

Determination of withdrawal times in individualized opportunistic screening colonoscopies

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Abstract

To investigate effects of bowel preparation, experience level of colonoscopists, and colonoscopy withdrawal time (CWT) on the quality of an individual opportunistic screening colonoscopy, according to adenoma detection rate (ADR).

Data were retrospectively analyzed from opportunistic screening colonoscopies ($n = 16,951$) at 4 hospitals of various care levels in China.

The ADR positively correlated with the experience level of the colonoscopist. The individualized CWT varied, depending on the quality of bowel preparation and the number of colonoscopies performed previously by the colonoscopist. In a setting of adequate bowel preparation, the mean CWT decreased with the increased experience of the colonoscopist. With poor and inadequate bowel preparation, no colonoscopist at any level of experience could obtain a satisfactory ADR.

For adequately prepared colonoscopies, minimum CWTs have been determined. Repeat colonoscopy is strongly recommended for patients with poor bowel preparation, regardless of the colonoscopist's experience.

Abbreviations: ADR = adenoma detection rate, ASGE = American Society for Gastrointestinal Endoscopy, CRC colorectal cancer, CSDE = Chinese Society of Digestive Endoscopy, CWT = colonoscopy withdrawal time, SD = standard deviation.

Keywords: adenoma detection rate, bowel preparation, colonoscopic withdrawal time, colonoscopy, colorectal adenoma polyps

1. Introduction

Colonoscopy is well recognized as crucial for successfully screening and diagnosing colorectal cancer (CRC) and precancerous polyps, and is the standard procedure for detection and removal of colorectal adenoma polyps.^[1] To improve the colonoscopic procedure, quality control guidelines now require a cecum intubation rate >90%, colonoscopy withdrawal time (CWT) ≥6 minutes, and adequate or excellent bowel preparation in >90% of the bowel. In addition, colonoscopists should

perform >150 procedures per year to ensure adequate experience, with an adenoma detection rate (ADR) of at least 1 adenoma found in each of 25 patients per 100 undergoing screening colonoscopy (that is, an ADR of 25%; specifically 20% for women and 30% for men aged ≥50 yr) in the United States and other western countries.^[2,3]

There is a substantial variation in the rates of CRC incidence worldwide.^[4] Notably, in China, the incidence rates of CRC and precancerous polyps are markedly lower compared with the

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Informed consent was obtained from all the individuals included in this study.

The study protocol was approved by the Research Ethics Committees at these hospitals: Nanfang Hospital Affiliated to Nanfang Medical University; