

## Nurses working in GI and endoscopic practice: a review

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**Background:** Over the last 10 years, nurses increasingly perform tasks and procedures that were previously performed by physicians.

**Objective:** In this review, we investigated what types of GI care and endoscopic procedures nurses presently perform and reviewed the available evidence regarding the benefits of these activities.

**Design:** Review of published articles on nurses' involvement in GI and endoscopic practice.

**Results:** In total, 19 studies were identified that evaluated performance and participation of nurses in GI and endoscopic practice. Of these, 3 were randomized trials on the performance of nurses in flexible sigmoidoscopy ( $n = 2$ ) and upper endoscopy ( $n = 1$ ). Fourteen nonrandomized studies evaluated performance in upper endoscopy ( $n = 2$ ), EUS ( $n = 1$ ), flexible sigmoidoscopy ( $n = 7$ ), capsule endoscopy ( $n = 2$ ), and percutaneous endoscopic gastrostomy placement ( $n = 2$ ). In all studies, it was found that nurses accurately and safely performed these procedures. Two further studies demonstrated that nurses adequately managed follow-up of patients with Barrett's esophagus and inflammatory bowel disease. Four of the 19 studies showed that patients were satisfied with the type of care nurses provided. Finally, it was suggested that costs were reduced if nurses performed a sigmoidoscopy and evaluated capsule endoscopy examinations compared with physicians performing these activities.

**Conclusions:** The findings of this review support the involvement of nurses in diagnostic endoscopy and follow-up of patients with chronic GI disorders. Further randomized trials, however, are needed to demonstrate whether this involvement compares at least as favorably with gastroenterologists in terms of medical outcomes, patient satisfaction, and costs. (*Gastrointest Endosc* 2007;65:469-79.)

Changes in health care have been challenging for professionals and patients, and increasing demands in care are providing the impetus for the expanding scope of nursing practice. Over the last few years, the role of nurses in health care has been expanding.<sup>1</sup> As before, nurses are working to provide services that complement or extend those provided by physicians. Recently, however, some nurses increasingly work as physician substitutes, performing tasks and procedures previously performed by physicians.<sup>2</sup> These nurses practice in a variety of settings with specialized expertise, eg, oncology,<sup>3</sup> geriatrics,<sup>4</sup> primary care,<sup>5</sup> obstetrics,<sup>6</sup> neonatology,<sup>7</sup> emergency care,<sup>8,9</sup> and surgery.<sup>10</sup> In the field of gastroenterology, clinical nurse specialists and nurse practitioners are similar terms for registered nurses who have completed an advanced degree in nursing and who are qualified in gastroenterology nursing. A few reports discuss the role of these nurses in gastroenterology and endoscopy.<sup>11,12</sup> Particularly with

regard to screening for colorectal cancer, it was concluded that nurses may contribute to the prevention and early detection of this malignancy.<sup>13-15</sup> Nevertheless, the number of studies that clearly and objectively identified the potential benefits of nurses as care providers in a gastroenterology setting are limited.

The aim of this review was to identify the types of GI tasks and endoscopic procedures provided by nurses complementary to or substituting for physician activities, and to review the available evidence regarding the benefits of this role in the GI setting.

### MATERIALS AND METHODS

We reviewed the literature from the databases PubMed and ISI Web of Science. Because the role of nurses in gastroenterology and endoscopy has been more specifically developed since the late 1990s, we only considered the time period January 1990 to June 2006 for this review. Four study types were eligible for inclusion:

- Randomized controlled trials (RCT): random allocation of patients to an intervention or control group.

**TABLE 1. Classification of methodologic quality of studies**

A1	Systematic review, which includes at least 2 independently performed studies on the A2 level.
A2	High-quality randomized double-blind controlled trial.
B	Comparative study, fulfilling not all characteristics of A2.
C	Noncomparative study.
D	Opinion of experts.

- Controlled trials (CT): the intervention group is compared with a control group selected by a nonrandom process or the intervention is followed and/or controlled through a second procedure by a gastroenterologist.
- Prospective studies (PS): prospective evaluation of the intervention; no control group.
- Retrospective studies (RS): retrospective evaluation of the intervention.

Two investigators (E.M.L.V., P.D.S.) extracted the data and assessed the study quality according to the schedule in Table 1. Participants in different studies were gastroenterologists, residents, and qualified nurses who work as a substitute to a gastroenterologist or as gastroenterologist supplements. This last group included, for example, nurse practitioners, clinical nurse specialists, advanced practice nurses, and registered nurses. Because the job title, education, and experience of nurses vary among and within countries, we did not select nurses by job title.

