Supplementary Material

Methods

Our Colonoscopy Quality Assurance Program database reflects comprehensive audits based on standardized clinical documentation.[1–4] We monitor preparation quality, cecal intubation rate, procedure times, and lesion detection rates for all colonoscopy indications.

Five CADe devices were installed in the Stanford Outpatient Procedure Center (CADe site) for an evaluation period from February 16, 2022 through May 13, 2022 (the implementation period). Stanford Hospital, Stanford Cancer Center South Bay, and Stanford Health Care in Emeryville, Pleasanton, and ValleyCare were the control sites. As in our previous studies,[2,4] clinical practice proceeded without any research-specific interventions.

Medtronic staff provided the support that is standard for any trial period of their device. We taped small signs to endoscopist and technician monitors as reminders to consider turning on CADe, but CADe use was left to the discretion of each endoscopist for every colonoscopy. For each colonoscopy, technicians recorded whether CADe was used.

CADe use. We considered all colonoscopies performed for any indication other than inflammatory bowel disease, including colonoscopies performed by endoscopists outside our division, who are not required to use our standardized documentation.

Quality metrics. For patients undergoing only 1 colonoscopy, that colonoscopy was potentially eligible. For patients undergoing multiple colonoscopies, a colonoscopy was potentially eligible if it occurred $\geq$12 months apart from another colonoscopy; for colonoscopies that occurred within 12 months of each other, only 1 was considered, determined as the first one with extent to the cecum and adequate preparation (Boston Bowel Preparation Scale $\geq$ 2 in each segment) or the first one with polypectomy.

Potentially eligible colonoscopies were included if they occurred during the study periods, were complete to the cecum with adequate preparation, were performed by members of our division who document reliably, and were performed for a screening/surveillance indication in our ADR-Extended to all Screening/Surveillance Score.[2] The few colonoscopies performed by endoscopists outside of our division were excluded because they are not required to use standardized documentation. As reported previously,[2,4] we decided a priori to exclude 3 low-volume endoscopists who do not record pathology results reliably.

Preimplementation period. We matched the number of procedures by endoscopist because detection rates vary widely by endoscopist. We searched back in time for each endoscopist from February 15, 2022 until sufficient consecutive colonoscopies with a screening/surveillance indication were found to match the overall number performed for these aggregated indications by that endoscopist during the implementation period. Procedures performed in the CADe vs control sites were handled separately. Most colonoscopies in the preimplementation period occurred within 3 months preceding the implementation period.

Analyses. One author (U.L.) extracted data, removed personal identifiers, and assigned blinded identifiers to endoscopists.[2] We determined the fraction of all complete colonoscopies in which endoscopists chose to use CADe.

We compiled summary statistics for demographics, colonoscopy indication, and preparation scores for the preimplementation and implementation periods in the CADe and control sites. For quantifying detection rates and corresponding uncertainty, we used the Clopper-Pearson estimate of 95% CI based on the exact binomial distribution. For modeling counts, we used a modified Poisson regression to estimate means, with 95% CI estimated using robust error variances. For variables reflecting length of time, we present means and 95% CIs assuming a normal distribution.

In total cohort analyses, for each study period, and separately for the CADe and control sites, we calculated detection rates for adenoma, advanced adenoma, sessile serrated lesions, advanced sessile serrated lesions, and advanced lesions (adenoma and/or sessile serrated lesions); mean adenomas per colonoscopy, mean lesions (defined as the sum of all adenomas and sessile serrated lesions) per colonoscopy, and mean advanced lesions (defined as the sum of all advanced adenomas and advanced sessile serrated lesions) per colonoscopy; total, insertion, and withdrawal times; and resection rates for non-neoplastic lesions (total number of polyps removed minus the sum of adenomas and sessile serrated lesions shown in the main text).

In analyses stratified by tertiles of baseline performance, we first calculated baseline metrics during the 12 months preceding the CADe implementation period for each endoscopist in the CADe site. For each metric, we aggregated endoscopists into tertiles by the preceding 12-month metric-specific baseline performance and performed calculations for the CADe site by tertile. For ADR, we plotted each individual endoscopist's paired preimplementation and implementation ADR, grouped by 12-month baseline ADR into tertiles, and ranked within tertile by preimplementation ADR.

