Comparing Quality, Safety, and Costs of Colonoscopies Performed by Nurse vs Physician Trainees


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BACKGROUND & AIMS: We evaluated the quality and safety of colonoscopies performed by nurse and physician endoscopy trainees as well as the cost differences.

METHODS: We performed a study of 7 nurse and 8 physician (gastroenterology fellows) endoscopy trainees at 2 medical centers in the Netherlands from September 2008 through April 2012. At the beginning of the study, the subjects had no experience in endoscopy; they were trained in gastrointestinal endoscopy according to the regulations of the Dutch Society of Gastroenterology, performing a minimum of 100 colonoscopies. Each trainee then performed 135 consecutive colonoscopies (866 total by nurse trainees and 1080 by physician trainees) under supervision of a gastroenterologist; the colonoscopies were evaluated for quality and safety. We performed statistical analyses of data, assessing multilevel and cost minimization. The mean age of the patients was 57 years, and about half were women in each group.

RESULTS: The endoscopic quality and safety were comparable between nurse and physician trainees. Overall rates of cecal intubation were 95% for nurses and 93% for physicians (P = .38), including procedures that required assistance from a supervisor; mean withdrawal times were 10.4 and 9.8 minutes, respectively (P = .44). Each group detected 27% of adenomas and had a 0.5% rate of complication. In both groups, the rates of unassisted cecal intubation gradually increased with the number of colonoscopies performed, from 70% for nurses and 74% for physicians at the beginning to 89% and 86%, respectively, at the end of the assessment period. Using a strategy in which 1 gastroenterologist supervises 3 nurses, the personnel costs decreased from $64.65 to $54.58.

CONCLUSIONS: In a supervised setting, nurse endoscopists perform colonoscopies according to quality and safety standards that are comparable with those of physician endoscopist and can substantially reduce costs.

Keywords: Colonoscopy Screening; Nurse Endoscopist; Quality Assessment.

In the Western world, colorectal cancer (CRC) is the third most commonly diagnosed cancer and the second leading cause of cancer-related death.1 Screening for CRC with the removal of adenomatous polyps has been shown to reduce the incidence of and mortality caused by CRC.2,3 This has led to the introduction of CRC screening programs in many countries over the past years.4,5 Regardless of the chosen strategy, any CRC screening program considerably increases the demand for colonoscopy.6–8 However, in many countries, the

Abbreviations used in this paper: ASA, American Society of Anesthesiologists; CRC, colorectal cancer; GI, gastrointestinal; NE, nurse endoscopist; PE, physician endoscopist.
colposcopy capacity is insufficient to meet this projected increase in demand, which serves as a barrier to CRC screening.\(^7\)\(^-\)\(^1\)\(^1\)

Training of nurse endoscopists (NEs) may expand the colonoscopy capacity. The introduction of NE training and performance in gastrointestinal (GI) endoscopy was first reported in 1977 by the Mayo clinic.\(^1\)\(^2\) Subsequent studies showed that NE were competent in performing upper GI endoscopy as well as sigmoidoscopy. These results formed the basis to advocate the involvement of NE in GI endoscopy services in several Western countries.\(^1\)\(^3\)\(^-\)\(^1\)\(^6\) Their involvement in endoscopy subsequently expanded to colonoscopy.\(^7\)

To date, however, only 4 studies have investigated the quality of colonoscopies performed by NE.\(^1\)\(^7\)\(^-\)\(^2\)\(^0\) These studies suggested that NE could become competent colonoscopists, but they were mostly small, single-center studies and did not compare the performance of NE with physician endoscopists (PEs). Therefore, the aim of the present study is to compare endoscopic quality, safety, and costs of nurse- and physician-trainee performed colonoscopy in a large, multicenter, prospective cohort study.

\section*{Methods}

Hospitals in the Netherlands, interested in introducing NE, were invited to participate in this multicenter prospective cohort study. In the Netherlands, the Health Care Professionals Law authorizes nurses to be trained in and perform specific delegated tasks, provided that the tasks are performed according to quality standards and under prespecified supervision.\(^2\)\(^1\) Each participating hospital recruited at least one NE from the pool of nurses working at their GI endoscopy unit. In addition, consecutive PE were enrolled from the group of GI fellows who, after a 2-year training in internal medicine, entered the 4-year course of gastroenterology training under the auspices of the departments of Gastroenterology and Hepatology of the Erasmus University Medical Center Rotterdam and the Maastricht University Medical Center. The study took place between September 2008 and April 2012.

