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Improving colonoscopy quality through individualised training programmes

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ABSTRACT

Introduction: In Denmark, quality-improvement initiatives aimed at providing a better colonoscopy service are few. The primary objective of this study was to improve colonoscopy quality at Aalborg University Hospital, Denmark, using structured training programmes. The secondary aim was to introduce a system for individual colonoscopist performance monitoring.

Methods: We conducted a colonoscopy-quality pilot study covering two major quality performance indicators: caecum intubation rate (CIR) and polyp detection rate (PDR). The pilot study was followed by colonoscopy training programmes offering experienced colonoscopists colonoscopy skills upgrading, polypectomy and train-the-trainers courses taught by English experts. Junior doctors completed a 20-day module-based colonoscopy-training programme. A regional individual colonoscopy quality-reporting system was developed as a supplementary file within the electronic health records.

Results: The CIR increased from 87.1% to 92.1% ($p < 0.001$) and the PDR from 33.7% to 41.7% ($p < 0.001$) in the course of the structured training programme. Multivariable analysis adjusting for patient sex, patient age and colonoscopy indication showed a significant increase in CIR ($p < 0.001$), but not in PDR ($p = 0.19$). The colonoscopy quality reporting system was introduced and now provides biannual feedback to all colonoscopists.

Conclusions: Quality-improvement initiatives may lead to an improved CIR and possibly PDR. Nationwide training programmes and performance monitoring should be implemented to further improve and monitor colonoscopy quality.

Funding: none.
Trial registration: not relevant.

In Denmark, colorectal cancer (CRC) is the second most common cancer among both men and women [1]. Colonoscopy is the gold standard for diagnosing CRC, either as a diagnostic test in symptomatic patients or as part of a CRC screening programme. Colonoscopy can be used to diagnose CRC or prevent disease by removal of premalignant polyps. However, identification of polyps is not guaranteed during colonoscopy, since polyps or even cancers can be missed during the procedure. CRC occurring shortly after a negative colonoscopy (a colonoscopy without malignancy) is usually referred to as post-colonoscopy colorectal cancer (PCCRC). Recent findings suggest that PCCRCs are more common in Denmark than in the English National Health Service [2].

The higher risk of Danish PCCRC coincides with a surprisingly low number of Danish colonoscopy-quality-improvement initiatives. The current Danish colonoscopy training, certification and quality monitoring resembles that of the English National Health Service 20 years ago [3]. In England, poor training and disappointing colonoscopy quality surveys met a firm response and a concerted effort to lift overall quality [4, 5]. In Denmark, there are no nationwide training programmes and no certification of colonoscopists, and individual colonoscopist performance monitoring is scarce. Only the Central Denmark Region has sought to systematically improve colonoscopy quality by introducing a series of training courses.

The primary aim of this study was to improve colonoscopy performance by introducing training programmes for junior and experienced colonoscopists. A secondary aim was to introduce a system for individual colonoscopist performance monitoring.

METHODS

Setting

The study was conducted at Aalborg University Hospital, North Denmark Region, Denmark. The study covered the main endoscopy unit at Aalborg University Hospital and a smaller satellite endoscopy unit in Hobro located 50 km away.

Performance indicators

The study had two main key performance indicators: The caecum intubation rate (CIR) and the polyp detection rate (PDR). The CIR was calculated as the percentage of colonoscopies with caecal intubation according to European guidelines [6]. The PDR was calculated as the percentage of colonoscopies discovering at least one polyp. The PDR differs from the adenoma detection rate (ADR), which includes only dysplastic polyps confirmed by histopathology.

