Parameters influencing the quality of colonoscopy in Belgium : a critical evaluation

E. Macken[1], S. Van Dongen[2], S. Francque[1], G. Van Hal[3]

(1) Antwerp University Hospital, 2650 Edegem, Antwerp, Belgium ; (2) University of Antwerp, 2610 Antwerp, Belgium ; (3) Medical Sociology and Health Policy, University of Antwerp, 2610 Antwerp, Belgium.

Abstract

Background and study aims : **In relation to recent implementation of colorectal cancer screening programs at the regional level, quality assessment of colonoscopy gains more interest in Belgium. In order to evaluate quality indicators of colonoscopies in Belgium, we retrospectively analysed data about colonoscopies performed between 2002-2010.**

Patients and methods : **Coded data concerning number of medical procedures and polypectomy were provided by the Intermutualistic Agency (IMA). This database was used to calculate different quality indicators such as polyp detection rate (PDR), use of sedation, amount of procedures and time interval according to physician and center type.**

Results : **Considerable differences in polyp detection rate (PDR) exist between different physicians and centers. Mean PDR significantly correlated with the number of colonoscopies performed each year. A minimum of 106 colonoscopies per year was identified to maintain competence. Recuperation rate for polyps was low, and time intervals between colonoscopies were generally too short in comparison to European and international guidelines.**

Conclusion : **In absence of a central colonoscopy registry in Belgium, our results were based on reimbursement data. Other quality parameters, although accuracy is questionable (eg. bowel cleansing and withdrawal time) are not systematically registered. Despite these difficulties, we were able to demonstrate that a minimum amount of 106 colonoscopies per year is necessary to maintain competence. The results from this large database can be used as a foundation to work out a quality colonoscopy bundle.** (Acta Gastroenterol. belg., **2018**, 81, **29-38**).

Key words : colonoscopy, quality, polyp detection rate

Introduction

In Belgium colorectal cancer was the second most frequently diagnosed cancer in women in the period 2004-2013, after breast cancer and the third most frequently diagnosed cancer in men after prostate and lung cancer. In 2013, 8670 colorectal cancers were diagnosed in Belgium : 3298 colon cancers and 1489 rectal cancers in men and 2923 colon cancers and 960 rectal cancers in women (1).

Tumour staging at diagnosis has been shown to predict prognosis : survival rates are better for those diagnosed early in the course of the disease. Global 5 year relative survival proportion in Flanders is 67 % for women and 66 % for men in the 2009-2013 cohort.

Quality of life also depends on the disease stage and is significantly worse in patients with an advanced stage in comparison with patients with earlier stages. Furthermore the cost for treatment of colorectal cancer is related to the staging of the tumor and rises with more advanced stages. Therefore there is a clear rationale to develop strategies that allow an early diagnosis in a less advanced stage. Until 2013 about half of all colon cancers were diagnosed in already advanced stages (III or IV) (1). In 2014, a shift towards more early stage diagnosis was observed in the Flemish Region due to implementation of a colorectal cancer screening program. The European Commission recommends an organised population-based screening for colorectal cancer by using a faecal occult blood test (FOBT) for all inhabitants of its countries between 50 and 74 years. The 3 different regions in Belgium chose different options. In Flanders, a population-based screening with the immunochemical FOBT was effectively implemented in October 2013. If the test is positive (abnormal sample), a colonoscopy should be performed. The potential benefit of this screening strategy largely depends on the quality of the colonoscopies performed. Since no centralized colonoscopy quality register exists in Belgium no quality data are available. Therefore, we studied colonoscopy practice in Belgium for a period of 9 years (2002-2010), based on the information of the IMA. We analysed the total number of procedures, the polypectomy rate, the use of sedation and intervals between the procedures. Whenever relevant, we also explored variation among physicians and hospitals.

Patients, material and methods

For the current analysis, the BCR pooled and pseudonymized data from IMA. IMA obtains data from all health insurance companies in Belgium. For this study, IMA data on specific procedures (listed in Table 1), that were claimed by the physician for reimbursement by the insurance companies, were used. The IMA datasets comprised data between 01/01/2001 and 31/12/2010.

Correspondence to : Elisabeth Macken, MD, Gastroenterology & Hepatology, Antwerp University Hospital, 2650 Edegem, Antwerp, Belgium.
Telephone +3238213310. Fax +3238214478
E-mail : elisabeth.macken@uza.be.

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Table 1. — **Examinations recorded and terminology**

Nomenclature code as per IMA	Type of examination	Remarks
472452-472463	rectosigmoidoscopy	
473130-473141	left colonoscopy	withdrawn 1/2/13
473174-473185	total colonoscopy	examination refunded for a complete or incomplete examination (until the hepatic flexure)
473955-473966	additional number for polypectomy	can be added to endoscopic examination since 1/2/09
473432-473443	ileoscopy	
473756-473760	ileoscopy with removal of tumor	
473211-473222	resection of polyps	can't be added to endoscopy refunded only once a year
472511-472522	rectoscopy	
588011-588022	pathologic examination	charged by pathologist
FULL COLONOSCOPY	total colonoscopy or ileoscopy (without resection) total colonoscopy	
FULL PROCEDURE	or ileoscopy or polypectomy (with or without resection)	
POLYPECTOMY	resection of polyps and additional number for resections of polyps	

All examinations and reimbursement codes included are listed in Table 1.