At baseline, the NE and PE included in the study were without any endoscopic experience. All enrolled endoscopists obtained formal training in GI endoscopy according to the standards as laid down in the regulations of the Dutch Society of Gastroenterology.\(^2\)\(^2\) The trainees were trained in and assessed for theoretical knowledge and technical skills. Basic hand skills were trained with the use of computer simulators (Olympus and Symbionix).\(^2\)\(^3\)\(^,\)\(^2\)\(^4\) Further technical skills were acquired by hands-on teaching from acknowledged GI endoscopy trainers. Initially, trainees only observed procedures, followed by attempting the less-demanding aspects of GI endoscopy, and gradually progressing to performing the entire procedure, including specific interventions. The trainees performed upper and lower GI endoscopies, including a minimum of 100 colonoscopies each. All training endoscopies were performed under direct supervision of a gastroenterologist, meaning that the gastroenterologist was present in the endoscopy room during the whole procedure. Instructions were given, and interference and assistance took place when necessary.

Colonoscopies were performed with or without moderate sedation (using midazolam and/or an opioid) at the discretion of the patient and endoscopist using the preparation and techniques according to the protocols of the participating hospitals as endorsed by the Dutch Society of Gastroenterology. With the NE, the supervising gastroenterologist administered the sedative medication. In addition, all endoscopists were trained to remove diminutive (1–5 mm) and small polyps (6–9 mm). Large polyps (≥10 mm) were removed by the supervising gastroenterologist.

After completion of the basic training, including at least 100 colonoscopies, each endoscopist next performed 135 consecutive colonoscopies, which were assessed for endoscopic quality and safety. These 135 colonoscopies per endoscopist were used to compare the performance of NE and PE. At this stage, the endoscopists were expected to progress through stages of decreasing supervision, extending from the initial complete direct supervision to a phase of partial indirect supervision. In the latter phase, the supervising gastroenterologist was not necessarily constantly present in the room but was present at the endoscopy unit and immediately available on demand for technical or diagnostic advice and assistance.

Colonoscopies were performed in patients referred for diagnostic colonoscopy and included asymptomatic and symptomatic patients. Patients were, in order of appearance, allocated to colonoscopy lists by secretarial staff of the endoscopy units, and the NE and PE were randomly assigned to a program without any prior insight in the details of the program and the patients on the list. Patients younger than 18 years or specifically referred for therapeutic procedures were allocated to expert endoscopist programs. All patients underwent a preprocedural assessment by a physician who was familiar with the patient and the procedure. The physical status of each patient was assessed using the American Society of Anesthesiologists’ (ASA) classification system. Patients were informed about the indication; preparation; the endoscopy itself; and possible interventions, including its benefits, risks, and limitations as well as possible alternatives. Informed consent was obtained, including consent for performing the colonoscopy with or without sedative/analgesic medication. Immediately prior to the procedure, the endoscopist performed a brief reassessment of the referred patient.
Endoscopist, Patient, and Procedure Characteristics

At baseline, the endoscopists’ demographics were obtained, including age, sex, and education. All endoscopists were required to maintain an accurate portfolio of their experience. All performed procedures were recorded on standardized data collection forms, supplemented by validated evaluation sheets and endoscopic skill assessment forms that have been recently validated in a similar form.25

Furthermore, data were obtained from endoscopy procedure reports and electronic medical records. The following patient and procedure characteristics were assessed: patient demographics; referrer; indication for the procedure; premedication; bowel preparation; reach of the procedure; whether cecal intubation was successful or not; cecal intubation time; withdrawal time; number of detected lesions; need for supervision with cecal intubation or any intervention, such as polypectomy; and complications. Information on the histology of the lesions that were removed during endoscopy was obtained from pathology reports.