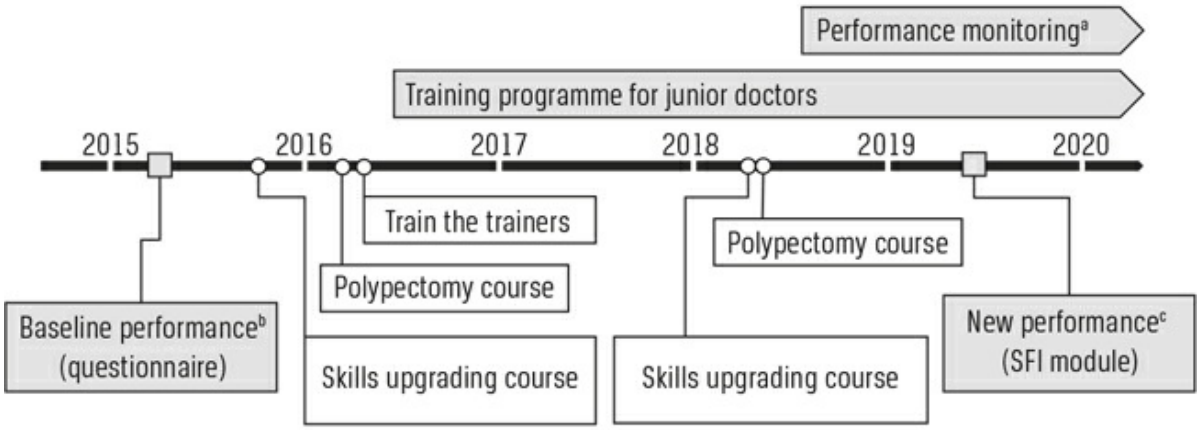
2015: Establishing baseline department performance

Baseline colonoscopy performance was established in 2015 in the form of a single-page questionnaire covering the CIR and the PDR. The survey encompassed all colonoscopies performed during a seven-week period. Colonoscopies were identified from booking records. The questionnaire was prefilled with patient name and identification number, and was distributed to the colonoscopists together with the paper-based health record (common procedure at the time). Unreturned questionnaires were identified from booking records and completed from electronic health records (EHR). The questionnaire was validated against the EHR on 100 colonoscopies with no errors related to CIR or PDR.

Quality-improvement initiatives

A multimodal approach was chosen to improve colonoscopy quality, targeting both experienced and junior colonoscopists (first-year surgical residents). A colonoscopy-reporting system was introduced to provide feedback to individual colonoscopists. A timeline of quality improvement initiatives is presented in **Figure 1**.

FIGURE 1 / Timeline of colonoscopy quality improvement initiatives.



SFI = supplementary file.
a) Individual colonoscopist performance monitoring.
b) Baseline department performance based on 894 colonoscopies.
c) New department performance based on 1,488 colonoscopies.

Two colonoscopy skills upgrading courses, two polypectomy courses and one train-the-trainer course were conducted from the autumn of 2015 to the spring of 2018. Each course lasted two days and had six participants. All colonoscopies from the endoscopy room were live-streamed and the videos displayed in an adjoining teaching room. Supervised by an expert from England, one delegate performed a colonoscopy, while the remaining delegates watched the video and discussed the case with another expert. The skills upgrading course covered areas such as scope handling, patient positioning and techniques to improve visualisation. The polypectomy course covered tips and tricks to improve the PDR, polyp removal tools, polyp classification and polyp lifting (for safer removal). The train-the-trainers courses were offered to selected colonoscopists expected to play a key role in the training of junior colonoscopists [7].

A module-based colonoscopy-training programme was developed for junior doctors. The training programme consisted of a two-day theory and simulator course followed by 20 days of supervised colonoscopies in the course of a three-month period. Competence improvements were tracked using the Assessment of Competence in Endoscopy by the American Society for Gastrointestinal Endoscopy [8, 9]. Each junior colonoscopist was assigned a personal trainer (mentor) who had previously completed the train-the-trainer course. Since the autumn of 2016, all first-year surgical residents have been enrolled in the modular training programme; at present, 14 junior doctors have completed the training programme.

