

## Public reporting of colonoscopy quality is associated with an increase in endoscopist adenoma detection rate

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**Background:** Colonoscopy is the predominant method for colorectal cancer screening in the United States. Previous studies have documented variation across physicians in colonoscopy quality as measured by the adenoma detection rate (ADR). ADR is the primary quality measure of colonoscopy examinations and an indicator of the likelihood of subsequent colorectal cancer. There is interest in mechanisms to improve the ADR. In Central Illinois, a local employer and a quality improvement organization partnered to publically report physician colonoscopy quality.

**Objective:** We assessed whether this initiative was associated with an improvement in the ADR.

**Design:** We compared ADRs before and after public reporting at a private practice endoscopy center with 11 gastroenterologists in Peoria, Illinois, who participated in the initiative. To generate the ADR, colonoscopy and pathology reports from examinations performed over 4 years at the endoscopy center were analyzed by using previously validated natural language processing software.

**Setting:** A central Illinois endoscopy center.

**Results:** The ADR in the pre-public reporting period was 34.3% and 39.2% in the post-public reporting period (an increase of 4.9%,  $P < .001$ ). The increase in the right-sided ADR was 5.1% ( $P < .01$ ), whereas the increase in the left-sided ADR was 2.1% ( $P < .05$ ). The increase in the ADR was 7.8% for screening colonoscopies ( $P < 0.05$ ) and 3.5% for nonscreening colonoscopies ( $P < .05$ ). All but 1 physician's ADR increased (range  $-2.7\%$  to  $10.5\%$ ). There was no statistically significant change in the advanced ADR (increase of  $0.8\%$ ,  $P = .22$ ).

**Limitations:** There was no concurrent control group to assess whether the increased ADR was due to a secular trend.

**Conclusion:** A public reporting initiative on colonoscopy quality was associated with an increase in ADR. (Gastrointest Endosc 2015;82:676-82.)

Through the diagnosis and removal of premalignant colonic lesions, endoscopic screening significantly reduces colorectal cancer (CRC) incidence and mortality; however, the quality of endoscopic testing varies.<sup>1-3</sup> The adenoma detection rate (ADR), a key marker of colonoscopy quality, can vary threefold across endoscopists.<sup>4,6</sup> The lower a

physician's ADR is, the greater the risk of his or her patients receiving a diagnosis of interval colon cancer, cancer detected after colonoscopy but before the next examination is due.<sup>5,7</sup>

Because of the direct link between ADR and subsequent cancer incidence, there is interest in interventions that

*Abbreviations:* ADR, adenoma detection rate; CRC, colorectal cancer.

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can increase the detection rate of premalignant lesions.<sup>8</sup> A recent systematic review evaluated interventions such as increasing the endoscopic withdrawal time, enhanced segmental withdrawal, and provider feedback on improving quality. The review concluded that existing interventions have generally been ineffective or inconsistent in improving the detection of premalignant lesions. For example, giving feedback to physicians on their polyp detection rates has had a mixed impact.<sup>9,10</sup>

Although it is being used widely in health care, public reporting has not yet been studied as an intervention to improve colonoscopy quality.<sup>11</sup> In New York State, surgeon-specific mortality rates after cardiovascular surgery have been reported since 1997. Hospital quality is reported publicly on Medicare's Hospital Compare Web site, and Medicare is moving toward more widespread physician public reporting by using its Physician Compare Web site.<sup>12</sup> Cardiology societies have begun studying the feasibility of public reporting by using clinical data from the National Cardiovascular Database Registry.<sup>13</sup> In the field of gastroenterology, public reporting could be based on quality data from national registries such as the GI Quality Improvement Consortium and the National Endoscopic Database, which both include millions of colonoscopy procedures.<sup>14,15</sup>

Given the growing use of public reporting in health care and interest in interventions to reduce CRC incidence through improved ADRs, our goal was to assess whether public reporting was associated with improved colonoscopy quality.

