists during their fellowship. General skills to perform endoscopy in children include technical strategies such as scope advancement and loop-reduction techniques, as well as cognitive competence to insure correct clinical indications for endoscopy and appropriate follow-up.

Endoscopy competency is recognized as a continuum. The Federation of International Societies of Paediatric Gastroenterology, Hepatology and Nutrition (FISPGHAN) is working to establish a worldwide curriculum for paediatric endoscopy (69, 109).

Q12. How can competencies be maintained?

Recommendation 12. The ESPGHAN Endoscopy SIG suggests that paediatric endoscopists should have objective assessment of competence in paediatric endoscopy. LoE: low SoR: weak Vote: 100% of agreement

Training in adult and paediatric endoscopy is moving from threshold numbers for the assessment of competence towards a more personalized continuous assessment with a validated assessment tool (63). The discussion in the literature on training in endoscopy is focused on trainees gaining competence in endoscopy. As this personalized method of training becomes clearer for gaining competence in endoscopy, the same model is now proposed for the evaluation of all endoscopy training; from novice to competence to excellence (63).

Within ESPGHAN maintaining competency in paediatric endoscopy is challenging. Some paediatric endoscopy departments have limited numbers of procedures but frequently supervise trainees. Once an endoscopist has gained competence in endoscopy it is difficult to move towards excellence as the endoscopist has to share the procedural volume with his colleagues and the trainees. Furthermore, a competent endoscopist becomes quickly a trainer for the trainees. Continuous upgrading of guidelines can lead to an experienced but outdated endoscopist. The rules for maintaining competence in endoscopy are not centrally guided within ESPGHAN as the National Societies are responsible for this task. Independent endoscopists should keep abilities along quality indicators and address deficiencies. Failure to do so impacts the societal goal of improving quality of care in children. Remediation options

include (1) to ask for supervision when performing specific endoscopy techniques and (2) to follow a re-training opportunity such as a hands-on-course addressing specific deficiencies.

However, there are no data on how to maintain competence in endoscopy within the ESPGHAN countries.

In summary, we feel that there is a need for more clarity on how to maintain competence in paediatric endoscopy within ESPGHAN. We, as well as others, suggest that the same training model for trainees is used for the evaluation of the entire endoscopy training (including certification of maintenance) (63). In this model, specific factors for paediatric endoscopists should be considered such as the limited numbers of endoscopies and the wide variation of practises among various paediatric endoscopists and centres (58).

Furthermore, there is a need for a structured training to attain excellence in endoscopy. Within ESPGHAN, there is a trend towards accreditation in endoscopy by the creation of centres of excellence. The re-certification at these centres is a good model for training, and the use of simulators could also contribute to the maintenance of competence, especially for therapeutic endoscopic skills.

Q13. What is the role of the National PGHN Societies?

The present role varies enormously between countries. Some play an active role in training and act as the conduit between regulatory bodies and the trainees with a strong curriculum framework, whereas in others the numbers of active members are too small to allow this to happen. At the moment there are no legal grounds for ESPGHAN to act as licensing authority. However, it is envisaged that the new ESPGHAN Council Member with a responsibility for drawing these National PGHAN Society Presidents together will be able to act in disseminating the training ideals that are set out in this document and in the future provide a platform upon which regulatory assessment may be planned. As in the North American model an exit exam may become the norm in Europe and the National PGHAN

Societies may become pivotal in this area specific to endoscopy as well as to the whole of the theoretical curriculum. This is needed.

DISCLAIMER:

"ESPGHAN is not responsible for the practices of physicians and provides guidelines and position papers as indicators of best practice only. Diagnosis and treatment are at the discretion of physicians".

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Figure 1: Framework for the integration of assessment throughout the endoscopy learning cycle (reproduced from Walsh CM (11)).

