Continuous ADR50 monitoring through automated linkage between endoscopy and pathology: a quality improvement initiative in a Brussels public hospital

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Abstract

Background and study aim: Adenoma detection rate in patients aged 50 years or older (ADR50) is considered by the European Society of Gastrointestinal Endoscopy (ESGE) a key performance measure for lower gastrointestinal endoscopy. Technical and human resources constrain implementation of recording quality monitoring. The aim was to deploy an infrastructure for continuous monitoring of endoscopy quality indicators. And to evaluate its potential benefit on quality performance.

Methods: A company reporting system was adapted by adding a dedicated tab for quality monitoring, including: preparation, progression, number of resected polyps. Automated linkage with the pathology database resulted in continuous monitoring of inter alia: rate of adequate bowel preparation, cecal intubation rate and ADR50. Continuous monitoring was done for all nine endoscopists working at our center, with individual feedback after 4, 9 and 28 months.

Results: A total of 1434 colonoscopies were performed during the first 9 months of monitoring, 682 during the first 4 months, 752 during the following 5 months. Five months after feedback a global increase in ADR50 of 4.6% (22.9% to 27.5%) (P<0.05) was observed, compared to the first 4 months. Thus meeting the benchmark (≥25%) recommended by ESGE. A durable effect of monitoring and feedback was observed after 28 months (ADR50: 29.4%).

Conclusions: An easy to use infrastructure for registration of quality monitoring in daily endoscopy practice, automatically linking the pathology database, facilitates continuous monitoring of endoscopy quality indicators. A global and durable ADR50 increase was observed after feedback, considered a quality improvement in performance of lower gastrointestinal endoscopy at our center. (Acta gastroenterol. belg., 2022, 85, 259-266).

Keywords: ADR50, automation, quality improvement, lower gastrointestinal endoscopy.

Abbreviations

AADR, advanced adenoma detection rate  
ADR, adenoma detection rate  
ADR50, adenoma detection rate in patients aged 50 years or older  
BBPS, Boston Bowel Preparation Scale  
CAD, computer-aided diagnosis  
CIR, cecal intubation rate  
CRC, colorectal cancer  
ESGE, European Society of Gastrointestinal Endoscopy  
GI, gastrointestinal  
IT, information technology  
NLP, natural language processing  
PDR50, polyp detection rate in patients aged 50 years or older  
RABP, rate of adequate bowel preparation

SNOMED CT®, Systematized Nomenclature Of Medicine Clinical Terms®  
%ADR p, percentage of adenoma among polyps resected

Introduction

Colonoscopy is an established screening for colorectal cancer (CRC), the fourth leading cause of death from cancer globally (1,2). Over 80% of CRC cases progress through the adenoma-adenocarcinoma process in 5-10 years (1). Colonoscopy can reduce CRC incidence and mortality through detection of tumors at an early stage, with the need for less advanced treatment, and through removal of precancerous lesions (1,3). Inversely, failing to detect adenomas during colonoscopy might augment the risk for interval CRC, which are CRC cases occurring before the next recommended colonoscopy. Adenoma miss rates are estimated as high as 24% in tandem studies (4,5). Possible reasons for these high adenoma miss rates and potential subsequent interval cancers are right-sided lesions, flat polyps and variation in quality measures taken by the endoscopist (6,7). Because of important individual performance variation, together with the implementation of nationwide screening programs for CRC, the field of lower gastrointestinal (GI) endoscopy was the first to address quality (8,9).

In 2017 the European Society of Gastrointestinal Endoscopy (ESGE) published a guideline on quality in lower GI endoscopy, assessing a heterogenous collection of potential performance measures. Based on available evidence and expert opinion, a distinction was made between minor and key performance measures in seven different quality domains (10). The highest level of evidence is seen for the following three key performance measures: rate of adequate bowel preparation (RABP), cecal intubation rate (CIR) and adenoma detection rate 50 (ADR50) (10).
RABP is the percentage of patients with an adequately prepared bowel assessed by a validated scale. The most studied and thus preferred is the Boston Bowel Preparation Scale (BBPS), which should be equal or superior to 6 out of 9 (11). Quality of bowel preparation is associated with a direct proportionality with CIR and ADR50 (12,13). ESGE proposes a minimum percentage of adequate bowel preparation of 90% with a target standard of more than 95% (10). This number is established on population-based studies and randomized clinical trials (14-17).

CIR is the percentage of colonoscopies reaching and visualizing the cecum and its landmarks. Cecal intubation means the complete length of the colon can be examined in search of lesions. Inverse proportionality is seen between CIR and the risk of interval CRC. ESGE proposes a minimum percentage of adequate bowel preparation of 90% with a target standard of more than 95% (10). Moderate quality evidence comes from large population-based studies (15,18).

ADR50 is the percentage of colonoscopies in patients aged 50 years or older with at least one adenoma identified. Detection and resection of these precursor lesions, is considered a corner stone of CRC prevention. ADR50 reflects adequate bowel inspection. However the true value of ADR50 comes from the established inverse proportionality between ADR50 and risk of interval CRC and even CRC mortality (19-21). This impact on the hard endpoint makes it one of the most interesting and widely recognized performance measures to monitor. ESGE proposes a target standard for ADR50 of more than 25% (10).

While RABP and CIR are relatively easy to track in daily endoscopy practice, monitoring of ADR50 relies on both endoscopy and pathology. In need for a histology diagnosis, in the end it is the pathology report concluding whether a resected polyp is an actual adenoma. And thus whether it can be included for calculating the ADR50. This gap between daily endoscopy practice and the pathology report, which is usually obtained only within a few days after the colonoscopy procedure, remains one of the main barriers for routine ADR50 monitoring today. Additionally, it is difficult to match colonoscopy and pathology results because the form of the reporting system of each examination is different. In many hospitals, endoscopy reports and pathology results are still recorded in a narrative format. Computing ADR50 by hand is labor intensive and time consuming.

Because quality in endoscopy is one of the top priorities of our institution, we aimed to construct a ready able, user friendly system for monitoring of performance measures with an emphasis on automated ADR50 tracking. Ideally with the available technical infrastructure yet in place, to suppress the need for use of additional financial resources. Above all we were curious what our individual and global ADR50 would be and whether it could be improved through intermediate individual feedback.

Methods

In order to reach our objective of monitoring performance measures in an automated fashion, efficient collaboration between three departments is required: the digestive endoscopy department, the pathology department and the information technology (IT) department, merging data from those two (Figure 1).

Endoscopy

Colonoscopy reports are written in a company reporting system called ENDOWBASE® (Olympus Corp., Tokyo, Japan). It is a user friendly, semi-standardized environment which is easy to adapt in accordance to local needs and emphasis. It gathers all relevant data with the potential of linking it to other significant data retrieved from distant, independent IT systems.

An adaptation of the standard reporting process was made by programming a new specific tab for quality monitoring. A dropdown menu required the following data to be reported by the endoscopist after each colonoscopy procedure: bowel preparation according to BBPS (3-9), degree of progression (rectum, sigmoid colon, descending colon, transverse colon, ascending colon, cecum, terminal ileum), indication and number of resected polyps. Every resected polyp was numbered and stored in a different container.

Pathology

Next to a detailed pathology report in a narrative format, all histology diagnosis are also referred to in a specific data format by using Systematized Nomenclature of Medicine Clinical Terms® (SNOMED CT®) (International Health Terminology Standards Development Organisation, London, UK). These codes are stored in a separate database called DIAMIC® (Dedalus Healthcare Group, Bonn, Germany).

IT

The IT department retrieved the endoscopy data from ENDOBASE® and matched it to the SNOMED...
In order to screen durability, a third period of monitoring was evaluated in May 2021. This time taking into account the six previous months (November through April 2021) with a total number of colonoscopy procedures comparable to the first and second monitoring period.

**Results**

During the first 9 months of monitoring an overall of 1434 colonoscopies were performed, 682 during the first 4 months, 752 during the following 5 months. RABP increased from 84.8% after 4 months to 88.7% in the second period. Whereas CIR was not subject to large change with 92.7% after 4 months, compared to 93.0% in the second period. PDR50 augmented from 35.5% after 4 months, to 37.2% during the second period. An increase in ADR50 was observed in seven out of nine endoscopy operators (Figure 2), resulting in a global, statistically significant increase of 4.6% (22.9% to 27.5% for the first period as compared to the second) (P<0.05). Thus reaching the predetermined ADR50 target standard by ESGE. Also in seven out of nine endoscopists %ADR p increased, resulting in a global increase of 12.1% (53.4% to 65.5% for the first period as compared to the second) (P<0.05).

During the third period of monitoring, from November 2020 through April 2021, 756 colonoscopy procedures were performed, 682 during the first 4 months, 752 during the following 5 months. RABP increased from 84.8% after 4 months to 88.7% in the second period. Whereas CIR was not subject to large change with 92.7% after 4 months, compared to 93.0% in the second period. PDR50 augmented from 35.5% after 4 months, to 37.2% during the second period. An increase in ADR50 was observed in seven out of nine endoscopy operators (Figure 2), resulting in a global, statistically significant increase of 4.6% (22.9% to 27.5% for the first period as compared to the second) (P<0.05). Thus reaching the predetermined ADR50 target standard by ESGE. Also in seven out of nine endoscopists %ADR p increased, resulting in a global increase of 12.1% (53.4% to 65.5% for the first period as compared to the second) (P<0.05).

**Calculating performance measures**

RABP, CIR, PDR50, ADR50 and %ADR p were defined as follows:

- **RABP** = (number of colonoscopy procedures with a BBPS equal or superior to 6 out of 9 / number of colonoscopy procedures) × 100
- **CIR** = (number of colonoscopy procedures that report reaching the cecum / number of colonoscopy procedures) × 100
- **PDR50** = (number of examinations with polyps in patients aged 50 years or older / total number of examinations) × 100
- **ADR50** = (number of examinations with adenomas in patients aged 50 or older / total number of examinations) × 100
- **%ADR p** = (number of confirmed adenoma on pathology reporting / number of resected polyps) × 100

**Validation of the automated ADR50 calculating system**

To verify the accuracy of the automated ADR50 arithmetic, a manual control was calculated for the global ADR50 and for two endoscopy operators independently by reviewing medical records.

**Performance audit**

Participation was mandatory for all nine senior endoscopists working at our institution with at least 10 years experience in colonoscopy. After the first 4 months of monitoring (January to April 2019) all participants were individually confronted with their personal numbers and an anonymous ranking was communicated. This was done in a neutral way, without the promise of any consequences. Some of them spontaneously asked for feedback on how to augment personal numbers. After another 5 months of monitoring (May to September 2019) we compared the data of these two separate periods. A second, similar feedback moment took place.
Table 1. — Results of monitoring performance measures

<table>
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<th>ADR50</th>
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RABP = rate of adequate bowel preparation, CIR = cecal intubation rate, PRD50 = polyp detection rate in patients aged 50 years or older, ADR50 = adenoma detection rate in patients aged 50 years or older, %ADR p = percentage of adenoma among polyps resected, 1st = first monitoring from January to April 2019 (682 colonoscopy procedures), 2nd = second monitoring period from May to September 2019 (752 colonoscopy procedures), 3rd = third monitoring period from November 2020 to April 2021 (756 colonoscopy procedures). All numbers are percentages (%).
Discussion

The importance of screening for CRC is recognized worldwide (1). The golden standard for CRC screening is colonoscopy. But its impact in screening programs is related to its quality. A heterogenous ensemble of quality indicators or performance measures is described in literature. The most established among them is ADR50, which is the percentage of colonoscopy procedures in patients aged 50 years or older in which at least one adenoma is resected. Strong evidence supports its correlation with interval CRC and even CRC mortality (19-21).

ADR50 remains today however one of the most difficult parameters to manage because of the difficulty in linking endoscopy data with pathology results. Also, many endoscopy units are still not employing standardized and structured reporting systems and pathology input forms.

At the other hand, calculating ADR50 manually is labor and time consuming. As a result the majority of endoscopy departments today are still unable to monitor their quality performance.

Tracking PDR50 is a proposed alternative to ADR50 monitoring. PDR50 is the percentage of colonoscopy procedures in patients aged 50 years or older in which at least one polyp is resected (22,23). It excludes the need for gap closure between endoscopy and pathology. However if poorly applied, nonselective resection of polyps without clinical significance only increases the financial burden. Expert societies like ESGE support that endoscopy data with pathology results. Also, many endoscopy units are still not employing standardized and structured reporting systems and pathology input forms.

At the other hand, calculating ADR50 manually is labor and time consuming. As a result the majority of endoscopy departments today are still unable to monitor their quality performance.

Commercial alternatives for ADR50 monitoring are either expensive or in development. In our proper endoscopy department we successfully established ourselves an automated computing system for tracking ADR50 in daily colonoscopy practice.

In the past, numerous attempts have been made to establish an algorithm capable of automatically calculating ADR50. The biggest challenge of such a system is the exact matching of endoscopy data and pathology results for each resected polyp. Some researchers have attempted to merge endoscopy and pathology data using natural language processing (NLP) (24-27). A technique to extract meaningful information from text reports (28). The merging system using NLP methodology has one major disadvantage, its error rate increases significantly with the amount of data analyzed (26,27). Our system is different in a sense that standardized endoscopy reporting is directly matched, one on one, with pathology data also standardly reported using SNOMED CT® codes. This results in quasi live tracking of the ADR. In the meantime researchers from the Korean National Cancer Center have also developed a similar ADR tracking method using standardized coding (29).

The advantage of continuously tracking ADR50 is the possibility of attempting to increase ADR50 individually and/or globally. Different ways of trying to do so are described in literature. The easiest, eldest and least expensive is through feedback (30). Kaminski was the first to report on this topic, describing ADR improvement through simple feedback. However the poorest performers at baseline were not able to increase their ADR sufficiently only through feedback (31). A Korean study used annual feedback and saw an increase in ADR in almost 75% of its participants (32). Another way to improve ADR numbers is through training, either peer-to-peer and/or with the help of specifically designed courses, both theory and hands-on. Coe demonstrated the value of educational efforts randomly assigning fifteen endoscopy operators, after a baseline observational period, to an intensive training course versus a non-training group. The trainees outperformed their colleagues with a mean ADR increase of 12% (33). Offering sustained education on how to identify and correctly remove adenoma is primordial (34). Later on Kaminski compared training versus feedback in forty endoscopy operators. Training improved mean ADR by 7.1%, while feedback augmented mean ADR by 4.2%. Also described is a sustained difference for the training group in mean ADR of 3.9%, 18 months after training (35). Rajasekhar tried to study the effect of implementing a bundle of four simple interventions during routine colonoscopy on ADR. Those being a withdrawal time of more than 6 minutes, the use of an antispasmodic (hyoscine butylbromide), position change (supine patient position for transverse colon examination) and rectal retroflexion. A global ADR increase was observed with major improvements for the poorest performers (36). More recently, other ways to increase ADR are the use of visual enhancement devices and computer-aided detection (CADe) through artificial intelligence (37,38).

In our single center experience, after the first 4 months of tracking ADR50, an anonymous ranking was published, and every operator received its personal ADR50. This was done neutrally without any promised consequences, but with the unforced possibility to ask for feedback if desired. We do believe this was important when starting to monitor personal ADR50 percentages. Because one can acknowledge a certain psychological barrier when an endoscopy operator is exposing its capacities through an objective parameter, next to a certain vulnerability when confronted by its numbers. The numbers were appreciated in different ways. But no matter personal numbers, each endoscopy operator was triggered and willing to augment its ADR50. Some actively asked for feedback. Seven out of nine endoscopy operators managed to increase their ADR50. Efforts to sort out a durable approach when using this no strings attached feedback technique are question to further study. One group compared quartile versus monthly feedback, showing significant benefit for the latter approach (39). An unannounced third feedback moment 19 months later revealed that global ADR50 was still correct and even slightly increasing. Surprisingly among the four operators who saw their ADR50 decreasing were the
two best endoscopists from the second period, albeit still largely superior to the proposed ESGE target standard of more than 25%. The five others continued to make progress. Overall, a durable effect of our continuous monitoring system on lower GI endoscopy performance can be concluded.

A footnote can be placed for the change in laxative use for bowel preparation at our institution. Since November 2020 (the beginning of the third period) we recommend Plenvu® (Norgine, Amsterdam, The Netherlands) where previously Picoprep® (Ferring Pharmaceuticals, Saint-Prex, Switzerland) was used. The increase in RABP of 3% might be affected by this change.

During our short study period reported here, ADR50 varied substantially between different endoscopy operators. This may be because of a diversity in indications. Although we differentiated on age (> 50 years old), due to technical constraints we did not exclude emergency nor therapeutic (e.g. endoscopic dilation in inflammatory bowel disease (IBD)) procedures. So one could assume the global ADR50 presented here might be falsely lower than the actual one. In addition, the participating endoscopy operators varied in terms of age, endoscopy experience and subspeciality (e.g. endoscopists specialized in screening colonoscopy, therapeutic endoscopists, IBD specialists, hepatologists). Which could result in potential consequences on their personal ADR50 numbers, based on their different subpopulations of patients undergoing a colonoscopy. But in the end, we do believe that the age criterion as applied here, which implies the standard CRC screening population, is of more importance and thus the above described potential bias could be considered as rather marginal. The modest number of colonoscopy procedures and operators included here are insufficient to perform further analysis to determine differences by subspeciality.

Our system currently does not distinguish complete from incomplete polyp resection, since this concept is not included in the SNOMED CT® coding language. Adapting the system in this philosophy would be easy in theory by adding a simple binary code to the pathology report for each resected specimen. But it won’t replace the necessity for every endoscopy operator to audit their pathology reports individually.

When taking a closer look the exact definition of ADR, one could appreciate that resecting more than one adenoma in one patient does not contribute to a higher ADR. This is a classic misconception about ADR that sometimes is still confusing endoscopists. However the evident goal of a screening colonoscopy procedure is to resect (among other) all potential adenoma. When resecting more than one polyp, each specimen is labeled and stored separately in a unique container. As such the pathologist reports in accordance to this unique numeration. A bottle neck here is the human accuracy and care applied to both labeling and reporting.

We are aware of the difficulty to implement our system, as described above, in another random endoscopy unit. Although using this paper as a manual is not completely impossible. But a couple of conditions are primordial. The collaboration of three different fields is key. First of all, a motivated and accessible IT department is needed to provide the technical knowhow and infrastructure in merging endoscopy and pathology data. Second, the pathology department has to complement their written reports with a coding system. Third, a user friendly and standard reporting system for endoscopy should be available in consideration of user convenience. The cost of this is often a major obstacle, especially for small endoscopy units. Above all, every endoscopy operator should be motivated to report in a standardized fashion and to fill out the required parameters in an honorable way. Next to the need to sometimes psychologically overcome the idea of exposure of their personal vulnerability. With consequential motivation to do better if needed. We acknowledge the need of a standardized ‘whole package’ that can be applied and implemented in every hospital system.

Further study, next to an open debate is necessary because of some questions left unanswered. From which number on is the added relevance of an ever-increasing ADR50 negligible? ESGE suggested an ADR50 of at least 25% is adequate, recently the American Gastroenterological Association (AGA) recommended ADR50 should be ≥30% (with an aspirational target of ≥35%) (40). This proposition was based on recent data suggesting that the risk of interval CRC is further reduced when ADR50 is about 35% or higher (41). Where to position the use of the advanced adenoma detection rate (AADR)? Which is defined as an adenoma that measures 10mm or more in size, contains a substantial villous component, of exhibits high-grade dysplasia (42). How can we technically integrate a resect and discard strategy in this whole? Is it possible to make ADR monitoring a nationwide obligation? Or should we evolve, like in some neighboring countries, towards a voluntary participation in quality assurance programs (43)? Should there be any consequences for sustained poor performers? Like exclusion from screening programs or an obligatory training of any kind? Sufficient time should be available to endoscopists to meticulously examine the entire colon mucosa (44). Therefore, one could state the number of performed screening colonoscopy procedures per day by one operator should be limited by national law to assure a certain quality standard. As such also reducing the incidence of preventable CRC and the unnecessary cost of repeated examination. Which can only be achieved by adequate colonoscopy practice in which adenoma are correctly observed and resected (43).

In conclusion, we established a ready able infrastructure for continuous quality monitoring in daily lower GI endoscopy practice. The integrated linkage between endoscopy and pathology is quite unique in its kind and enables to automatically track ADR50, overcoming previous barriers. A global and durable ADR50 increase was observed after individual feedback, which can be
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considered as a quality improvement in the performance of lower GI endoscopy at our center.

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Conflict of interest

There is no conflict of interest.

References


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