## METHODS

### Setting

Quality Quest for Health of Illinois (<http://www.qualityquest.org>) is a nonprofit health care collaborative of providers, employers, and health plans that share the goal of improving the quality of care in Central Illinois. One Quality Quest initiative focused on colonoscopy quality. A team of gastroenterologists, pathologists, and surgeons created a global colonoscopy quality measure that included the following evaluation criteria: (1) timing and interval of the colonoscopy; (2) serious procedural complications such as perforation, hospitalization, and bleeding requiring blood transfusion and report of the patient's risk; (3) report of the quality of the bowel preparation; (4) completion of the procedure with appropriate imaging documentation of landmarks; (5) complete information provided to the pathologist when specimens are sent for evaluation; (6) time spent in withdrawal or examining the colon; and (7) appropriate recommendation for time of a follow-up colonoscopy. ADRs were collected and reported to Quality Quest with the expectation that they would eventually be included in the public report. Surgeons and gastroenterologists in Peoria and Decatur, Illinois hand-collected the

necessary data elements from their records and submitted these data to establish a report of colonoscopy quality (<http://www.qualityquest.org/quality-reports/colonoscopies/index.php>). Physicians are listed by name in descending order of performance based on the overall colonoscopy quality index that combines the quality measures into a single number. The public reporting initiative began in August 2010. Twenty-eight endoscopists were included in the initiative, whereas 9 others were excluded due to insufficient volume (<30 cases/year). Caterpillar, the major employer in the community, mandated endoscopist participation in the initiative as a condition for being included in the provider network for their employees. Among those participating were physicians at Central Illinois Endoscopy, a private practice of 11 gastroenterologists. The physicians at this center are general gastroenterologists whose primary focus is clinical care. During the study period, the endoscopy center used high-definition endoscopic equipment.

### Data

The data used in the public reporting initiative were not used in the analyses. Instead, in partnership with Central Illinois Endoscopy, reports of all outpatient colonoscopies and pathology performed between July 2009 and May 2013 were independently analyzed by the research team. Colonoscopy was performed at a private endoscopy center. The practice uses an electronic health record (ProVation, Minneapolis, Minn), and the colonoscopy reports are a combination of structured reports and free text entered by the physicians. The electronic health record was implemented in July 2009.

### Abstracting necessary data elements from reports

This study is a retrospective review of 20,040 colonoscopy and associated pathology reports. All reports were de-identified and transferred electronically to the Department of Biomedical Informatics at the University of Pittsburgh. Relevant data from the reports were abstracted by using a previously developed natural language processing (NLP) computer-based software application. Details of the development and testing of this tool are provided in more depth elsewhere.<sup>6,16-18</sup> In brief, NLP is a field of computer science through which programs can "read" written text and pull out key variables. The accuracy of the NLP program was confirmed by comparing a set of 453 reports analyzed by the NLP program and manually abstracted by a group of physicians. The key variables identified included colonoscopy indication, quality of bowel preparation, removal of polyps, size of polyps, and presence of adenomas. Adenomas were identified in the pathology report, and advanced adenomas were those with a villous component or high-grade dysplasia or were 10 mm or greater in size. Adenoma location was classified as right, left, or unclear. Right-sided adenomas were those proximal to the

**TABLE 1. Patient and procedure characteristics in pre- and post-reporting periods**

	All colonoscopies in study period (N = 17,526)	Colonoscopies before public reporting (July 2009-April 2010) (n = 2627)	Colonoscopies after public reporting (November 2010-May 2013) (n = 14,899)	P value
Age of patient, y*	59.4 (SD 11.9)	60.4 (SD 12.2)	59.3 (SD 11.9)	<.001
<40	1007 (5.7%)	144 (5.5%)	863 (5.8%)	.528
40-49	1307 (7.5%)	209 (8.0%)	1098 (7.4%)	.292
50-59	6388 (36.4%)	832 (31.7%)	5556 (37.3%)	<.001
60-69	5223 (29.8%)	777 (29.6%)	4446 (29.8%)	.785
≥70	3440 (19.6%)	612 (23.3%)	2828 (19%)	<.001
Sex†				
Male	7312 (46.9%)	1191 (45.4%)	6121 (47.2%)	.104
Female	8289 (53.1%)	1431 (54.6%)	6858 (52.8%)	
Indication for colonoscopy				
Screening	6694 (38.2%)	736 (28.0%)	5958 (40.0%)	<.001
Surveillance	5191 (29.6%)	886 (33.7%)	4305 (28.9%)	<.001
Other indications	5641 (32.2%)	1005 (38.3%)	4636 (31.1%)	<.001
Family history of colorectal cancer reported				
Yes	1768 (10.1%)	246 (9.4%)	1,522 (10.2%)	.182
No	15,758 (89.9%)	2381 (90.6%)	13,377 (89.8%)	
Colonoscopy completed				
Prep adequate	16,751 (95.6%)	2456 (93.5%)	14,295 (95.9%)	<.001
Incomplete procedures	457 (2.6%)	66 (2.5%)	391 (2.6%)	.74

SD, Standard deviation.

\*A total of 162 reports were missing the age variable, so the mean age was calculated based on the remaining 17,364 reports (2574 before and 14,791 after public reporting).

†A total of 1925 reports were missing the sex variable so calculation of sex frequencies were based on 15,601 reports (2622 before and 12,979 after public reporting).

descending colon including those in splenic flexure or those at a depth greater than or equal to 50 cm. Unclear location was designated if the adenoma the location was an anastomosis. By using the  $\kappa$  statistic, the rate of agreement between physicians and the NLP program for the ADR measure was 0.72, a rate typically considered to indicate good agreement.<sup>18</sup>

Indication was broken down into 3 categories: (1) screening (patients with no history of colonoscopy, inflammatory bowel disease, or family history of colon cancer); (2) high-risk screening or surveillance (patients with history of polyps or family history of colon cancer); (3) other (all other colonoscopies performed for symptoms such as GI bleeding or abdominal pain or a history of inflammatory bowel disease). Up to 3 indications for the colonoscopy were captured. If the endoscopist reported the indication for colonoscopy as being both for screening and to address symptoms, it was categorized as a screening colonoscopy.

## Data analysis

The primary aim was to compare colonoscopy quality in the period before and after the public reporting initiative of August 2010. Data in the transition period

(3 months before and 3 months after public reporting [May 2010-October 2010]) were excluded in the main analysis to address anticipatory improvements in quality as well as provide time for any quality improvement activities to have effect. For sensitivity analyses, this 6-month transition period was not excluded, and results were found to be similar. The ADR was calculated for all colonoscopies and separately for screening colonoscopies. Two of the 11 gastroenterologists joined the practice after the group's involvement in the Quality Quest initiative. For the other 9 physicians, we compared each physician's pre- and post-period ADRs. The data were analyzed by using IBM SPSS (version 20.0; Armonk, NY). Univariate statistical analyses were performed to describe the study population. Student *t* and  $\chi^2$  tests were used to determine differences in continuous and categorical variables, respectively. The study protocol was reviewed and approved by the Institutional Review Boards of the University of Pittsburgh Medical Center and Harvard Medical School.

## RESULTS

A total of 20,038 colonoscopies were performed between July 2009 and May 2013, for an average of

**TABLE 2. Adenoma detection rate by colonoscopy type in pre- and post-reporting periods**

Quality measures	All colonoscopies (N = 17,526)	Colonoscopies before public reporting (July 2009-April 2010) (n = 2627)	Colonoscopies after public reporting (November 2010-May 2013) (n = 14,899)	P value
All colonoscopies				
Polyp detection rate	9653 (55.1%)	1284 (48.9%)	8369 (56.2%)	<.001
Adenoma detection rate	6747 (38.5%)	901 (34.3%)	5846 (39.2%)	<.001
Right colon adenoma detection rate	4714 (26.9%)	593 (22.6%)	4121 (27.7%)	<.001
Left colon adenoma detection rate	2747 (15.7%)	364 (13.9%)	2383 (16.0%)	.005
Advanced adenoma detection rate*	2176 (12.4%)	307 (11.7%)	1869 (12.5%)	.219
Large adenoma detection rate	1859 (10.6%)	256 (9.7%)	1603 (10.8%)	.120
Villous, dysplastic changes, or carcinoma rate	685 (3.9%)	113 (4.3%)	572 (3.8%)	.260
Serrated adenoma	1247 (7.1%)	153 (5.8%)	1094 (7.3%)	.005
Adenoma to polyp ratio	0.699	0.701	0.698	
Limited to screening colonoscopies				
Polyp detection rate	3953 (59.1%)	381 (51.8%)	3572 (60.0%)	<.001
Adenoma detection rate	2646 (39.5%)	240 (32.6%)	2406 (40.4%)	<.001
Right colon adenoma detection rate	1841 (27.5%)	159 (21.6%)	1682 (28.2%)	<.001
Left colon adenoma detection rate	1145 (17.1%)	113 (15.4%)	1032 (17.3%)	.181
Advanced adenoma detection rate*	797 (11.9%)	71 (9.6%)	726 (12.2%)	.045
Large adenoma detection rate	712 (10.6%)	64 (8.7%)	648 (10.9%)	.070
Villous, dysplastic changes, or carcinoma rate	224 (3.3%)	25 (3.4%)	199 (3.3%)	.936
Serrated adenoma	506 (7.6%)	44 (6.0%)	462 (7.8%)	.086
Adenoma-to-polyp ratio	0.668	0.629	0.673	
Other quality measures				
Withdrawal time reported	2954 (16.9%)	8 (0.3%)	2946 (19.8%)	<.001
ASA classification of patient reported†	11,239 (64.1%)	1 (0%)	11,238 (75.4%)	<.001
Informed consent documented	17,525 (100%)	2627 (100%)	14,898 (100%)	.675
Quality of colonoscopy prep reported	16,751 (95.6%)	2456 (93.5%)	14,295 (95.9%)	<.001