Statistical Analysis

Descriptive statistics were used to analyze and report the data. Unassisted cecal intubation was defined as having reached the cecum without assistance from the supervising gastroenterologist. The cecal intubation time was defined as the time from insertion of the colonoscope into the rectum until identification of the cecum. The withdrawal time was the time needed from cecal identification to withdrawal of the endoscope from the anus. The mean withdrawal times were calculated with exception for the time needed for removal of the polyps.26 The total time was defined as the time from insertion of the colonoscope until withdrawal from the anus, including the time needed for interventions and waiting times for supervision. The polyp and adenoma detection rates were defined as the percentage of colonoscopies with polyps and adenomas, respectively. Generalized estimating equations were used for a 2-level analysis to compare the outcome parameters in 2 groups while correcting for the individual endoscopists nested within the groups.

In a generalized linear mixed model (specifically a form of logistic regression for longitudinal data), we compared cecal intubation rates between the 2 groups over the course of the assessment period. In this model, the variables group and number of endoscopies were used as independent variables, and the interaction between these 2 was also included. The variable number of endoscopies was modeled by a 3\( ^{st} \) spline with 2 knots. Correlations between the repeated measurements of endoscopists were accounted for by including a random intercept term for the endoscopists.

In addition, cost minimization analyses were performed to compare personnel costs between PE colonoscopy and a scenario whereby one gastroenterologist supervises multiple NE. Cost calculations were based on 234 workable days per year and 8 working hours per day, using the salary schemes of university hospitals in the Netherlands. Regarding NE, we used the mean examination time per colonoscopy of 30 minutes. A total of 3744 colonoscopies could be performed per unit per year. In the case of gastroenterologists, we estimated 25 minutes examination time per colonoscopy and 4492.8 performed colonoscopies per unit per year. Since we focused on cost differences, we ignored any nonpersonnel costs (material, investments, maintenance expense, and overhead costs), which we assumed were similar in both scenarios.

The primary outcome measurement of the study was the adenoma detection rate. The sample size was chosen based on a presumed adenoma detection rate of 25%. In order to yield 80% power to detect a 5% decrease in adenoma detection (1-sided type I error of 5%), we aimed to recruit 6 NE and 6 PE performing 862 colonoscopies per group.

Statistical analysis was performed using the SPSS 20 program (SPSS Inc, Chicago, IL). The institutional review boards of the participating centers approved the study.

Results

Endoscopist, Patient, and Procedure Characteristics

A total of 7 NE and 8 PE from 8 Dutch hospitals participated in this study. Most NE were women (men/women, 1/6), whereas PE had an even sex ratio (men/women, 4/4). The median age was 32 years for both NE and PE (range 27.4–49.2 for NE and 29.7–34.6 for PE, \( P = 1.87 \)). All endoscopists completed the training, including a minimum of 100 performed colonoscopies each.

The number of upper and lower GI endoscopies that was performed during the training period by NE and PE are shown in Table 1.

After having finished the training part of the study, each endoscopist performed 135 colonoscopies in consecutive patients who were planned for colonoscopy.

Table 1. Upper and Lower GI Endoscopies Performed by NE and PE During the Training Period

<table>
<thead>
<tr>
<th>Endoscopies during training period, median (range)</th>
<th>NE (n = 7)</th>
<th>PE (n = 8)</th>
<th>( P ) value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastro/sigmoidoscopies</td>
<td>0 (0–203)</td>
<td>358 (211–559)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Colonoscopies</td>
<td>100 (100–200)</td>
<td>114 (100–200)</td>
<td>.54</td>
</tr>
</tbody>
</table>

*Mann-Whitney U test
In total, 1946 out of the planned 2025 colonoscopies (135 consecutive colonoscopies per endoscopist) (96%) were performed and assessed for competency, the remaining 79 (4%) colonoscopies were not performed because one NE dropped out. Of the 1946 colonoscopies, 866 (45%) were performed by NE and 1080 (55%) by PE. The patient and procedure characteristics of the colonoscopies are shown in Table 2. The patients’ age and sex were similar in both groups, with a mean patient age of 57 years and an approximate 50/50 male/female distribution. However, NE patients had ASA risk scores I or II more often (98% vs 91% \( P < .01 \)) and were more often referred for symptomatic indications (76% vs 66%, respectively \( P < .01 \)). Moderate sedation with midazolam, with or without pethidine/fentanyl, was administered to 99% of the NE patients and to 92% of the PE patients \( P < .01 \). Bowel preparation was excellent or good in approximately 80% of the NE and PE patients \( P = .29 \).