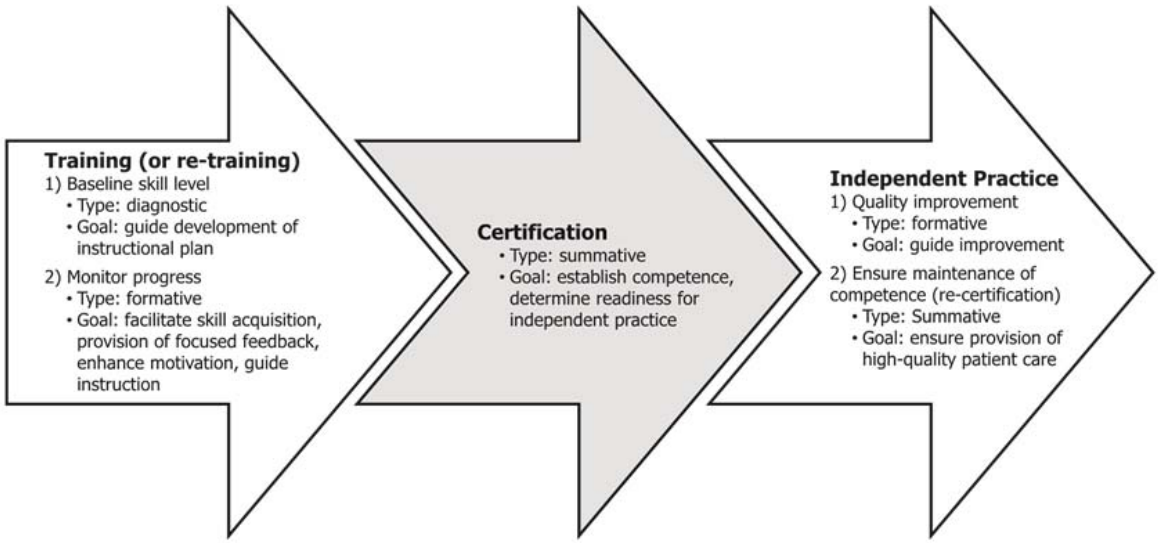

Table 1. Recommendations of minimal training requirements in paediatric endoscopy

(modified from Walsh CM (39)).

Professional organization	**Country**	**Lower GI Endoscopy**		**Upper GI endoscopy**	
		Competence threshold (number of required procedures)	**Other requirements**	**Competence threshold (number of required procedures)**	**Other requirements**
North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN) (37)	North America	**120** 10 snare polypectomies	120 ileocolonoscopies (ICs) or consistent caecal intubation ≥90 % by the end of fellowship training	**100** (10 with foreign body removals and 15 with control of bleeding (variceal or nonvariceal) with various methods[a] and/or IC with control of bleeding)	
Joint Advisory Group (JAG) in GI Endoscopy Paediatric Certification (British Society for Paediatric Gastroenterology, Hepatology and Nutrition (BSPGHAN) Endoscopy Working Group) (19)	UK	**100**	ICIR>60 % Caecal intubation >90 % Formative direct observation of procedural skills (DOPS) >90 % 3s + 4s (>10 DOPS) Serious complications	**100**	Intubation of second part of the duodenum >95 % Retroflexion>95 % Unassisted physically >95 % Formative DOPS >90 % 3s + 4s (minimum 10

			<0.5 %[b] Attended "Basic Skills Course Lower GI Endoscopy" Summative assessment (≥2 assessors, ≥2 procedures)		DOPS) Attended "Basic Skills Course in Upper GI Endoscopy" Summative assessment (≥2 assessors, ≥2 procedures)
Conjoint Committee for Recognition of Training in Gastrointestinal Endoscopy (88)	Australia	**100** (≥75 % in paediatric patients, some polypectomy experience)	Caecal intubation rate ≥90 %	**200** (≥100 in paediatric patients, ≥10 therapeutic procedures of which ≥5 involve control of upper GI haemorrhage)	
European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) (4)	Europe	**not specified**	Not specifically defined	**not specified**	Not specifically defined

BSPGHAN: British Society of Paediatric Gastroenterology, Hepatology and Nutrition; DOPS: direct observation of procedural skills; ESPGHAN: European Society for Paediatric Gastroenterology, Hepatology and Nutrition; GI: gastrointestinal; IC: ileocolonoscopy; ICIR: independent caecal intubation rate; JAG: Joint Advisory Group; NASPGHAN: North American Society for Pediatric Gastroenterology, Hepatology and Nutrition.