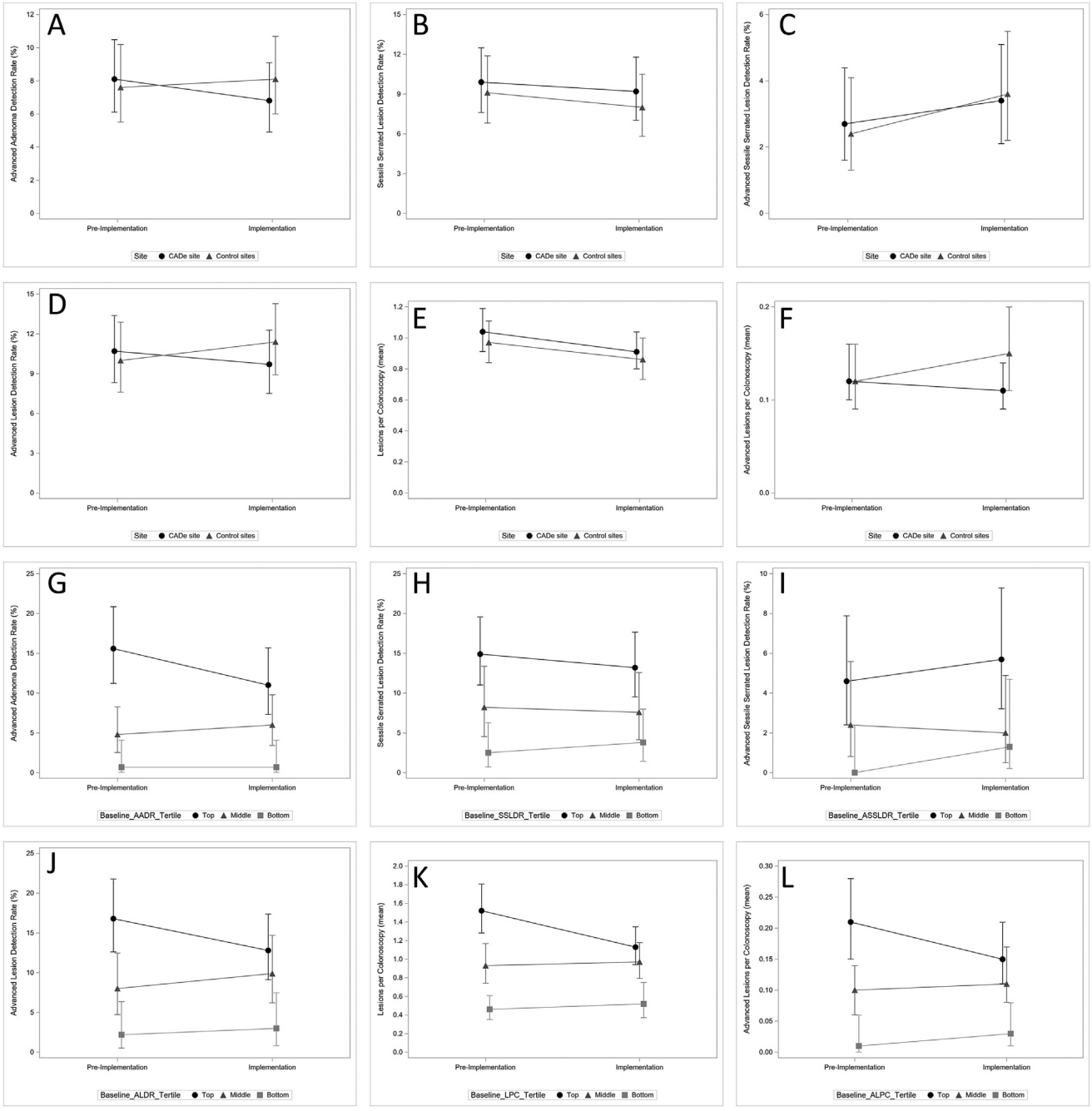
We used generalized estimating equations to estimate associations between CADe implementation and study outcomes. Our models accounted for correlation of observations within endoscopists using the robust sandwich estimator and for other potential predictors. We applied generalized estimating equation techniques by regressing each outcome on a set of variables: an indicator for colonoscopy in the CADe site or control site, an indicator for colonoscopy in the preimplementation or implementation period, an interaction between these 2 indicators (corresponding to the parameter of interest ["does change in ADR differ with vs without CADe?"]), and patient age and sex and colonoscopy indication. Correlation of outcomes across colonoscopies within endoscopist was accounted for through robust sandwich estimation.