The following keywords were used: advanced practice nurse, nurse practitioner, variations on the word "nurse," Barrett's esophagus, esophageal cancer, esophagus, cancer screening, gastric cancer, stomach, inflammatory bowel disease, IBD, Crohn's disease, ulcerative colitis, colon, colorectal carcinoma, pancreas, pancreatic carcinoma, liver, hepatocellular carcinoma, liver transplantation, hepatitis, endoscopy, sigmoidoscopy, gastroscopy, colonoscopy, gastroenterology, dyspepsia, reflux, irritable bowel syndrome, and IBS. Also, reference lists of published articles were investigated. Systematic reviews, non-English language articles, and studies only published in abstract form were excluded.

## RESULTS

### Description of studies

Nineteen studies were identified that evaluated the performance and participation of nurses in gastroenterology and endoscopy (Table 2).<sup>16-34</sup> Of these, 3 were RCT,<sup>16-18</sup> 8 were CT,<sup>19-26</sup> 6 were PS,<sup>27-32</sup> and 2 were RS.<sup>33,34</sup>

Assessment of the methodologic quality of the studies is shown in Table 2. In 13 studies, nurses performed an endoscopic procedure, ie, esophagoscopy,<sup>19</sup> upper endoscopy,<sup>16,20</sup> EUS,<sup>27</sup> and flexible sigmoidoscopy (FS).<sup>17,18, 21-23,28-31</sup> In 2 studies, nurses interpreted video capsule endoscopy (VCE).<sup>26,32</sup> In 2 other studies, nurses assisted in the placement of a percutaneous endoscopic gastrostomy (PEG) catheters.<sup>24,25</sup> Finally, in 2 studies, nurses were responsible for managing patients with GI disorders, ie, inflammatory bowel disease (IBD)<sup>33</sup> and Barrett's esophagus (BE).<sup>34</sup>

### Upper-GI endoscopy

One randomized study compared the adequacy and the accuracy of a diagnostic upper-GI endoscopy performed by 5 medical and 2 nurse endoscopists.<sup>16</sup> The videotaped procedures were assessed by a gastroenterologist blinded to the identity of the endoscopist. An adequate view was obtained in 53% of doctors' endoscopies and 92% of nurses' (difference 38%, 95% confidence limits [CL] 31%, 47%). In adequately viewed areas, the mean agreement between doctor and expert and between nurse and expert was 81% and 78%, respectively (difference 8%, 95% CL -1%, 6%). The types of lesions missed, most commonly gastritis, were similar for doctors and nurses. There was no difference between doctors and nurses in the rate of biopsy performance (90% vs 91%;  $P = .86$ ).

Wildi et al<sup>19</sup> investigated nurse-led screening for esophageal disorders. In this study, a nurse performed an esophagoscopy in 40 patients by using a small-caliber endoscope, followed by a standard endoscopy performed by a supervising gastroenterologist. Both the nurse practitioner and the gastroenterologist were blinded to each other's findings. Sensitivities of small-caliber esophagoscopy by the nurse and standard endoscopy by the gastroenterologist for detecting abnormalities were 75% and 95% (95% CI [confidence intervals] 67%-82%), respectively, whereas specificities were 98% and 95% (95% CI 96%-99%), respectively. Particularly, nurses underestimated the presence of esophageal rings. Because 2 different types of endoscopes were used, it became unclear whether the lower sensitivity was explained by the use of the small-caliber endoscope or by the performance of the nurse.

Smale et al<sup>20</sup> studied 480 patients who underwent upper-GI endoscopy performed by 2 nurses and 7 physicians, and assessed sedation requirements and patients' anxiety, discomfort, satisfaction, and attitude toward future sedation. No differences were found in preprocedural anxiety, discomfort during introduction of the endoscope, and during the further procedure or postprocedural examination rating between nurses and physicians.