Differences among Physicians and hospitals

For comparisons among physicians, we compared 3 specialties and age classes. We used the NSIII (national institute for sickness and invalidity insurance) number (unique identification number for each physician also coding for the qualification of the physician).

Some physicians changed their NSIII number during the years. In Belgium 119 specialists changed from specialist in internal medicine to specialist in gastroenterology, most of them in 2009, most likely driven by changes in reimbursement rules for endoscopic procedures and privileging. These physicians were considered as gastroenterologists throughout the study period.

Although in bigger training hospitals procedures are also performed by trainees, examinations are not recorded like that because colonoscopies performed by a trainee are rewarded less than colonoscopies performed by specialists. Normally they should be supervised and claimed by a licensed gastroenterologist.

We focused on the examinations performed by gastroenterologists, specialists in internal medicine and surgeons. To study the amount of procedures per physician per year, only physicians who were present in the database for more than one year (between first and last procedures) were taken into account. In doing so, only 1 % of all procedures were discarded, yet several specialists were herewith excluded (number of gastroenterologists reducing from 628 to 599, number of internists reducing from 368 to 219 and number of surgeons reducing from 452 to 318). A full colonoscopy was defined as a total colonoscopy or ileoscopy without resection. A full procedure was defined as a total colonoscopy or ileoscopy (with or without resection) or polypectomy (Table 1). We calculated the number of full procedures and the proportion of physicians performing >100, >150 and >300 full procedures per year, based on existing guidelines and quality criteria. We also calculated the proportion of physicians performing >50 resections per year. As we were unaware of the true age of the physician, we defined a young specialist as a physician appearing in the dataset after 2003 (i.e., no records in 2001, 2002 and 2003), and older specialists (who presumably retired) as those disappearing before 2008 (i.e., no records in 2008, 2009 and 2010). In this way, we were able to identify 116 young and 13 'pre-retirement' physicians.

Hospitals were divided in 3 groups : one group included the regular hospitals: general hospitals and university hospitals (127 hospitals); the second group included psychiatric hospitals, geriatric hospitals, military hospitals and revalidation centers, further called 'other hospitals'; the third group included private practices.

Polyp detection rate

We were able to estimate polyp detection rates (PDR) on the basis of the nomenclature of the different procedures (Table 1). PDR was defined as all polypectomies divided by all full procedures (see Table 1 for definitions). PDR was calculated separately for males and females focusing on all first full colonoscopies in patients older than 50 years, and also for the whole population based on all colonoscopies without taking age or gender into account. Use of an overall PDR simplifies PDR measurement, and produces similar results compared to screening-only PDR (2). We compared PDR statistically among the 3 types of physicians, types of hospitals, between procedures under deep sedation or conscious sedation (see below) using chi-square tests. In case more than two groups were compared, after a significant overall test,

pairwise comparisons were also performed and p-values were adjusted for multiple testing using Bonferroni.

The association between the numbers of full procedures per year and the PDR was explored graphically, in order to make recommendations about the minimum of number of full procedures required each year for a physician to be considered as sufficiently experienced in detecting polyps.

As we expect the association to level off at some breakpoint, a piecewise regression was performed to identify such a threshold value. This point could be considered as a criterion for minimal number of full procedures required.

Polyp recovery rates

Polyp recovery rates (percentage of excised polyps that are retrieved for pathologic examination) were also calculated for all physicians and compared among the three types of physicians, among hospital types, between gastroenterologists, between physicians of different age. Comparison of polyp recovery rates between physicians with different colonoscopy volumes was performed.

Time interval between procedures

We calculated the number of procedures per patient as well as the time interval between different procedures. To achieve this, we calculated the time between all subsequent procedures within patients. We first focused on all procedures and full colonoscopies irrespective of whether a resection was performed and provide descriptive statistics. Next we provided histograms of time intervals between a full colonoscopy without resection and subsequent full procedure, and between a procedure with resection and subsequent full procedure.

Use of deep sedation

The use of deep sedation (propofol sedation with general anaesthesia) was estimated for all examinations and for the full colonoscopies separately. Variation in the use of deep sedation among hospitals is presented in a histogram. PDR was compared among procedures performed with and without deep sedation. Finally, the correlation between the proportion of procedures performed under deep sedation for each physician and their respective PDR was calculated and presented in a graph.

Results

General results

Number of procedures and differences among physicians and hospitals

In Belgium 2,403,385 examinations (colonoscopy, left colonoscopy and rectoscopy) were performed from 01/01/2002 until 31/12/2010 in 1,333,682 patients. After cleaning the data and omitting double procedures, 2,382,727 examinations were retained in 1,333,682 patients. Among these examinations, 1,027,949 full colonoscopies were performed in 829,028 patients and 1,326,126 full procedures were performed in 994,047 patients. The majority of the patients (63 %) underwent only one examination. Most of the procedures were performed by gastroenterologists (628 gastroenterologists performing 2,079,484 procedures (87 % of total amount of procedures)) and specialists in internal medicine (368 internists performing 200,304 procedures (8 % of total amount of procedures)), some procedures were performed by pediatricians (94 pediatricians performing 6498 procedures (0.28 % of total amount of procedures total)) and surgeons (452 surgeons performing 73,052 procedures (3 % of total amount of procedures). The remaining 1.72 % was performed by other specialists.

The least active physician performed only 2 colonoscopies on 2 different persons in 9 years, while the most active physician performed on average 3,262 procedures per year of which 1,092 full procedures, most of them in a private practice (93.4 %). Six physicians performed on average more than 1,500 endoscopies a year, most

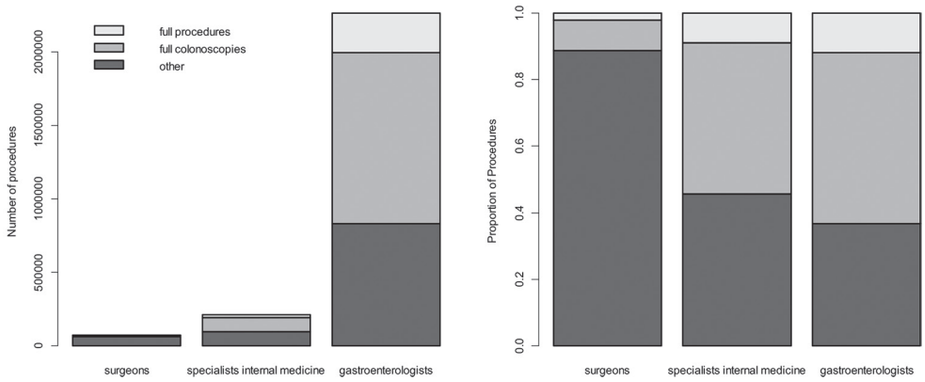

Figure 1. — Number and proportion of different procedures performed by gastroenterologists (n = 628), specialists internal medicine (n = 368) and surgeons (n = 452).

Table 2. — **Average number of full procedures and resections for each specialisation per year and physician. The proportion of physicians performing more than 100, 150 and 300 full procedures and more than 50 resections are also provided for each type of physician.**

Full procedures (FP)	mean (SD)	>100	>150	>300
gastroenterologist	254 (175)	81%	73%	35%
internist	57 (101)	23%	18%	5%
surgeon	2.7 (18)	1%	1%	0%
Resections (RE)	mean (SD)	>50		
gastroenterologist	61 (58)	49%		
internist	12 (25)	6%		
surgeon	0.7 (5)	1%		

of them left colonoscopies, all of them work in private practices, combined with one or several hospitals.

Most procedures (78.9 %) were performed in an outpatient ambulatory setting (no hospitalization), only 21.1 % in hospitalized patients.

Overall, gastroenterologists performed most procedures and proportionally performed somewhat more full colonoscopies and full procedures compared to specialists in internal medicine. Surgeons performed the fewest procedures and proportionally very few full colonoscopies and full procedures compared to the other two groups of physicians (Fig. 1).

At the level of the number of procedures per year and physician, gastroenterologists performed about 5 times more full procedures and resections per year compared to internists (Table 2). In addition, surgeons performed relatively few full procedures and resections (Table 2).

In our dataset 49 % of gastroenterologists performed 50 or more resections per year (calculated in all patients). Only 6 % of general internists and 1 % of surgeons, perform more than 50 resections per year (Table 2).

Polyp detection rates

Mean polyp detection rate on the basis of a first full procedure at the age of 50 or older was 33.5 % for men and 22.8 % for women. Overall, and irrespective of age, PDR equaled 23.7%. There was a substantial amount of variation in PDR among individual physicians (Fig. 2). PDR was highest in gastroenterologists and lowest for internists, a difference that was statistically significant (fig 3). PDR was highest in general and university hospitals, and significantly lower in private practices and lowest in the 'other' hospitals (Fig 3). On the average, younger physicians had a higher PDR, but only the difference between young and middle-aged gastroenterologists was statistically significant (Fig 3).

To compare PDR among physicians with a different volume of full procedures per year, we first created quintiles on the basis of the number of full procedures performed in the group of patients for which the PDR was calculated (i.e., first full procedures in patients aged 50 or older or all full procedures). Physicians who did less than 50 full procedures in total were excluded to avoid large sampling variation in the PDR estimations. For the male and female PDR of patients of 50 years and older, quintiles were defined as : Q1 : 6-64 ; Q2 : 65-107 ; Q3 : 108-149 ; Q4 : 150-210 ; Q5 : 211-512. For the PDR overall, based on all full procedures, quintiles were defined as : Q1 : 6-118 ; Q2 : 119-190 ; Q3 : 191-277 ; Q4 : 278-380 ; Q5 : 381-1092. The PDR of physicians differed significantly between the quintiles for males (ANOVA : $F_{4,626} = 6.22$, $p<0.0001$), females (ANOVA : $F_{4,626} = 4.02$, $p<0.01$) and overall (ANOVA :

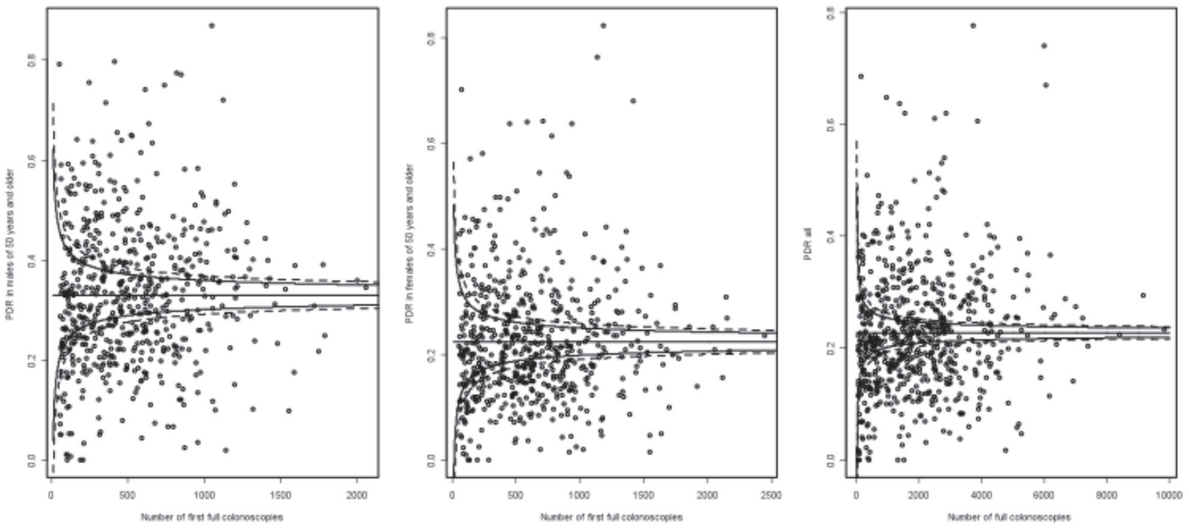

Figure 2. — Funnel plot of the variation in polyp detection rates among physicians. Results are presented for the first full procedures in males and females aged 50 years or older and overall irrespective of gender and age. Solid lines represent 95 % confidence bands, dashed lines are 99 % confidence bands.[IP1][ME2]

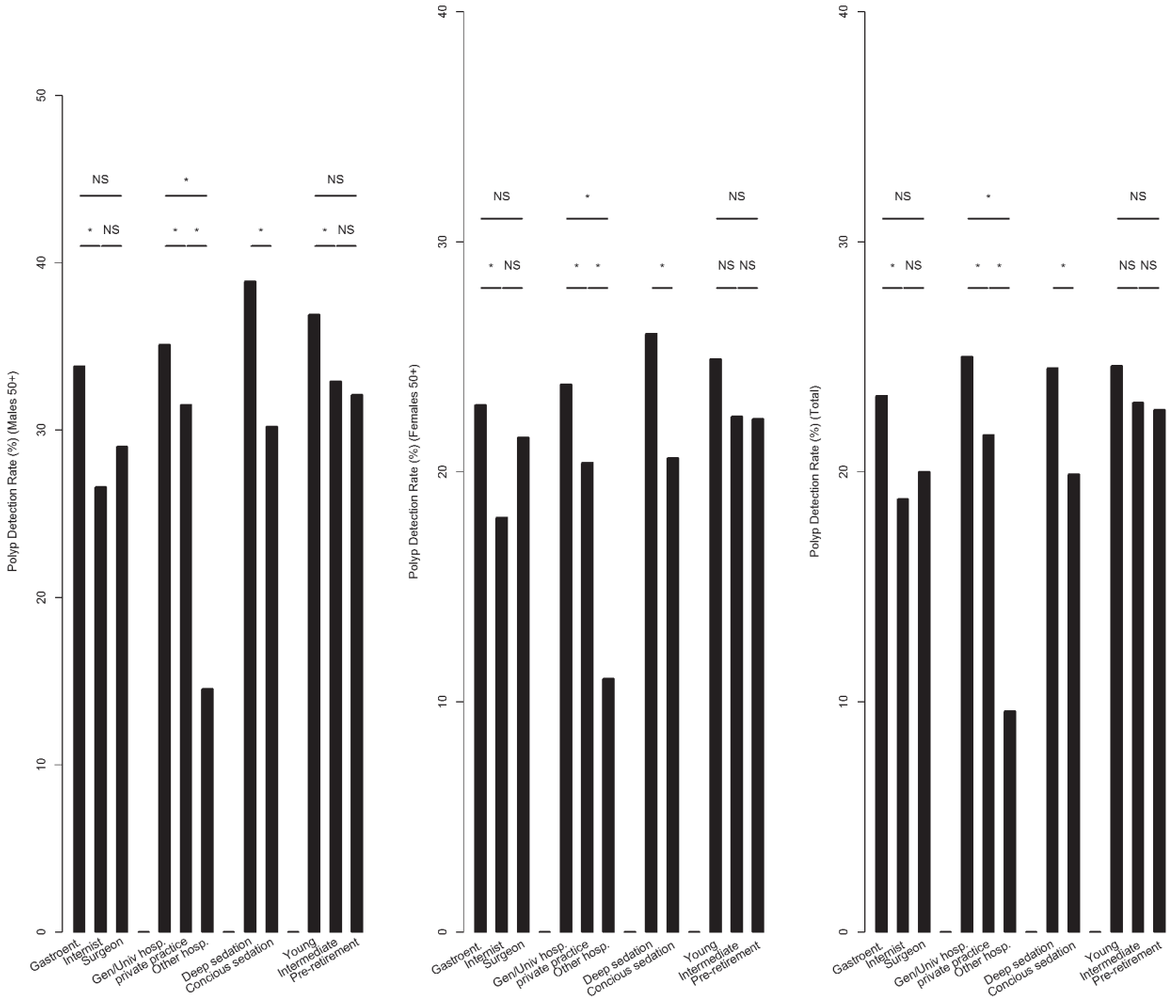

Figure 3. — Bar chart of polyp detection rate in males and females of > 50 years (first colonoscopies) and overall polyp detection rate (irrespective of age, gender, and number of colonoscopies) in relation to specialty, hospital, volume of endoscopies and age of physician.