The association between CADe implementation and outcomes was estimated through the coefficient of the interaction term (difference-in-difference estimator),

interpreted as the mean difference in changes of the outcome from the preimplementation period to the implementation period comparing the CADe site vs the control sites. For binary outcomes (eg, adenoma detected/not), we assumed a binomial distribution and logit as the link function. Odds ratios, 95% CIs, and *P* values are reported. For counts (eg, APC), we assumed a Poisson distribution with the log link. If over-dispersion was detected (φ estimated using Pearson's χ^2 statistic and degrees of freedom; over-dispersion if $\varphi > 1$), we used a negative-binomial distribution instead. Risk ratios, 95% CIs and *P* values are reported. For continuous outcomes (eg, withdrawal time), we assumed a normal distribution or a log-normal distribution if the assumption of normality and equal variance of the residuals from the model was invalid. For absolute or percent relative changes within the CADe site, 95% CIs and *P* values are reported. For our primary outcome (ADR), family-wise Type I error was controlled at level = 0.05. Analyses were performed using SAS v9.4 (SAS Institute Inc, Cary, NC).

Supplementary References

1. Ladabaum U, et al. Am J Gastroenterol 2021; 116:1365–1370.
2. Ladabaum U, et al. Clin Gastroenterol Hepatol 2021; 19:1873–1882.
3. Ladabaum U. Gastroenterology 2021; https://doi.org/10.1053/j.gastro.2021.09.068.
4. Ladabaum U, et al. Clin Gastroenterol Hepatol 2022; 20:2895–2904.



Supplementary Figure 1. *(A)* Advanced adenoma detection rate, *(B)* sessile serrated lesion detection rate, *(C)* advanced sessile serrated lesion detection rate, *(D)* advanced lesion detection rate, *(E)* lesions per colonoscopy, and *(F)* advanced lesions per colonoscopy during the pre-implementation and implementation periods in the CADe (computer-aided detection) site and control sites. *(G)* Advanced adenoma detection rate (AADR), *(H)* sessile serrated lesion detection rate (SSLDR), *(I)* advanced sessile serrated lesion detection rate (ASSLDR), *(J)* advanced lesion detection rate (ALDR), *(K)* lesions per colonoscopy (LPC), and *(L)* advanced lesions per colonoscopy (ALPC) during the preimplementation and implementation periods in the CADe site, aggregated by tertiles of endoscopist 12-month baseline metric-specific performance.

Supplementary Table 1. Patient Demographics, Colonoscopy Indications, Bowel Preparation Quality, Lesion Detection Rates, Procedure Times, and Non-Neoplastic Lesion Resection Rates in the Preimplementation and Implementation Periods in the CADe and Control Sites and Lesion Detection Rates by Tertiles of Metric-specific 12-Month Baseline Endoscopist Performance in the Preimplementation and Implementation Periods in the CADe Site