### EUS

Meenan et al<sup>27</sup> investigated a training program for EUS. Apart from 4 senior fellows in gastroenterology, 1 nurse

**TABLE 2. Nurses in gastroenterology and endoscopy: interventions and outcomes**

Study	Design	Classification of study	Participants	Intervention	Results	Nurse title
Upper-GI endoscopy						
Meaden et al <sup>16</sup>	RCT	A2	367 Patients; 2 nurses; 4 GI physicians; 1 physician	Upper-GI endoscopy	Adequate view doctors vs nurses: 53% vs 92% (95% CL 31, 47%). Agreement expert doctors vs nurses: 81% vs 78% (95% CL -1%, 6%). No differences in rate of biopsy performance. No differences in missed lesions (mostly gastritis).	Registered nurse
Smale et al <sup>20</sup>	CT	B	480 Patients; 2 nurses; 7 GI physicians	Upper-GI endoscopy	Nurses vs physicians: no differences in preprocedure anxiety ( $P = .61$ ), discomfort during intubation ( $P = .97$ ), discomfort during examination ( $P = .90$ ), postprocedure examination rating ( $P = .79$ ).	Registered nurse
Wildi et al <sup>19</sup>	CT	B	40 Patients; 1 nurse; 1 GI physician	Esophagoscopy	Small-caliber endoscopy by nurse vs video endoscopy by physician: sensitivity 75% vs 95% (CI 67%-82%), specificity 98% vs 95% (CI 96%-99%). Nurse: missed all 4 of esophageal rings.	Nurse practitioner
EUS						
Meenan et al <sup>27</sup>	PS	C	300 Patients; 1 nurse; 4 GI physicians	Training program EUS	Nurse showed a comparable degree of competence in mediastinal scanning (12.5 of 18 points vs 18 of 18, 16.6 of 18, 15.7 of 18, and 11.8 of 18 points, respectively).	Registered nurse
FS						
Basnyat et al <sup>30</sup>	PS	C	706 Patients; 1 nurse	FS, nurse-led service	Cause for bleeding identified in 642 of 706 patients (91%). Satisfaction with service: 246 of 249 patients (99%). Cost reduction: \$80.	Registered nurse
DiSario and Sanowsk <sup>17</sup>	RCT	B	212 Patients; 5 nurses; 5 residents	Training program FS	Nurses vs residents: no differences in missing lesions (total miss rate 4 of 250 lesions, 1.6%), mean insertion depth (46 vs 44 cm), and mean procedure time (16 vs 16 min). 1 of 5 nurses achieved no proficiency.	Registered nurse; practice nurse

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TABLE 2 (continued)

Study	Design	Classification of study	Participants	Intervention	Results	Nurse title
Goodfellow et al <sup>31</sup>	PS	C	282 Patients; 1 nurse	FS, nurse-led service	Abnormalities identified in 217 of 282 patients (77%). 1 of 161 lesions (1%) missed compared with back-to-back double-contrast barium enema.	Nurse practitioner
Maule <sup>21</sup>	CT	B	2611 Patients; 4 nurses; 2 GI physicians	FS	Nurses missed 1 of 269 lesions (0.3%). Mean insertion depth: nurse 39 cm, physician 45 cm ( $P = .001$ ). Patients' discomfort: physicians more cramping ( $P = .001$ ). No correlation between cramping and insertion depth.	Registered nurse Practice nurse
Schoenfeld et al <sup>18</sup> (1999)	RCT	A2	313 Patients; 3 nurses; 4 GI physicians	FS	Miss rate adenomatous polyps: nurse 3 of 14 (21%), physician 6 of 30 (20%) ( $P = .91$ ). Miss rate all polyps: nurse 22 of 128 (17%), physician 41 of 139 (29%) ( $P = .02$ ). Mean insertion depth: nurse 55 cm, physician 61 cm ( $P < .00001$ ).	Registered nurse
Schoenfeld et al <sup>22</sup> (1999)	CT	B	383 Patients 1 nurse; 3 surgeons; 3 GI physicians	FS	Detection rate adenomas: nurses 8 of 114 (7%), surgeons 11 of 139 (8%), physicians 12 of 130 (9%) ( $P = .81$ ). Mean insertion depth: nurses 53 cm, surgeons 50 cm, physicians 54 cm ( $P = .01$ ). Mean procedure time: nurses 8.3 min, surgeons 7.6 min, physicians 6.8 min ( $P = .0001$ ). Satisfaction: overall no differences ( $P = .60$ ).	Registered nurse
Schroy et al <sup>28</sup>	PS	C	100 Patients; 1 nurse; 1 GI physician	FS	Endoscopy by nurse vs physician's review: sensitivity 75%, specificity 94%. 8 of 36 lesions (22%) identified only by physician, 4 of 36 lesions (11%) identified only by nurse.	Nurse practitioner
Shapero et al <sup>29</sup>	PS	C	488 Patients ; 2 nurses; 1 GI physician	FS	Nurses identified 75 of 488 lesions (15%).	Registered nurse

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TABLE 2 (continued)