### Endoscopic Performances

Table 3 summarizes the endoscopic performance of the endoscopists in both groups. Endoscopic quality and safety were comparable between NE and PE. The overall

<table>
<thead>
<tr>
<th>Performance Parameter</th>
<th>NE (n = 7) (866 colonoscopies)</th>
<th>PE (n = 8) (1080 colonoscopies)</th>
<th>( P ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cecal intubation rate</td>
<td>n = 804</td>
<td>n = 1023</td>
<td>.04</td>
</tr>
<tr>
<td>Unassisted</td>
<td>77%</td>
<td>88%</td>
<td>.38</td>
</tr>
<tr>
<td>Overall</td>
<td>95%</td>
<td>93%</td>
<td>.52</td>
</tr>
<tr>
<td>Mean cecal intubation time, min (SD)</td>
<td>12.2 (5.8)</td>
<td>11.5 (6.0)</td>
<td>.44</td>
</tr>
<tr>
<td>Mean withdrawal time, min (SD)</td>
<td>10.4 (4.2)</td>
<td>9.8 (4.3)</td>
<td>.82</td>
</tr>
<tr>
<td>Mean total time, min (SD)</td>
<td>29.8 (11.2)</td>
<td>30.3 (12.4)</td>
<td>.68</td>
</tr>
<tr>
<td>Polyp detection rate (%)</td>
<td>45</td>
<td>44</td>
<td>.93</td>
</tr>
<tr>
<td>Adenoma detection rate (%)</td>
<td>27</td>
<td>27</td>
<td>.68</td>
</tr>
<tr>
<td>Carcinoma detection rate (%)</td>
<td>3</td>
<td>4</td>
<td>.99</td>
</tr>
<tr>
<td>Complications</td>
<td>n = 859</td>
<td>n = 1079</td>
<td>.99</td>
</tr>
<tr>
<td>No complications</td>
<td>855 (99.5%)</td>
<td>1074 (99.5%)</td>
<td>.33</td>
</tr>
<tr>
<td>Bleeding</td>
<td>3 (0.3%)</td>
<td>1 (0.1%)</td>
<td>.82</td>
</tr>
<tr>
<td>Perforation</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>.44</td>
</tr>
<tr>
<td>Cardiorespiratory</td>
<td>1 (0.1%)</td>
<td>4 (0.4%)</td>
<td>.68</td>
</tr>
</tbody>
</table>

*Only colonoscopies without intervention and without needed supervision included in calculation.

*Mean total time of colonoscopies, including time needed for intervention and waiting times for supervision.
cecal intubation rates (including those procedures whereby assistance from a supervisor was necessary) were 95% and 93% ($P = .38$), mean cecal intubation times were 12.2 and 11.5 minutes ($P = .52$), and mean withdrawal times were 10.4 and 9.8 minutes, respectively ($P = .44$). The mean total times of the procedures (including the time needed for interventions and the waiting times for supervision) were 29.8 and 30.3 minutes in NE- and PE-performed colonoscopies, respectively ($P = .80$).

During the assessment period, in both groups, the unassisted cecal intubation rates gradually increased with the amount of colonoscopies performed (Figure 1). In both NE and PE, the spline significantly increased from the beginning of the assessment period toward the end ($P < .01$). Compared with PE, NE had lower unassisted cecal intubation rates in the beginning of the assessment period (70% vs 74%, respectively); also during the assessment, they were less than those of the physicians. Toward the end, the 2 splines converged (89% for NE and 86% for PE, respectively), although the differences between the 2 groups were at no point in time statistically significant.

A total of 1597 lesions were detected during the assessment period. The polyp detection rates were 45% for colonoscopies performed by NE and 44% for colonoscopies performed by PE ($P = .82$). Adenoma detection rates were 27% for both NE and PE ($P = .93$). The mean adenoma number per positive procedure was 2.2 and 1.8 for NE and PE, respectively ($P = .14$). The details on the histology of all removed polyps are shown in Table 4.