	CADe Site, Preimplementation Period	CADe Site, Implementation Period	Control Sites, Preimplementation Period	Control Sites, Implementation Period	Difference-in-Difference, Odds Ratio or Risk Ratio	*P* value[a]
Demographics						
No. of colonoscopies	619	619	538	553		
No. of endoscopists	24	24	27	28		
Female patients, n (%)	315 (50.9)	330 (53.3)	259 (48.1)	274 (49.5)		
Mean patient age, y (SD)	56.6 (10.1)	57.3 (10.3)	59.9 (10.4)	60.2 (10.8)		
Median patient age, y (interquartile range)	55 (49-64)	56 (49-65)	60 (51-68)	60 (51-69)		
Colonoscopy indication, n (%)						
Screening first	213 (34.4)	227 (36.7)	170 (31.6)	186 (33.6)		
Screening not first	160 (25.8)	163 (26.3)	158 (29.4)	166 (30.0)		
Surveillance	182 (29.4)	188 (30.4)	177 (32.9)	177 (32.0)		
Family history	64 (10.3)	41 (6.6)	33 (6.1)	24 (4.3)		
Mean Boston Bowel Preparation Scale score (95% CI)	8.4 (8.3-8.4)	8.4 (8.3-8.5)	8.3 (8.2-8.4)	8.2 (8.1-8.3)		
Lesion detection rates						
Adenoma detection rate (ADR) (95% CI)	41.8 (37.9-45.8)	40.1 (36.2-44.0)	40.7 (36.5-45.0)	35.8 (31.8-40.0)	1.14 (0.83-1.56)	.41
Advanced adenoma detection rate (95% CI)	8.1 (6.1-10.5)	6.8 (4.9-9.1)	7.6 (5.5-10.2)	8.1 (6.0-10.7)	0.77 (0.51-1.17)	.22
Sessile serrated lesion detection rate (95% CI)	9.9 (7.6-12.5)	9.2 (7.0-11.8)	9.1 (6.8-11.9)	8.0 (5.8-10.5)	1.05 (0.64-1.73)	.83
Advanced sessile serrated lesion detection rate (95% CI)	2.7 (1.6-4.4)	3.4 (2.1-5.1)	2.4 (1.3-4.1)	3.6 (2.2-5.5)	0.81 (0.39-1.68)	.58
Advanced lesion detection rate (95% CI)	10.7 (8.3-13.4)	9.7 (7.5-12.3)	10.0 (7.6-12.9)	11.4 (8.9-14.3)	0.79 (0.52-1.19)	.26
Mean APC (95% CI)	0.89 (0.77-1.02)	0.78 (0.68-0.90)	0.85 (0.73-0.98)	0.71 (0.60-0.85)	1.08 (0.80-1.45)	.63
Mean lesions per colonoscopy (95% CI)	1.04 (0.91-1.19)	0.91 (0.80-1.04)	0.97 (0.84-1.11)	0.86 (0.73 – 1.00)	0.99 (0.74-1.32)	.95
Mean advanced lesions per colonoscopy (95% CI)	0.12 (0.10-0.16)	0.11 (0.09-0.14)	0.12 (0.09-0.16)	0.15 (0.11-0.20)	0.75 (0.46-1.23)	.25
Procedure times and non-neoplastic lesion resection rates						
Mean total time, min (95% CI)	26.1 (25.3-26.9)	26.7 (25.8-27.6)	19.8 (19.2-20.5)	20.0 (19.1-20.9)	1.01 (0.91-1.11)	.91
Mean insertion time, min (95% CI)	8.5 (8.1-8.9)	8.6 (8.2-9.0)	6.8 (6.4-7.3)	7.1 (6.6-7.6)	0.97 (0.84-1.11)	.63
Mean withdrawal time, min (95% CI)	17.5 (16.7-18.2)	18.0 (17.2-18.8)	13.2 (12.5-13.9)	12.8 (12.1-13.5)	1.07 (0.95-1.20)	0.29
Mean total time when no polyp removed, min (95% CI)	22.7 (21.7-23.8)	25.3 (23.7-27.0)	18.5 (17.5-19.6)	17.9 (16.8-19.1)	1.10 (0.91-1.32)	.33
Mean total time when polyp removed, min (95% CI)[b]	28.2 (27.0-29.3)	27.5 (26.4-28.6)	20.7 (19.8-21.7)	21.9 (20.5-23.2)	0.95 (0.86-1.05)	.30
Mean insertion time when no polyp removed, min (95% CI)	9.2 (8.5-10.0)	8.9 (8.1-9.7)	7.8 (7.0-8.6)	7.7 (6.7-8.6)	0.97 (0.76-1.23)	.78