Study	Design	Classification of study	Participants	Intervention	Results	Nurse title
Wallace et al <sup>23</sup>	CT	B	3701 Patients; 1 nurse; 2 physician assistants; 15 GI physicians	FS	Mean insertion depth: nonphysicians (including 1 nurse) 52 cm, physicians 55 cm ( $P < .001$ ). Detection rate polyps: nonphysicians 619 of 2323 (27%), physicians 321 of 1378 (23%) ( $P = .34$ ). Detection rate neoplastic polyps: nonphysicians 180 of 2323 (8%), physicians 80 of 1378 (6%) ( $P = .35$ ). Cost reduction: \$97.	Nurse practitioner
VCE						
Levinthal et al <sup>26</sup>	CT	B	20 Patients; 1 nurse; 1 GI physician	VCE	Miss rate lesions: nurse 2 of 27 lesions (sensitivity 93%, CI 74%-99%), physician 3 of 27 lesions. Nurse: emptying time and time of passage ileocecal valve within 1 min from time physician in 18 of 20 patients (agreement 90%, CI 67%-98%).	Registered nurse
Niv and Niv <sup>32</sup>	PS	C	50 Patients; 1 nurse; 1 GI physician	VCE	Complete agreement in 12 cases interpreted as normal. Thumbnail selection: nurse 130 vs physician 99, agreement in 93 of 96 cases (97%). Miss rate: nurse 3 in 3 patients, physician 4 in 3 patients. Mean computed transit time gastric and small bowel: nurse 26 and 304 min, respectively, physician 26 and 318 min, respectively. Mean reading time: nurse 100 min vs physician 59 min. Mean reading time after thumbnail selection: 10 min. Cost reduction: \$324.	Nurse practitioner
PEG						
Patrick et al <sup>25</sup>	CT	B	35 Patients; 1 nurse; 3 GI physicians	PEG, nurse-assisted	Complications: nurse 0 of 20 (0%), physicians 0 of 15 (0%).	Registered nurse
Sturgess et al <sup>24</sup>	CT	B	100 Patients; 1 nurse; 3 GI physicians	PEG, nurse-assisted	Complications: nurse 2 of 50 (4%), physician 2 of 50 (4%). 30-day mortality: nurse 4 of 50 (8%), physician 6 of 50 (12%).	Nurse practitioner

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TABLE 2 (continued)

Study	Design	Classification of study	Participants	Intervention	Results	Nurse title
Management of GI disorders						
Nightingale et al <sup>33</sup>	RS	C	344 Patients; 1 nurse	IBD nursing service	38% Reduction of hospital visits. 19% reduction of in-hospital stay. Patients in remission increased from 63% to 69%. Satisfaction: improvement on information giving ( $P < .001$ ), and advice on maintaining health ( $P < .001$ ).	Nurse specialist
Schoenfeld et al <sup>34</sup>	RS	C	123 Patients; 1 nurse	Treatment of BE, nurse-directed	Variation from guidelines: interval between surveillance endoscopy 5 of 269 events (1.9%), treatment of reflux 7 of 358 events (1.3%). Satisfaction: overall care 90 of 102 patients (88%), questions answered 90 of 102 patients (88%), patient education 87 of 102 patients (76%).	Registered nurse

was also trained. Examinations performed by the nurse were limited to views of the esophagus and the proximal stomach, whereas the physicians also examined the duodenum. Assessment of the ability to perform EUS was judged by an experienced endosonographer by using a point-score system. A total of 18 points were awarded for the ability to produce "best views with certainty." After 25 examinations, the nurse showed a comparable degree of competence (mean score of 12.5 of 18 points) in evaluating the mediastinum to that of the other trainees (18 of 18, 16.6 of 18, 15.7 of 18, and 11.8 of 18, respectively).

## FS

Nine studies investigated FS performance by nurses in terms of accuracy, efficacy, and safety.<sup>17,18,21-23,28-31</sup> The miss rate of lesions was reported in 2 randomized studies.<sup>17,18</sup> This was determined by the supervision of all FS procedures by a qualified endoscopist in 1 study<sup>17</sup> and by back-to-back endoscopy by a senior gastroenterologist in another study.<sup>18</sup> The nonrandomized studies reported detection rate of lesions (Table 1).<sup>21-23,28-31</sup>

In 1 of the 2 randomized studies, 260 patients were randomized to undergo FS performed by a nurse ( $n = 5$ ) or by a resident ( $n = 5$ ).<sup>17</sup> Early in the training, 3 small polyps and 1 diverticulum were missed (1.6% of 250 lesions) by 3 nurses and 1 resident each. The mean insertion depth of FS performed by trainees was 44 cm compared with 46 cm in nurses. One nurse did not achieve proficiency after 35 procedures. No differences were observed in procedure

tolerance among patients examined by nurses and residents. In the second randomized study, 328 patients were randomized to undergo screening FS performed by a nurse or a gastroenterologist.<sup>18</sup> Within 5 minutes of completion of the first FS, a second FS was performed. The gastroenterologist who performed the second endoscopy was blinded to the type of endoscopist. Gastroenterologists inserted the sigmoidoscope further than nurses (61 vs 55 cm, respectively;  $P < .00001$ ). Although gastroenterologists missed more polyps (29% vs 17%;  $P = .02$ ), gastroenterologists and nurses had a similar frequency in missing adenomatous lesions (20% vs 21%;  $P = .91$ ).

Maule<sup>21</sup> compared 1881 FS procedures performed by 4 nurses with 730 procedures performed by 2 physicians. No differences were found in the detection rate of adenomas and colorectal cancers between nurses and physicians. In this study, discomfort and the perceptions of patients undergoing FS procedures were also measured. Of the measured variables, only cramps were more frequently experienced by patients if performed by physicians compared with nurses ( $P = .001$ ). Although physicians had a greater mean depth of insertion (39 cm vs 45 cm;  $P = .001$ ), there was no correlation between cramps and insertion depth.

In 2 prospective studies, consecutive patients were assigned to have FS performed by the first available endoscopist, ie, a nurse, a physician assistant, a surgeon, or a GI physician.<sup>22,23</sup> No differences were observed in the detection of adenomas (Table 1). In 1 study, the mean insertion



depth was less for surgeons compared with the nurse and the gastroenterology fellows (50 vs 53 vs 54 cm, respectively;  $P = .01$ ).<sup>22</sup> In the second study, the mean depth of FS performed by nonphysicians (nurse or physician assistant) was 52 cm compared with 55 cm by physicians ( $P < .001$ ).<sup>23</sup> Patient satisfaction was measured in one of these studies by a questionnaire.<sup>22</sup> Although the nurses received better scores on some of these scales than the physicians, no differences were detected for overall satisfaction, communication, and technical and interpersonal skills between both types of endoscopists.

In 4 studies, FS procedures performed by 5 nurses were recorded on a videotape and were reviewed by 3 physicians to validate the results.<sup>28-31</sup> It was reported that FS performed by nurses was effective and safe (Table 1).

Basnyat et al<sup>30</sup> evaluated a nurse-led open-access FS service for patients with rectal bleeding. A cause of bleeding was identified in 642 of 706 patients (91%). Underlying pathologies that accounted for rectal bleeding were found in 171 patients (24%) and these included polyps, IBD, solitary rectal ulcer syndrome, and colorectal cancer. Ninety-nine percent of the first 249 patients were satisfied with the performance of the nurses and indicated that they received adequate information before undergoing the procedure. In another study, the investigators reported that 99% of the nurse-led procedures were classified as being successful, whereas, in 77% of patients, abnormalities were identified.<sup>31</sup> Only 9 of 249 patients (4%) had moderate discomfort, whereas 238 of 249 patients (95%) had minimal discomfort. FS in 2 patients (1%) had to be discontinued because of discomfort.

Regardless of the type of endoscopist, no complications were reported in all 9 published studies on FS.<sup>17,18,21-23,28-31</sup> Two studies compared costs of FS performed by nurses or physicians.<sup>23,30</sup> For this, Wallace et al<sup>23</sup> included salary, pathology costs, staff support, equipment and supplies, and nonphysician training costs for the comparison. The costs per examination were lower for procedures performed by nonphysicians (\$186) than for those performed by physicians (\$283). In another study, costs of a nurse-led open-access FS service were estimated at \$81 per patient, whereas the costs of a physician-led outpatient referral were \$161 per patient.<sup>30</sup>

## VCE

Two studies evaluated whether nurses were able to detect lesions on VCE recordings (Table 1).<sup>26,32</sup> Twenty VCE examinations<sup>26</sup> and 50 VCE examinations,<sup>32</sup> respectively, were interpreted by a nurse and, independently, re-reviewed by a gastroenterologist. In the first study,<sup>26</sup> the nurse missed 2 (a small angioectasia and a small-bowel erosion) of 27 significant lesions seen by the gastroenterologist, whereas the gastroenterologist missed 3 lesions seen by the nurse. These 3 lesions were small red spots thought to be angioectasias. In the second study, there was complete agreement between a nurse and a gastroen-

terologist for all 12 cases interpreted as normal.<sup>32</sup> In the remaining cases, the nurse made 130 selections and the gastroenterologist made 99 selections. Complete interobserver agreement was achieved for 93 of 96 lesions (97%) categorized as significant by the gastroenterologist. The nurse missed 3 lesions in 3 patients, and the gastroenterologist missed 4 lesions in 3 patients. The nurse, however, needed more time to read the VCE examination than the gastroenterologist (mean 100 vs 59 minutes).