ASA, American Society of Anesthesiologists.

\*Adenoma size  $\geq 10$  mm or pathology consistent with villous component or dysplastic changes.

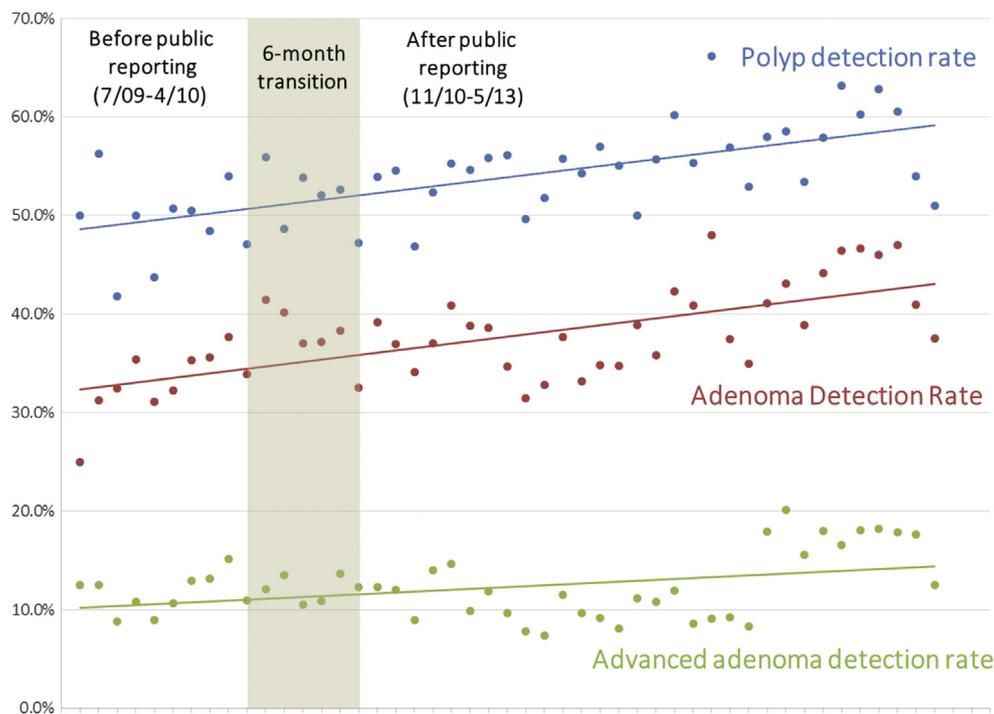
†American Society of Anesthesiologists Physical Status classification system.

426 reports per month. After the exclusion of a 6-month transition period (3 months before and 3 months after initiation of public reporting), 17,526 reports were included.

Patient and procedure characteristics were compared between the pre- and post-public reporting periods (Table 1). There was a greater percentage of patients 50 to 59 years of age in the post-public reporting period compared with the pre-public reporting period (37.3% vs 31.7%,  $P < .001$ ). Screening colonoscopies were more common in the post-public reporting period (40.0% vs 28.0%,  $P < .001$ ). A family history of CRC was reported in 10.1% of patients overall. The adequacy of colonoscopy preparation was also higher post-public reporting (95.9% vs 93.5%,  $P < .001$ ) with a similar rate of incomplete procedures (2.6% vs 2.5%,  $P = .74$ ).

The ADR for all colonoscopy exams was higher in the post-public reporting period compared to the pre-public reporting period (34.3% to 39.2%, an increase of 4.9%;  $P < .001$ ) (Table 2, Fig. 1). This difference was most pronounced for the screening colonoscopies (32.6% vs 40.4%, an increase of 7.8%;  $P < .001$ ) versus all other indications (35.0% vs 38.5%, an increase of 3.5%;  $P < .05$ ). Right-sided ADRs increased by 5.1% post-reporting (from 22.6 to 27.7%,  $P < .01$ ) and left-sided ADRs increased by 2.1% (from 13.9% to 16.0%,  $P < .01$ ). Eight of the 9e gastroenterologists who practiced in both time periods had an increase in their ADRs post-public reporting (range of increase  $-2.7\%$  to 10.5%) (Fig. 2).

There was no significant change in the advanced ADR between the pre- and post-reporting periods (11.7% to 12.5%, increase of 0.8%;  $P = .22$ ). Among screening



**Figure 1.** Polyp, adenoma, and advanced adenoma detection rates in the pre- and post-reporting periods. Each data point represents a month of data. Linear trend line is fitted across monthly observations for the entire study period.

colonoscopies, there was a significant increase in advanced ADR (9.6% to 12.2%, an increase of 2.6%;  $P = .045$ ), but there was no change among colonoscopies for other indications (12.5% to 12.8%, an increase of 0.3%;  $P = .72$ ). There was a significant increase in the detection of serrated polyps across all colonoscopies (5.8% to 7.3%, an increase of 1.5%;  $P = .005$ ).

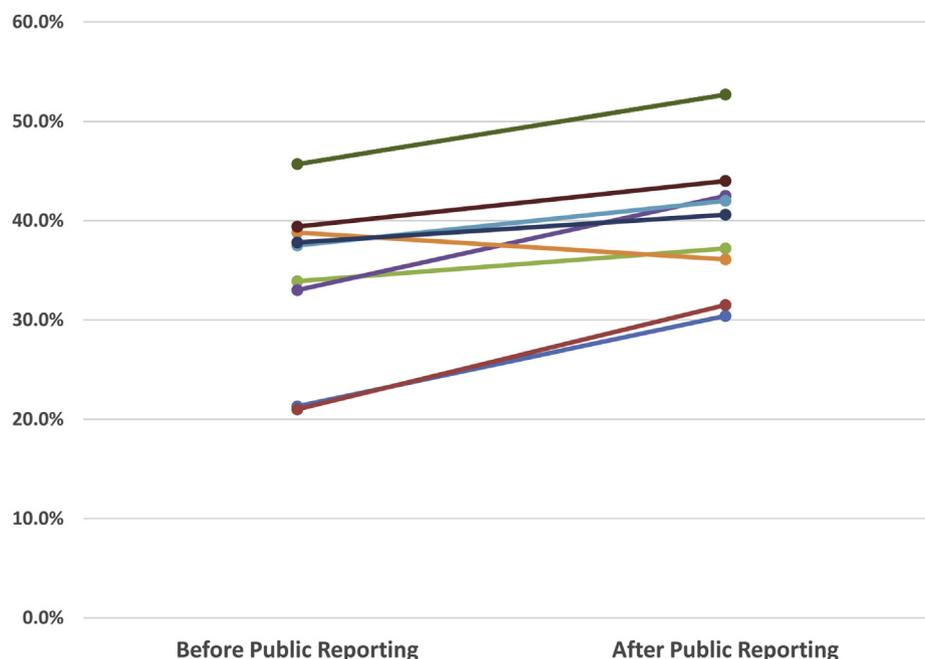
On other quality measures, a marked increase was noted in the documentation of endoscope withdrawal time between the pre-reporting and post-public reporting periods. (0.3% vs 19.8%,  $P < .001$ ) and patient American Society of Anesthesiologists classification (0% to 75.4%,  $P < .001$ ).

## DISCUSSION

Public reporting as a quality improvement intervention is new to gastroenterology but is used widely in other areas of health care. In August 2010, a local quality improvement organization in Central Illinois began publicly reporting the colonoscopy quality of individual physicians. To investigate the effect of this initiative on the quality of colonoscopy, we compared the ADR in the period before and after a single practice's participation in a public reporting initiative. There was a relative increase of 14% in the ADR for all colonoscopy exams in the post-public reporting period (absolute increase of 4.9 percentage points). The increase in ADR was greater for right-sided adenomas versus left-sided adenomas, and the ADRs for all but 1 gastroenterologist were higher after public reporting.

Although there was a notable increase in ADR associated with the public reporting initiative, what drove this increase is less clear. In the practice, physicians received monthly feedback on their ADRs and other quality measures, and performance was discussed at regular practice meetings. In an effort to improve bowel preparation, the center changed to a split-dose preparation and set an internal goal that 90% of patients have good or excellent bowel preparation.<sup>19,20</sup> In addition, the improvement in ADR could have been simply due to a temporal trend in increasing ADR. The absence of a comparison gastroenterology practice in which no public reporting initiative was instituted hampers our ability to determine the amount of ADR increase attributable to the reporting initiative.

Three potential pathways have been proposed in the literature to explain how public reporting can motivate health care providers to improve quality: the selection pathway, change pathway, and reputation pathway.<sup>16</sup> In the selection pathway, low-quality providers are motivated to improve quality because of concern that otherwise they will lose patient volume. In the change pathway, simply identifying deficiencies motivates providers to change, and it does not matter whether the feedback is offered privately or publicly. In the reputation pathway, providers are motivated by concerns about a diminished reputation among peers and negative public opinion.<sup>11</sup> Although these pathways are not mutually exclusive, previous work has hinted that the reputational pathway might be most important of the 3 pathways. One study compared quality improvement among hospitals receiving public versus



**Figure 2.** Adenoma detection rate by physician in pre- and post-reporting periods.

private feedback and found public reporting had a greater effect on improving hospital performance.<sup>8</sup> The implication is that the hospitals were motivated by concerns about patient choice or their reputation. Reputation might be the key mechanism because, contrary to expectations, data suggest that patients do not use quality information to choose their providers,<sup>11</sup> including colonoscopy.<sup>21</sup> Concerns about reputation may explain why we found a slightly larger increase in colonoscopy quality with public reporting compared with previous research that evaluated the impact of private feedback.<sup>22</sup>

Although public reporting is becoming more widespread, it is important to emphasize that it does not always improve quality. In a recent systematic review of public reporting in health care, the authors noted many studies either having a small impact or being ineffective in improving quality.<sup>17</sup> One potential explanation for this mixed impact is that to motivate behavior change, physicians must accept the quality measure and trust the methodology.<sup>23</sup> In many of the previous studies on public reporting, the studies did not examine clinically accepted measures, whereas in this study, we examined the ADR, which is more widely accepted in the gastroenterology community.

Colonoscopy is the predominant method of screening in the United States. In observational studies, the benefit of colonoscopy is less in the proximal than in the distal colon.<sup>24-26</sup> It is encouraging that we observed a greater increase in the ADR in the proximal compared with the distal colon.

Our study has several key limitations. We did not have a control group of gastroenterologists who did not partic-

ipate in the public reporting initiative. Therefore, as noted previously, we cannot assess whether the increases in the ADR and the advanced adenoma detection that we observed were due to a generalized temporal trend or were due to the public reporting initiative. It is possible that differences in the patient populations pre- and post-public reporting account for some of the observed differences. Yet, when we limited our analyses to a more homogeneous set of procedures, screening colonoscopy, the differences were even greater. Because a new electronic health record was introduced, we were only able to capture 9 months of data before public reporting, a limited time period to characterize quality before public reporting. It is possible that the gastroenterologists responded to the public reporting initiative by changing their patterns of documentation, and this change could explain the improvement that we see in outcomes such as adequacy of bowel preparation. However, the ADR was the major outcome, and reporting bias is unlikely to play a role in this outcome as the presence of an adenoma was assessed by an outside pathologist. Our study included gastroenterologists in a single private practice and may not be generalizable to other practice settings in different regions. Also, the willingness of this practice to analyze and subject its data to scrutiny might signal an interest in quality improvement, whereas other practices may not have responded similarly.

In summary, a public reporting initiative focused on colonoscopy quality was associated with a significant increase in the ADR. Public reporting may be a means to improve colonoscopy quality.

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