Complication rates were 0.5% (4 of 866) and 0.5% (5 of 1080) ($P = .99$), respectively. There were 4 complications (0.5%) in 859 colonoscopies performed by NE: 3 patients suffered from rectal bleeding following

<table>
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<th>Table 4. Polyps Detected During Colonoscopy</th>
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<tbody>
<tr>
<td><strong>NE (n = 7) (866 colonoscopies)</strong></td>
</tr>
<tr>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>No polyp detected</td>
</tr>
<tr>
<td>Polyp detected</td>
</tr>
<tr>
<td>Total number of polyps detected</td>
</tr>
<tr>
<td>Not removed, n (%)</td>
</tr>
<tr>
<td>Removed, n (%)</td>
</tr>
<tr>
<td>Histology of removed polyps</td>
</tr>
<tr>
<td>Normal tissue, n (%)</td>
</tr>
<tr>
<td>Pseudopolyp, n (%)</td>
</tr>
<tr>
<td>Hyperplastic polyp, n (%)</td>
</tr>
<tr>
<td>Adenoma, n (%)</td>
</tr>
<tr>
<td>Carcinoma, n (%)</td>
</tr>
<tr>
<td>Other, n (%)</td>
</tr>
<tr>
<td>Missing, n (%)</td>
</tr>
</tbody>
</table>

Figure 1. Learning curves (including 95% confidence intervals) of NE (red) and PE (blue). The graphs represent the unassisted cecal intubation rates in the course of the assessment period.
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Table 5. Cost Minimization Scenario to Compare Personnel Costs Between Colonoscopy Performed by a Gastroenterologist and a Scenario Where 1 Gastroenterologist Supervises 3 NEs

<table>
<thead>
<tr>
<th></th>
<th>Gastroenterologist</th>
<th>NE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastroenterologist</td>
<td>(9614 × 12 × 1.08 × 1.37)/ (45.59/3 NE) = 4492.8 = €37.99 × 1.08 × 1.37/9744</td>
<td>€15.20</td>
</tr>
<tr>
<td>NE</td>
<td>(2744 × 12 × 1.08 × 1.37)/9744 = €13.01</td>
<td></td>
</tr>
<tr>
<td>Nurse</td>
<td>(2744 × 12 × 1.08 × 1.37)/4492.8 = €10.84</td>
<td>€13.81</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>€48.83</strong></td>
<td><strong>€41.22</strong></td>
</tr>
</tbody>
</table>

polyectomy, and 1 patient developed bradycardia and hypotension during the colonoscopy. Five complications (0.5%) occurred in the PE group: 1 patient had post-polypectomy bleeding, and 4 patients developed cardiorespiratory symptoms during the colonoscopy resulting in 2 admissions (1 patient developed atrial fibrillation with heart failure and another patient, severe tachycardia >170/min).

Costs

Costs were compared in a cost-minimization analysis comparing colonoscopies performed by either a gastroenterologist or by an NE (in a scenario whereby 1 gastroenterologist supervises 3 NE). The calculations were based on a mean duration of 30 minutes per colonoscopy in NE-performed colonoscopies and 25 minutes per colonoscopy in the case of gastroenterologists. The calculations accounted for salary costs of the endoscopist and of one assisting endoscopy nurse. The mean personnel costs (euros) declined from €48.83 to €41.22 per procedure (−€7.61) in the NE scenario (Table 5).

Discussion

This study is the first prospective comparative study evaluating the quality of colonoscopies performed by NE and PE in a large setting. We found that NE perform colonoscopies with similar quality and safety as PE in terms of the generally accepted quality measures, such as unassisted cecal intubation rates, adenoma detection rates, withdrawal times, and complication rates. The unassisted cecal intubation rates were 95% in NE and 93% in PE; the mean withdrawal times were 10.4 and 9.8 minutes, respectively; the adenoma detection rates were 27% for both; and the complication rates were 0.5% and 0.5%, respectively. However, during the assessment period, the unassisted cecal intubation rates of the NE were slightly less than those of the PE most of the time; but in both groups, they gradually increased with the amount of colonoscopies performed and reached 89% (NE) and 86% (PE) at the end of the assessment. Furthermore, we found that in a scenario of 1 gastroenterologist supervising 3 NE, personnel costs in NE-performed colonoscopies were lower compared with colonoscopies performed by a gastroenterologist.