The costs of interpreting VCE were calculated in 1 study.<sup>32</sup> The costs per examination for the standard procedure (physician only) were \$573, which decreased if the nurse had made preliminary thumbnail selections (\$249).

## PEG

Two studies evaluated the safety of nurse-assisted placement of a PEG catheter (Table 1).<sup>24,25</sup> The nurse was responsible for cleansing and anesthetizing the abdominal surface, making an incision, introducing a guidewire, delivering the PEG catheter, and securing it with the locking device. In both studies, no differences in procedure-related complications, infections around the PEG site, or feeding-tube-related problems were observed between nurse-assisted and physician-assisted placement.

## Management of GI disorders

Nightingale et al<sup>33</sup> evaluated nurse-directed care in the management of patients with IBD. The main aim of this service was to improve education and support for patients and their family and other health care professionals involved in the management of patients with IBD. The involvement of a nurse resulted in a 38% reduction in hospital visits and a 19% reduction in in-hospital stays, compared with a historical control group. The number of patients in remission increased from 63% to 69%. Patient satisfaction improved with regard to information on IBDs ( $P < .001$ ) and advice to prevent illness and to maintain health ( $P < .001$ ).

Schoenfeld et al<sup>34</sup> retrospectively studied the effectiveness of nurse-directed care of patients with BE. By using guidelines, a nurse adjusted antireflux medications, evaluated biopsy reports, determined the interval between surveillance endoscopies, and provided education for patients with BE. In 123 patients, it was found that variation from the guidelines with regard to the interval of surveillance endoscopy and treatment of reflux symptoms was less than 2%. In addition, most patients were satisfied with overall medical care (88%), with the replies to their questions (88%), and with patient education (76%). Half of the patients indicated that the overall medical care would not change if a physician replaced the nurse, and 38% of patients preferred the nurse to a physician.

## DISCUSSION

The use of diagnostic endoscopy has rapidly increased over the last 5 to 10 years. This is, among other factors, because of the increased awareness of screening for premalignant disorders of the GI tract, particularly BE and adenomatous polyps. In addition, the introduction of new endoscopic techniques resulted in an increased demand on the endoscopic capacity. It is noted, however, that it is difficult to have the manpower for the increased demand for both diagnostic and therapeutic endoscopy. The introduction of nurse-led endoscopy, particularly for diagnostic upper endoscopy and sigmoidoscopy, could be a solution for this shortage.

The findings in the reviewed studies suggest that nurses can well perform some of the tasks and diagnostic procedures previously performed by physicians. This review showed that nurses were able to perform diagnostic upper endoscopy, EUS, and FS, and to interpret VCE examinations in an effective and safe way, with results similar to those obtained by physicians (Table 1). In addition, it was found that nurses could actively participate in PEG insertion.<sup>24,25</sup> Nevertheless, it is important to emphasize that the quality of the design and the methodology used in most studies was weak. We found only 3 randomized trials<sup>16-18</sup>; the remainder were comparative or noncomparative studies.<sup>19-34</sup> If nurse endoscopy is introduced in the endoscopic setting, training is obviously of utmost importance, and nurse endoscopists should follow a training program that is comparable with that of fellows. Professional organizations, such as the Joint Advisory Group on Gastrointestinal Endoscopy in the United Kingdom<sup>35</sup> and the Society of Gastrointestinal Nurses and Associates in the United States<sup>36</sup> have developed guidelines to ensure that nurses are performing endoscopies according to and in line with these guidelines. These guidelines all incorporate recommendations for appropriate training and accreditation in endoscopy, comparable with those for physician trainees. In addition, it is clearly stated in these guidelines that noncompliance would leave nurses vulnerable to medicolegal actions. Guidelines should guarantee that nurses are able to adequately perform diagnostic procedures, such as upper endoscopy for surveillance of BE or dyspepsia; FS for screening of colorectal cancer; diagnostic colonoscopy for symptoms of hematochezia or surveillance of IBD; diagnostic EUS in the diagnostic workup of esophageal, gastric, and pancreatic tumors; and interpreting VCE; and should be involved in some therapeutic procedures, eg, PEG insertion (Fig. 1).