Supplementary Table 1. Continued

	CADe Site, Preimplementation Period	CADe Site, Implementation Period	Control Sites, Preimplementation Period	Control Sites, Implementation Period	Difference-in-Difference, Odds Ratio or Risk Ratio	*P* value[a]
Mean insertion time when polyp removed, min (95% CI)	8.1 (7.6-8.6)	8.4 (7.9-8.9)	6.2 (5.7-6.6)	6.6 (6.0-7.2)	0.99 (0.83-1.17)	.87
Mean withdrawal time when no polyp removed, min (95% CI)	13.4 (12.6-14.2)	16.3 (14.8-17.8)	10.7 (10.1-11.3)	10.1 (9.5-10.7)	1.26 (1.00-1.59)	.052
Mean withdrawal time when polyp removed, min (95% CI)[b]	20.0 (18.9-21.0)	19.0 (18.1-19.9)	14.9 (13.8-15.9)	15.2 (14.1-16.3)	0.96 (0.84-1.10)	.55
Mean non-neoplastic polypectomy per colonoscopy (95% CI)	0.7 (0.6-0.8)	0.8 (0.7-0.9)	0.5 (0.4-0.6)	0.4 (0.4-0.5)	1.35 (0.94-1.96)	.11

Lesion detection rates by tertiles of metric-specific 12-month baseline endoscopist performance in the preimplementation and implementation periods in the CADe site

	CADe Site, Preimplementation Period Detection Rate (95% CI)	CADe Site, Implementation Period Detection Rate (95% CI)
ADR		
Top	53.5 (47.0-60.0)	47.7 (41.3-54.2)
Middle	40.5 (33.4-48.0)	43.2 (36.0-50.7)
Bottom	28.5 (22.2-35.4)	27.5 (21.3-34.3)
Advanced adenoma detection rate		
Top	15.6 (11.2-20.9)	11.0 (7.3-15.7)
Middle	4.8 (2.5-8.3)	6.0 (3.4-9.8)
Bottom	0.7 (0.0-4.1)	0.7 (0.0-4.1)
Sessile serrated lesion detection rate		
Top	14.9 (11.0-19.6)	13.2 (9.5-17.7)
Middle	8.2 (4.5-13.4)	7.6 (4.1-12.6)
Bottom	2.5 (0.7-6.3)	3.8 (1.4-8.0)
Advanced sessile serrated lesion detection rate		
Top	4.6 (2.4-7.9)	5.7 (3.2-9.3)
Middle	2.4 (0.8-5.6)	2.0 (0.5-4.9)
Bottom	0.0 (0.0-2.4)	1.3 (0.2-4.7)
Advanced lesion detection rate		
Top	16.8 (12.6-21.8)	12.8 (9.1-17.4)
Middle	8.0 (4.7-12.5)	9.9 (6.2-14.7)
Bottom	2.2 (0.5-6.4)	3.0 (0.8-7.5)

	CADe Site, Preimplementation Period Mean (95% CI)	CADe Site, Implementation Period Mean (95% CI)
APC		
Top	1.31 (1.08-1.58)	0.96 (0.80-1.16)
Middle	0.73 (0.58-0.93)	0.81 (0.63-1.04)
Bottom	0.43 (0.33-0.57)	0.46 (0.35-0.61)
Lesions per colonoscopy		
Top	1.52 (1.28-1.81)	1.13 (0.94-1.35)
Middle	0.93 (0.74-1.17)	0.97 (0.79-1.18)
Bottom	0.46 (0.35-0.61)	0.52 (0.37-0.75)

Supplementary Table 1. Continued

	CADe Site, Preimplementation Period Mean (95% CI)	CADe Site, Implementation Period Mean (95% CI)
Advanced lesions per colonoscopy		
Top	0.21 (0.15-0.28)	0.15 (0.11-0.21)
Middle	0.10 (0.06-0.14)	0.11 (0.08-0.17)
Bottom	0.01 (0.00-0.06)	0.03 (0.01-0.08)

Values are n (%) unless otherwise defined.
[a]ADR was prespecified as the outcome for the primary analysis. Other analyses are secondary. These *P* values are not adjusted for multiplicity of tests.
[b]Includes the time needed to perform polypectomy.