So far, only a few studies have compared the endoscopic quality of NE performing full colonoscopies with those of PE.18–20 These small, single-center studies showed that adequate training of NE to perform full colonoscopy yielded similar quality and similar low complication rates when compared with colonoscopies performed by PE. Prior data from our group evaluating the quality and safety of NE-performed colonoscopies in 10 NE performing 1000 colonoscopies in a multicenter cohort study showed that NE performed colonoscopies according to the international recognized quality standards, including an unassisted cecal intubation rate over 90% and an adenoma detection rate of about 27%.17 These studies, however, did not compare the progress and performance of NE with PE. The present study, therefore, directly compared colonoscopies performed by NE and PE with similar training and performance in the same patient categories and the same setting.

The results obtained in the current study are mostly in agreement with those of the previous studies and show that NE are competent in performing colonoscopies, although a regular training program does not yet bring them at a level that fully meets international guideline recommendations and standards. In the Netherlands, a minimum number of 200 colonoscopies are requested for certification for colonoscopy (Dutch Society of Gastroenterology). At the end of the assessment period (thus after having finished at least 235 colonoscopies), the unassisted cecal intubation rates of both NE and PE were still slightly less than the required 90%. However, overall (unassisted and assisted) cecal intubation met the international standards27 rates in both groups. These results support that NE similar to PE can learn to perform diagnostic colonoscopies at a high quality and safety level.

It is generally recognized that the capacity of PE will be insufficient for the increased demand for endoscopic procedures, resulting from the introduction of CRC screening programs. In the Netherlands, a nationwide CRC screening program will be implemented in 2013 to 2018 to cover the 55- to 75-year-old age group. Screening will be performed by means of biennial fecal immunochemical testing, and it is estimated that this will lead to a yearly demand for approximately 80,000 extra colonoscopies. It is important to consider the impact of a nationwide CRC screening program on the endoscopic capacity and manpower to avoid unacceptable waiting times. There are several possibilities to approach this problem. First, indications to perform endoscopy should be appropriate. Studies have shown that 23% to 39% of all GI endoscopies are being performed for inappropriate indications or at inappropriate surveillance intervals when compared with the guidelines.28–30 Then training
additional PE can increase capacity. However, fellowship positions are expensive and time consuming and, thus, do not yield a sufficient endoscopic capacity within a short time. The training of NE to perform colonoscopies in a supervised setting may be an effective and cost-saving alternative. A recent survey performed among Dutch gastroenterologists showed that gastroenterologists are positive toward a significant role for NE, with restrictions to diagnostic and minimally invasive therapeutic procedures.31

There are several important issues to the establishment of nurse endoscopy. The guidelines for NE training and the criteria to maintain procedural competence after training need to be defined. These guidelines should rely on available studies regarding the endoscopic skills of NE and be comparable with that of fellows. For that purpose, the Dutch Society of Gastroenterologists has developed such guidelines together with a 1-year training program, among others based on the results of the current study. Once competence has been demonstrated, national institutions should credential individual endoscopists to perform the respective endoscopic procedures. In addition, clear job descriptions must define the scope of practice and specific responsibilities for NE and their supervisors. This will also clarify the legal implications and effectiveness for the proposed strategy when gastroenterologists supervise multiple NE. Furthermore, reimbursement policies should be adapted to facilitate a cost-effective and adequate reimbursement. Overcoming these issues will allow the introduction of NE in the GI endoscopic service.

The main limitation of this study is that patients were not randomized between NE and PE but, on a consecutive basis, assigned to the next endoscopy list. Furthermore, during training, PE simultaneously performed a fair number of gastroscopies, whereas most NE did not, which probably led to differences in training. On the other hand, the main advantage of this study is the large size of our cohort of endoscopists and the large number of colonoscopies that were performed and evaluated.

In summary, this study provides support that, with the same training and supervision, NE perform colonoscopies with similar quality and safety as PE. However, NE had slightly lower unassisted intubation rates and during training needed more assistance by a supervisor. On the other hand, they performed procedures on more symptomatic patients than PE and performed less gastroscopies and sigmoidoscopies during the training period, which may be reflected in the difference. Our results demonstrate that NE can perform colonoscopies with high-quality standards but might require longer training periods or a broad training including both upper and lower GI endoscopies.

Our data are generalizable to all patients with ASA I and II who are undergoing diagnostic colonoscopy. They advocate the involvement of NE in colonoscopy. The introduction of nurse endoscopy is relevant in many countries in terms of the colonoscopy demand and health care costs.

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