Surprisingly, only 2 studies were identified in which nurses managed patients with specific GI disorders, ie, IBD and BE.<sup>33,34</sup> It is conceivable that nurses also could be involved in the management of patients with other chronic GI disorders, such as chronic pancreatitis and IBS<sup>37</sup> (Fig. 2). If so, clinical guidelines and supervision of physicians are recommended to support nurses in daily

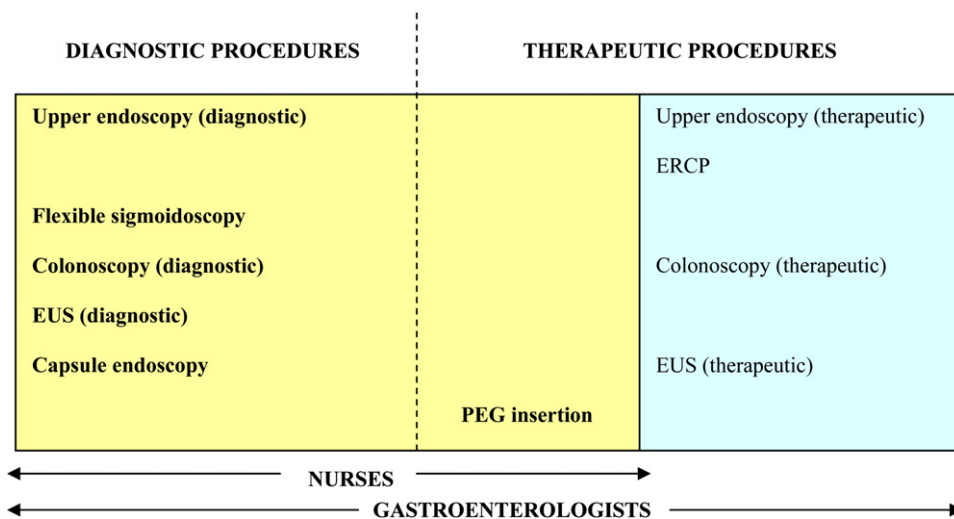
practice. In addition, it is important that patients are discussed in regular multidisciplinary meetings. Further studies, however, are needed to evaluate the exact role of nurses in these disorders. In addition, nurses could well play a role in the palliative care of patients with incurable or recurrent cancer of the GI tract, eg, esophageal cancer, gastric cancer, pancreatic cancer,<sup>38</sup> or colorectal cancer.<sup>39</sup> It is known that nurses increasingly are involved in the care of patients in liver transplant programs<sup>40,41</sup> and in managing patients undergoing treatment for hepatitis C.<sup>42,43</sup> Finally, the role of the stoma therapist nurse is well established in many centers.<sup>39,44</sup>

Are nurses already widely involved in the GI practice? Pathmakanthan et al<sup>45</sup> investigated the contribution of nurses in endoscopic procedures and the attitude of physicians toward this involvement by mail questionnaire in teaching and district general hospitals throughout the United Kingdom. It was found that 67 of 176 responding hospitals employed 102 nurse endoscopists. Forty-four (43%) of these nurse endoscopists performed both upper endoscopy and FS, with only upper endoscopy and only FS performed by 17 nurses (17%) and 31 nurses (30%), respectively. Three nurses (3%) performed colonoscopy, whereas 7 (7%) were involved in all 3 procedures. Nurse endoscopists were found to provide good and safe patient care in the majority of endoscopy units. This, however, was not systematically studied. Lead clinicians stated that they were keen to restrict nurse endoscopy to diagnostic upper endoscopy and FS. Perceived benefits included good patient acceptability, improved care, and safety. Most clinicians predicted an important but still restricted role for nurse endoscopy in the provision of endoscopic services unless efficacy and safety were clearly proven.