A colonoscopy reporting system was developed based on a supplementary file (SFI) within

the EHR. Programming of the SFI was done by the regional business intelligence (BI) unit. The SFI consists of a series of input fields collecting information on each procedure. The SFI is used to generate a basic colonoscopy report for each procedure and to calculate performance indicators for each colonoscopist. SFI data include previously described performance indicators such as the CIR and the PDR, but also additional indicators such as number of polyps, nurse-reported patient comfort levels and withdrawal time (**Figure 2**) [10]. Individual colonoscopy performance reports are generated biannually. Un-anonymised individual reports are sent by e-mail to each colonoscopist and the head of department. Each performance report contains individual key performance indicators that are compared to department average scores and recognised performance goals (Figure 2). Anonymised output and performance reports are presented at endoscopy unit meetings to visualise individual performance differences and overall department performance.

FIGURE 2 / An example of the colonoscopy report.

Colonoscopist	Start	End
Anonymous	First date	Last date

Screening colonoscopies (procedures: 150)	Your performance[a]	Performance indicator
CIR, unadjusted	**94.0** (89-97)	⟩ **95%** optimal ⟩ **90%** acceptable **94.6%** unit average
PDR	**68.7** (61-76)	**56.0%** unit average
Average no. of polyps per positive procedure	**3.4** (2.7-4.1)	**2.6** unit average

Diagnostic colonoscopies (procedures: 172)	Your performance[a]	Performance indicator
CIR, unadjusted	**88.4** (83-93)	⟩ **90%** acceptable 90.2% RN average
PDR	**41.9** (34-50)	31.5% unit average

Other	Your performance[a]	Performance indicator
Total number of colonoscopies	**324**	⟩ 50

Nurse-reported comfort level[b]: Score ≤ 3	**90.4%** (87-93)	⟩ 65% 88.2% unit average
Nurse-reported comfort level[b]: Average score	**2.3** (2.2-2.4)	2.3 unit average
Retrieved polyps	**83.7%** (80-87)	⟩ 90% 89.0% unit average
Withdrawal time ⟩ 7 min., without polypectomy	**82.6%** (75-88)	⟩ 90% 70.1% unit average

CIR and PDR adjusted for case mix

	Your performance[a]	Performance indicator
CIR, unadjusted	**91.0%** (87-94)	92.0% unit average[c]
PDR	**54.0%** (48-60)	42.8% unit average[c]

CIR = caecum intubation rate; PDR = polyp detection rate; RN = North Denmark Region.
a) Shown with 95% confidence intervals.
b) Score from 1 (no discomfort) to 5 (severe discomfort).
c) Endoscopy unit average performance given an identical case mix to each individual colonoscopist, adjusted for colonoscopy indication, patient sex and age.

2019: Establishing new department performance

The CIR and the PDR, based on SFI data, were obtained for a 14-week period in the spring of 2019. To analyse internal data consistency, 100 colonoscopies were identified from booking records and investigated in the colonoscopy reporting system (SFI data) and the EHR. Three colonoscopies were missing in the colonoscopy reporting system (SFI not completed). Caecum intubation was obtained in all missing cases. In five colonoscopies, the identity of the colonoscopist was not reported, potentially affecting the individual performance reports, but not the department's performance.

Statistics

Statistical analysis was conducted using Stata MP 15.1. Univariable performance comparison before and after the quality improvement initiatives was conducted using the χ^2-test. Multivariable analysis was conducted controlling for age, sex and colonoscopy indication using logistic regression.

The colonoscopy performance report was generated from SFI data delivered by the BI unit. Stata loops generate a performance spreadsheet containing key performance indicators with 95% confidence intervals for each colonoscopist.

Trial registration: not relevant.

RESULTS

The 2015 colonoscopy quality survey covered 894 colonoscopies, of which 838 (93.7%) were returned by colonoscopists. The remaining 56 forms were completed on the basis of the EHR. Total CIR was 87.1% with a lower CIR among diagnostic colonoscopies (85.5%) than among screening colonoscopies (92.2%). Total PDR was 33.6%; 26.5% for diagnostic colonoscopies and 55.9% for screening colonoscopies (**Table 1**).