* : results are statistically significant ($p < 0.05$). NS : not statistically significant ($p > 0.05$).

F4,640 = 5.20, p<0.001). For the PDR of males, pairwise comparisons showed that the PDR of the first quintile was significantly lower than all others, while for the other 4 (Q2-Q5), PDR did not differ significantly (PDR of males : Q1 : 28.0% ; Q2 : 33.2% ; Q3 : 34.5% ; Q4 : 32.4% ; Q5 : 36.1%) For the PDR of females, only 2 pairwise comparisons were statistically significant, where the PDR of Q1 was significantly lower than that of Q3 and Q5 (PDR of females : Q1 : 19.5% ; Q2 : 22.7% ; Q3 : 23.5% ; Q4 : 21.2% ; Q5: 24.8%). Finally, for the overall PDR the average for Q1 was significantly lower than the average PDR of Q4 and Q5 (PDR all full procedures : Q1 : 19.3% ; Q2 : 23.0% ; Q3 : 22.5% ; Q4 : 23.4% ; Q5 : 25.5%). Figure 4 shows the results of the piecewise regression model of the association between the number of full procedures per year and the PDR of physicians performing more than 50 full procedures in total. The curve is significantly rising and levels off at a breakpoint of 106 (SE+32) full procedures a year, after which the increase in PDR is no longer statistically significant.

Polyp recovery rates

Overall, pathology was only charged in 49 % of patients who underwent a resection. The polyp recovery rate improved from 42.7 % in 2007 to 59.6 % in 2009-2010. The lowest rate was observed in private practices (35.9%). All differences were highly significant (p<0.0001). There was no significant difference in polyp recovery rate between gastroenterologists (47%), specialists in internal medicine (49%) and surgeons (53%). However, the difference in recovery rate was statistically significant between the three age classes (young : 53%; middle : 47%; pre-retirement : 42% ; p = 0.04) but none of the two-way comparisons were significant. As for PDR, there appeared to be a large amount of variation in polyp

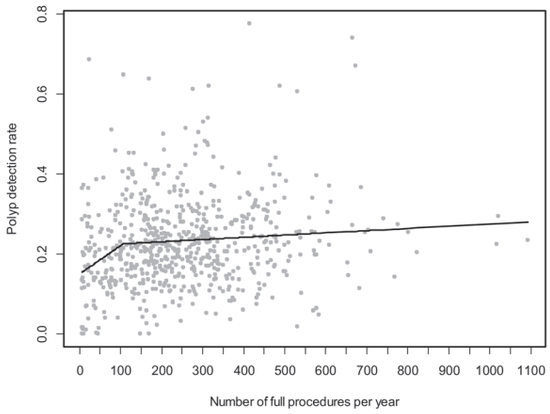

Figure 4. — Number of full procedures per year [IP1][ME2] for each physician in relation to the polyp detection rate. A piecewise regression model with one break point was fitted showing a breakpoint at 106 (SE = 32). The slope equaled 0.0007 (SE = 0.0003, p<0.0001) before the breakpoint, and equaled 0.00006 (SE=0.00003, p>0.05) after the breakpoint..

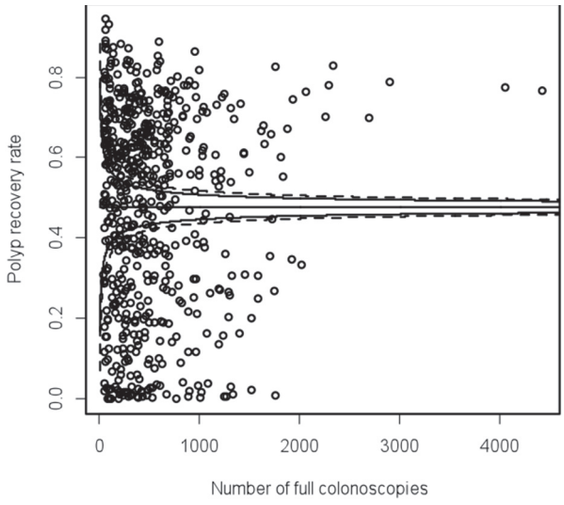

Figure 5. — Funnel graph of variation in polyp recovery rates among physicians performing more than 50 procedures per year. Solid lines represent 95% confidence bands, dashed lines are 99% confidence bands.

recovery rate among physicians (Fig. 5). Only 36 (6%) physicians recuperate the polyp in more than 80 % of cases.

Time interval between procedures

Of all 1,333,682 patients in our dataset with at least one examination, 994,047 (74 %) underwent at least one full procedure, of which 222,499 patients (22%) had more than one full procedure. Mean number of procedures per patient is 1.29, with a maximum of 156 (left colonoscopies). The mean interval between two colonoscopies is 1.28 years (median 0.49 years), and mean interval between two full procedures is 2.73 years (median 2.4 years).

The histograms (Fig. 6 and 7) show the intervals between the colonoscopies without resection and with resection respectively. Many colonoscopies are rescheduled after 1, 2 or 3 years.

Use of deep sedation

Overall, 62.7 % of examinations were performed under conscious sedation and 37.3% under deep sedation. Of all full colonoscopies, 38.3% were performed under conscious sedation and 61.7% under deep sedation.

There is considerable variation among hospitals, where some hospitals always use deep sedation, some never do (Fig. 8).

Polyp detection rate was significantly higher when the procedure was performed under deep sedation (fig 3). Figure 9 shows the correlation between the PDR and the proportion of full procedures performed with deep sedation, which was significantly positive (r+0.19, p<0.0001).

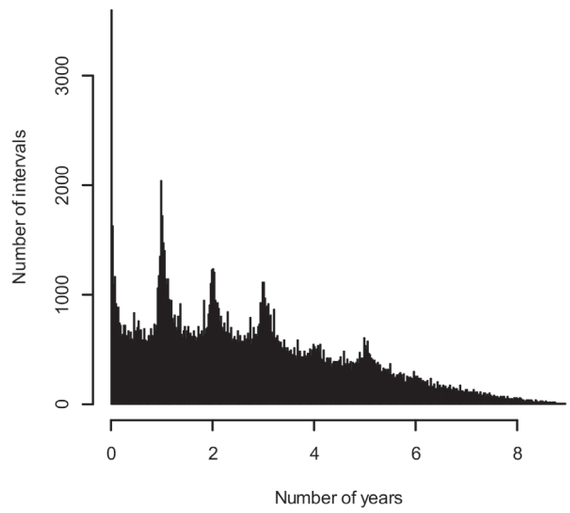

Figure 6. — Histogram of intervals between two full coloscopies without resection.

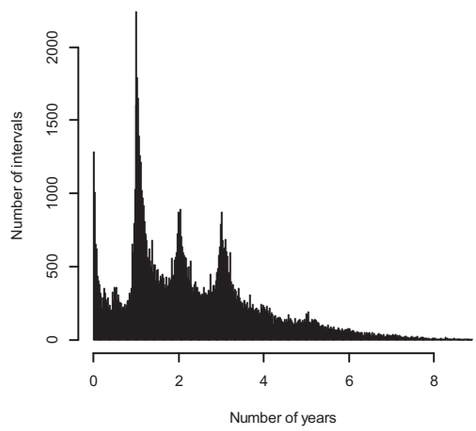

Figure 7. — Histogram of intervals between a colonoscopy with resection and a subsequent colonoscopy.

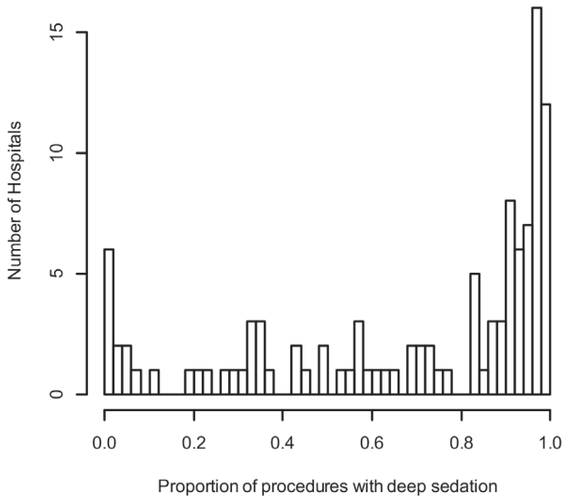

Figure 8. — Use of deep sedation in the different hospitals.

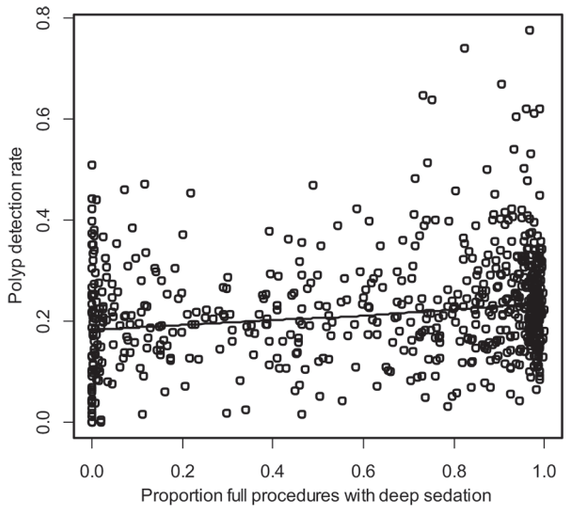

Figure 9. — Correlation between polyp detection rate and proportion of full procedures performed with deep sedation for each physician. The correlation coefficient equaled 0.19 and was highly significant ($p<0.0001$).

Discussion

Monitoring and evaluation of quality indicators of diagnostic and therapeutic interventions in medicine is considered indispensable in the overall quality assessment of medical care. In the field of gastrointestinal diseases quality assurance of endoscopic examinations is increasingly recognized, specifically for colonoscopies associated with population-based screening programs for CRC.

Triggered by the recent implementation of such a screening program in the Flemish Region, the current study aimed to analyse the practice of colonoscopies performed in Belgium.

As no centralized colonoscopy quality register exists in Belgium (3), we had to rely on data we obtained from the IMA, which are based on invoice data (reimbursements). Due to privacy reasons we had no access to the medical reports to verify data accuracy. As such, accuracy of the data depends on the correct registration of the technical act by the performing physician.

In Belgium 1,027,949 full colonoscopies were performed in nine years, signifying 114,216 colonoscopies a year or 1,047 colonoscopies per 100,000 inhabitants (10900000 inhabitants in 2010). We subsequently analyzed several parameters we obtained.

Performing an adequate volume of colonoscopies annually is necessary to gain and obtain competence. To gain competence, based on caecal intubation, numbers between 200 and 300 are advocated (4-6). In the UK guidelines a minimum number of 100 colonoscopies per annum is required to maintain competence (6). Harewood showed that a minimum of 200 executed procedures performed by junior endoscopists is required to maintain competence.

Only few studies have been performed about obtaining competence. A fixed minimum annual number is not established, but numbers between 100 and 200 have been proposed (6-8). Most studies use caecal intubation as a reference for competence, but the relationship with the adenoma detection rate (ADR) is not well established. The European CRC screening guidelines propagate a volume of > 300 colonoscopies performed annually (9), but this number can be debated. Pace et al. showed that a higher annual volume of colonoscopies is associated with improved PDR, ADR and completion rates (10). However, gastroenterology specialty appears to be a better predictor than the annual volume for predicting ADR (10-11). Other studies found no relationship between quality parameters and the annual volume of colonoscopies (12). In a Canadian study no relationship between the annual volume and the incidence of post colonoscopy colorectal cancer (PCCRC) was found (13). We however noticed a significant correlation between PDR and the annual volume of colonoscopies. A minimal annual number of procedures is required to maintain endoscopic competence. Since overall PDR is significantly lower in the first quintile, a number of at least 118 colonoscopies yearly seems to be required. Based on our results, we suggest a minimum number of 106 colonoscopies per year (Fig. 4). In the UK a minimum number of 100 screening colonoscopies per year has been agreed upon.

The mean number of colonoscopies performed annually by Belgian gastroenterologists is 254. This number is an overestimation since some examinations are performed by trainees. Seventy-three percent of gastroenterologists perform more than 150 colonoscopies a year, and only 35 % perform more than 300 colonoscopies a year. Moreover, considerable differences exist between different physicians and hospitals. Only 258 physicians out of 632 performed more than 2 full colonoscopies in 10 years time. On the contrary, some physicians perform

more than 1,500 or even 3,000 examinations a year, mostly in private practice. In a British study the mean annual number of colonoscopies performed was 130 (8), and in a US study it was only 55 (14).

The setting of the colonoscopy (non-hospital based colonoscopy) has been shown to be associated with post colonoscopy colorectal cancer (13). In our study, we found considerable differences between different types of setting. PDR is significantly lower in private practices and in other hospitals than in regular hospitals. Several factors can play a role to explain this observation. Policies of the hospitals or institutions can influence the quality of colonoscopy by deciding on bowel preparation instructions, timing of colonoscopy and workforce. Also, the approach to colonoscopy training is an important factor for colonoscopy performance with the availability of good trainers and possibility of participation in endoscopy courses (15). Kaminski showed in Poland that this indeed could allow to improve the overall performance of an endoscopy center (16). As no detailed data on several of these potential causal factors are available, we cannot make firm conclusions on the underlying reasons for the observed differences, but the data stress the need for standardized procedures regardless of the type of institution and the need for training and expertise.

ADR is considered one of the key quality indicators of colonoscopies (17), and has been shown to be associated with interval colorectal cancer (13, 18-19). As we had no access to data on the pathology of the polyp, we calculated the PDR, which has been demonstrated to be a reliable estimate of adenoma detection rate (20-21), although there are some conflicting results concerning polyps in the left hemicolon (22). Polyp detection rate is much easier to use and can be used as a surrogate quality parameter for ADR, if it is validated for each endoscopist. For all Belgian physicians performing colonoscopy during these 9 years, PDR was 33.5 % for men and 22.8 % for women for all first colonoscopies performed in patients older than 50 years.

PDR was 23.7 % for all colonoscopies in all age groups. It should be noted, however, that our results are based on reimbursement codes and, as this is linked with income, subject to over-registration and hence the data can be an overestimation.

Furthermore, reimbursement of a polypectomy of a very small hyperplastic polyp in the sigmoid, an inflammatory polyp or a big 2 cm adenoma is the same, also influencing the accuracy of the data.

Big differences exist between the endoscopists, leading to underperformance or overperformance on an individual basis. The lowest PDR was 0%, and the highest 100 % (Fig. 2).

PDR is higher for young physicians, which probably stands for their greater awareness, emphasized during their training. We found a relationship between specialized training in colonoscopy and effectiveness. PDR was higher for gastroenterologists than for other specialists and significantly lower in private practice (13). An association between the specialty (gastroenterologist) and the reduced risk of death from CRC after colonoscopy was described previously in a US cohort (23). It seems plausible that while performing more colonoscopies, technique improves and more complete procedures are performed and more lesions on a difficult location (e.g. behind folds) or subtle lesions that can be easily overlooked (e.g. sessile serrated lesions) will be recognized.

Following the guidelines (9), in 90 % of polypectomies recovery of the polyp is necessary and pathological examination has to be performed. The pathological examination of the polyp helps to determine the surveillance interval and to establish the nature of the polyp (high or low risk adenoma). It is also a marker of the technical skills of the endoscopist. In our study polyp recovery was only 49 %. These results may be an underestimation since other (incorrect) ways for reimbursement (not measured in our study) may have been used by physicians. We assume also that a lot of polyps removed were small polyps, not worth picking up, but as we had no access to the individual data, this remains an assumption. When taking into account only the polyps sent for pathological examination, PDR falls to 11.6 %. Polyp recovery varied markedly, and was significantly lower in private practices and for pre-retirement gastroenterologists. The lack of data on the pathology of polyps removed is clearly a bias for this retrospective study. The correlation between the pathology results of the resected polyps and the polypectomy rates and the other quality parameters will be assessed in future studies.

Although minor differences exist between the European and US guidelines, they agree that in case of a qualitatively good bowel preparation and the presence of only small hyperplastic polyps in rectum or sigmoid, surveillance colonoscopy is recommended after 10 years in the absence of genetic predisposition. If more than 3 adenomas, or an adenoma > 10 mm, with villous characteristics or with high grade dysplasia is completely resected, surveillance is recommended after 3 years. European guidelines state that for high risk adenomas surveillance is recommended after 3 years and after 5 years in case of low risk adenomas, after 6 months in case of incomplete resection (24-25). In our study, for colonoscopies performed in 2002 without resection, surveillance colonoscopies were performed after 1, 2, 3 and 4 years but not after 5 years. Surveillance colonoscopies after polypectomy were set mostly after 1 year, also after 2 and 3 years. These intervals are hence not conform the guidelines, and unless bowel preparation was not sufficient this means that surveillance colonoscopies are scheduled far too quickly and too frequently, which overloads the health system and raises the costs. A high quality colonoscopy should lead to longer surveillance interval.

There is considerable variation in sedation practice between different countries and centers. In Belgium,

most full procedures are performed under deep sedation. Decision to use deep sedation is depending on the situation on-site and the availability and practice of the anesthesiologist and related to the usual practice of the endoscopist and the hospital, and to the expectations of the patient. In Belgium, propofol sedation may only be administered by an anesthesiologist, and hence not by an anesthetic technician, implying higher costs for the patient and community, and an incentive for choosing this type of sedation as this leads to a higher income for the hospital and for the anesthesiologist. Moreover, extra societal costs related to absence from work have to be considered. Some patients expect to not feel any discomfort during the procedure, but these expectations can vary between different countries. On the other hand, the rapid onset of action of propofol makes it ideal for short procedures, and for patients, especially with a difficult colon, it can be more comfortable.

One of the advantages of conscious sedation is the much easier possibility of position changes during colonoscopy. Position changes could lead to a higher ADR (26). However, results vary and in other studies the effect of position changes on ADR is uncertain (27-28).

Most studies showed no correlation between type of sedation and ADR (29-30). ADR in screening colonoscopies was not increased by the use of propofol (31).

We found however a significantly higher PDR in colonoscopies performed under deep sedation, compared to colonoscopies performed under conscious sedation. However, there can be a bias because PDR varies so widely between different physicians. Some endoscopists perform their colonoscopies always under deep sedation or always under conscious sedation, and PDR varies with the endoscopist. As mentioned earlier, the lack of data on the pathology of polyps removed is a bias and the correlation between the ADR and the type of sedation will have to be assessed in future studies.

General considerations

A colonoscopy is an expensive and invasive examination, and there is a clear need to measure and record performance. As outlined previously, in our study we had to rely on reimbursement codes and we didn't have information about quality data like bowel cleansing or caecal intubation rate.

We demonstrated that the endoscopist performance varies considerably. This is partly due to money driven reporting in Belgium by some physicians, who are rewarded for quantity and not for quality. A low polyp recovery rate suggests overuse of the reimbursement number 'polypectomy' due to the higher refund. After all, the income of the physician is in most hospitals directly related to the procedures performed.

Our results also show that a minimum of 106 performed colonoscopies per year is necessary to hold competence. But motivation and training of the endoscopist is probably the most important factor related with quality of endoscopy. A colonoscopy is not effective when used by poorly trained physicians or when performed hastily. A careful examination of the colon necessarily consumes substantial time but is not rewarded properly.

This systematic data collection of the population can prove a valuable tool to mastermind a quality bundle that can be validated against hard outcomes like post colonoscopy colorectal cancer and cancer death. In absence of a quality register, we could use these data (amount of colonoscopies, interval between colonoscopies, PDR and ADR) to measure quality. A high quality colonoscopy should be rewarded properly. Higher quality colonoscopies will lead to an improved health and less overutilization, thus lesser costs. From improving quality the whole society will benefit.

In conclusion, based on information of the IMA, the Belgian gastroenterologist is performing an adequate amount of colonoscopies a year, suggested to be at least 106. PDR varies significantly between centers and endoscopists, and is significantly lower in non-gastroenterologists, in pre-retirement gastroenterologists and in private practices. Based on reimbursement codes, polyp recovery is with 49 % very much below the standard. Based on these data, a quality bundle for colonoscopy could be worked out.

The strength of our study is that it is the first review that comprises information about all colonoscopies performed in Belgium during a 9 year follow-up period. Limitations are that data are based on reimbursement codes which do not contain information about other quality parameters (eg histology), and that pathologists may use other codes than the correct ones used in our study.

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