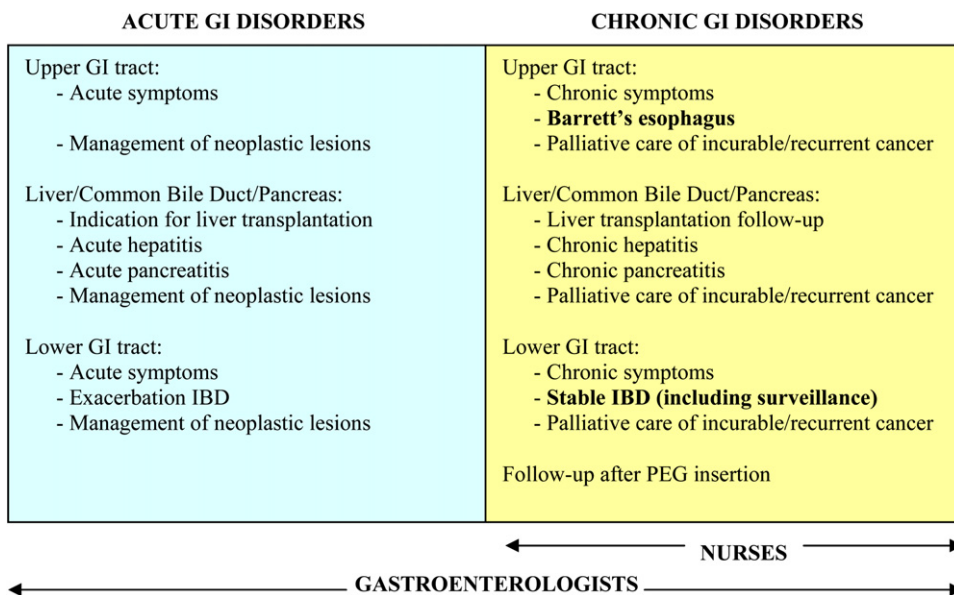
Lal et al<sup>46</sup> performed a postal survey of endoscopic training programs for internal medicine ( $n = 445$ ), family practice ( $n = 471$ ), physician assistants ( $n = 118$ ), and nurse practitioners ( $n = 149$ ) in the United States to evaluate the availability and the structure of FS training in these specialties. The overall response rate was 63%. Most internal medicine (89%) and family practice (99%) programs offered FS training versus only 12% of physician assistant and none of nurse practitioner programs. Family practice programs were more likely to offer training ( $P < .001$ ), require training ( $P < .001$ ), and teach biopsy techniques ( $P < .001$ ). Internal medicine programs were more likely to have minimum requirements ( $P < .001$ ) and required a minimum of 25 procedures per trainee ( $P < .001$ ). Physician assistant programs were less structured and often lacked minimum requirements. It was concluded that FS training was still restricted or nonexistent among physician assistant and nurse practitioner programs in the United States.

The need for efficient patient education and counseling is growing with the ongoing development of new GI and endoscopic technologies.<sup>47</sup> Studies show that patient





**Figure 1.** Schematic representation showing which endoscopic procedures could be performed by nurse endoscopists as physician substitutes (highlighted are procedures for which some evidence of its efficacy if performed by nurses has been published).



**Figure 2.** Schematic representation of GI disorders that could be managed by nurses as physician substitutes (highlighted are disorders for which some evidence of its efficacy if performed by nurses has been published).

education conducted by nurses may be beneficial to ensure compliance and cost-effectiveness.<sup>48,49</sup> In a study that investigated a pre-endoscopy patient education program, it was found that patient education before endoscopic procedures was able to reduce the rate of examination failures and their attending costs.<sup>48</sup> In addition, optimal information to patients may benefit patient satisfaction and decrease anxiety.

As a result of technologic advances, changes in work practices, and instrument processing procedures, contemporary endoscopy services have increasingly become expensive to maintain.<sup>50</sup> The introduction of nurse endos-

copy could lead to significant cost savings. We found only 3 studies in which the costs of FS<sup>23,30</sup> and the interpretation of VCE examinations<sup>32</sup> if performed by nurses were evaluated. This low number was somewhat unexpected in light of the widely held view that nurse-led care may generate cost savings.

In conclusion, the findings of this review supported the involvement of nurses in different types of GI care and diagnostic endoscopic procedures (Figs. 1 and 2). In the majority of reviewed studies, nurses worked as physician substitutes. However, it is important to realize that, so far, only 3 randomized studies were published in which

the performance of nurses and physicians in GI endoscopy were compared. Therefore, little solid evidence is presently available to definitely conclude that the involvement of nurses in the gastroenterology and endoscopy setting is of benefit to all parties involved, ie, patients, gastroenterologists, and society. More randomized trials need to objectively demonstrate that nurses' performance of GI tasks and endoscopic procedures compare at least favorably with physicians in terms of medical outcomes (accuracy and safety), patient satisfaction, and costs.

## DISCLOSURE

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