TABLE 1 / Characteristics of colonoscopies.

	2015	2019
All colonoscopies		
N	894	1,488
Patient age, yrs, mean	63.1	64.8
CIR (95% CI)	87.1 (84.8-89.3)	92.1 (90.6-93.4)
PDR (95% CI)	33.7 (30.6-36.9)	41.7 (39.1-44.2)
Screening colonoscopies		
n (%)	218 (24.4)	614 (41.3)
Patient age, yrs, mean	63.1	64.0
CIR (95% CI)	92.2 (87.8-95.4)	94.6 (92.5-96.3)
PDR (95% CI)	55.9 (49.1-62.7)	56.0 (52.0-60.0)
Diagnostic colonoscopies		
n (%)	676 (75.6)	874 (58.7)
Patient age, yrs, mean	63.1	65.3
CIR (95% CI)	85.5 (82.6-88.1)	90.3 (88.1-92.2)
PDR (95% CI)	26.5 (23.2-30.0)	31.6 (28.5-34.8)

CI = confidence interval; CIR = caecum intubation rate; PDR = polyp detection rate.

The 2019 output based on SFI data covered 1,488 colonoscopies. Overall CIR was 92.1%, with a lower CIR among diagnostic colonoscopies (90.3%) than among screening colonoscopies (94.6%). Total PDR was 41.7%, 31.6% for diagnostic colonoscopies and 56.0% for screening colonoscopies (Table 1).

Univariable analysis using the χ^2-test found an overall increase in CIR and PDR ($p < 0.001$). Multivariable analysis adjusting for age, sex and indication found an odds ratio (OR) for reaching the caecum of 1.63 in 2019, which was significantly higher than in 2015 ($p < 0.001$) (**Table 2**). The OR for polyp detection in 2019 was 1.13 compared to 2015, but this finding was not significant ($p = 0.19$) (Table 2).

TABLE 2 / Logistic regression for caecum intubation and polyp detection.

	OR (95% CI)	p-value
Caecum intubation		
Patient age, per year	0.98 (0.96-0.99)	< 0.001
Indication:		< 0.001
Diagnostic	1.00 (ref.)	
Screening	1.85 (1.33-2.58)	
Patient sex:		0.95
Female	1.00 (ref.)	
Male	0.99 (0.75-1.30)	
Year of colonoscopy:		< 0.01
2015	1.00 (ref.)	
2019	1.63 (1.24-2.15)	
Polyp detection		
Patient age, per year	1.03 (1.02-1.04)	< 0.001
Indication:		< 0.001
Diagnostic	1.00 (ref.)	
Screening	3.10 (2.59-3.73)	
Patient sex:		< 0.001
Female	1.00 (ref.)	
Male	1.73 (1.46-2.06)	
Year of colonoscopy:		0.19
2015	1.00 (ref.)	
2019	1.13 (0.94-1.36)	

CI = confidence interval; OR = odds ratio; ref. = reference.

The SFI was implemented at the endoscopy units in Aalborg and Hobro by January 2019. By summer 2019, the remaining three endoscopy units in the North Denmark Region had

implemented the SFI.

DISCUSSION

Each of the introduced quality-improvement initiatives has previously proven to be effective. Training programmes by English experts significantly improved both CIR and PDR/ADR in studies from Poland and the Central Denmark Region [11, 12]. To our knowledge, fast-track or module-based colonoscopy training programmes have so far not been evaluated in controlled trials, but have been shown to be effective training methods in other surgical fields [13]. Individual colonoscopy reporting systems with regular feedback are known to increase the ADR, even without additional training, which is most likely owed to the Hawthorne effect with a more meticulous scrutiny of the mucosal wall [14].