[a]Methods to control bleeding may include injection, band ligation, electrocautery (e.g., heater probe, multipolar probe, argon plasma coagulator, loop application, haemostatic clips), or additional methods as they become available.

[b]Serious complications are defined as death, perforation, significant bleeding requiring transfusion, unplanned post-procedure hospital stay of over 24 hours (related to the procedure) or admission to hospital due to a complication of the procedure following discharge from the endoscopy Unit. Complication rates are comparable with those reported in the literature: perforation rate <1/500 for all patients and <1/1000 for patients undergoing screening; postpolypectomy bleeding rate <1%.

Table 2. Assessment levels according to Miller's pyramid and potential assessment methods in the field of gastrointestinal endoscopy skills (reproduced from Walsh CM (39)).

Assessment level	Assessment construct	Assessment method
Does	Knowledge, skills, and attitudes integrated in context	Performance integrated into practice (e.g. direct observation, practice portfolio, workplace-based assessments)
Shows how	Integrated knowledge, skills, and attitudes	Demonstration of learning (e.g. simulation, standardized patient-based tests)
Knows how	Applied knowledge	Clinical context-based tests (e.g. problem-based scenarios, extended matching multiple choice questions)
Knows	Knowledge	Factual tests (e.g. multiple choice questions, short answers)

Table 3. Recommended endoscopic procedures in order to obtain competency.

Level 1 (routine)	Level 2 (complex)	Level 3 (advanced)
Mainly diagnostic:	**Straightforward therapeutic techniques:**	**More advanced techniques at a major centre:**
Diagnostic OGD	PEG	Single stage PEG
Diagnostic IC	Oesophageal dilation with bougies and balloons with or without topical application of Mitomycin C	Diagnostic and therapeutic endoscopic retrograde cholangiopancreatography (ERCP)
Polypectomy	Foreign body removal	Endoscopic ultrasound (EUS)
	Haemostasis with all techniques except OTSC but including Hemospray®, argon plasma coagulation (APC), bipolar and monopolar electrocautery, endoclips, thrombin application and variceal techniques	Pancreatic cyst drainage with cystotome
	Variceal banding	double-balloon enteroscopy (DBE), single balloon enteroscopy (SBE)/lap-assisted enteroscopy
	PEGJ	Endoscopic mucosal resection (EMR)
	Achalasia balloon dilation	Endoscopic subserosal resection (ESSD)
	Video capsule endoscopy (VCE)	Peroral endoscopic myotomy (POEM)
		Duodenal web division by endoknife
		Pyloric stenosis division by endoknife and balloon dilation
		Oesophageal stricture/stenosis pre-dilation with incision by endoknife
		Laparoscopic assisted percutaneous endoscopic jejunostomy (LAPEJ) (with lap surgeon)
		Injection of botulinum toxin into pyloric canal or ampulla of Vater
		Colonic stricture dilation with or without topical application of Mitomycin C

		OTSC to close fistulae
		Full thickness biopsy with the OTSC system
		Excision and division of oesophageal congenital lesions such as webs, diverticuli and congenital stenoses
		Injection of 'tissue glue' in to oesophageal-respiratory tree fistulae in order to promote closure
		Histoacryl glue injection to fundal varices
		Advanced forms of endo-diagnostic techniques including confocal endomicroscopy
		Retro-endoscopic per-PEG endoscopic dilation of oesophageal strictures
		Non-general anaesthesia PEG placement in patients with critically poor respiratory reserve e.g. end-stage Duchenne muscular dystrophy

APC: argon plasma coagulation; DBE: double-balloon enteroscopy; EMR: endoscopic mucosal resection; ERCP: endoscopic retrograde cholangiopancreatography; ESSR: endoscopic subserosal resection; EUS: endoscopic ultrasound; IC: ileocolonoscopy; LAPEJ: laparoscopic assisted percutaneous endoscopic jejunostomy; OGD: oesophagogastroduodenoscopy; OTSC: over-the-scope-clip; PEG: percutaneous endoscopic gastrostomy; PEGJ: percutaneous endoscopic transgastric jejunostomy; POEM: peroral endoscopic myotomy; SBE: single balloon enteroscopy; VCE: video capsule endoscopy