Quality improvement initiatives raised the CIR significantly from 87.1% to 92.1%, which corresponds to 39% fewer incomplete procedures. The results for the PDR were less clear. Univariable analysis did show a significant increase in overall PDR from 33.7% to 41.7%. However, the increase in PDR was caused mainly by a higher proportion of screening colonoscopies in the 2019 procedures (Table 1). The PDR for screening colonoscopies remained unchanged around 56%. This result is somewhat disappointing since training programmes by English experts produced PDR improvements for screening colonoscopies in the Central Denmark Region. The study conducted in the Central Denmark Region was designed differently, i.e. as an intervention study by a train-the-trainer course for experienced colonoscopists. The study also had a non-intervention group. PDR was measured shortly before and after the course, and PDR increased significantly in both the intervention and the non-intervention groups. For both the intervention and the non-intervention groups, the PDR baseline was lower in the Central Denmark Region (32.2% and 47.4%, respectively) than in the North Denmark Region (55.9%), leaving a larger room for improvement [11].

For diagnostic colonoscopies, the PDR was more encouraging as it rose from 26.5% to 31.6%. However, interpretation of data from a reporting system based entirely on an SFI should be made with caution as there is a risk of inflating the PDR. Monitoring could promote unwanted behaviour by performing polypectomies on obviously benign polyps that would otherwise have been left untouched. This phenomenon is referred to as “gaming the system” [15]. Monitoring the PDR/ADR ratio can be used to investigate any potential issue. Comparing the 2015 PDR (from SFI data) and ADR (from the Danish screening programme) reveals no indication of gaming, since the PDR and the ADR were almost identical (55.9% and 54%, respectively) [16]. This corresponds well with previous findings that the PDR is an acceptable marker for ADR, especially if the PDR/ADR ratio is audited continuously [15, 17]. Nonetheless, lack of incorporation with histopathology is a limitation. The benefits of removing small low-risk adenomas are debatable; but the removal of large high-risk

adenomas is not [18]. We know that the finding of medium and high-risk adenomas varies from 24% to 44% among Danish hospitals in the screening programme, indicating a huge potential for quality improvement [16].

It should be noted that indicators such as PDR and ADR are surrogate markers for the PCCRC rate. Individual PCCRC rates can be calculated, but this requires thousands of procedures and years of follow-up, making it impractical. Previous studies have established a significant association between individual colonoscopist ADR/polypectomy rate and PCCRC [19, 20].

The European Society of Gastrointestinal Endoscopy (ESGE) has published recommendations on colonoscopy-quality monitoring, but very few such recommendations have yet been implemented in Denmark [10]. Expanding the hospital-based performance tracking from the Danish screening programme to a system with individual colonoscopist performance tracking on all colonoscopies is obtainable. The system is based on codes for procedure, diagnosis and histopathology. In principle, an additional code with the unique healthcare authorisation number and data related to colonoscopy indication would be sufficient. The latter can be obtained from an SFI. Developing SFIs is currently a regional task, but by 2022 only two providers of EHR systems to Danish Regions will exist. Development and integration of an SFI in just two multiregional systems should make the task easier.

In England, the National Endoscopy Database, the Joint Advisory Group on GI Endoscopy and the Bowel Cancer Screening Programme provide a framework for nationwide performance tracking, endorsed colonoscopy training courses and colonoscopist certification [5]. Such initiatives have not yet been implemented in Denmark.

CONCLUSIONS

The quality improvement initiatives in the North Denmark Region have significantly improved the CIR and possibly the PDR at Aalborg University Hospital. An individual colonoscopist performance reporting system has now been implemented at all endoscopy units in the North Denmark Region. However, reporting systems and colonoscopy training are in dire need of improvement in order to comply with the ESGE recommendation and provide colonoscopy training comparable to that undertaken in England. Establishment of national initiatives to improve colonoscopy quality is recommended.

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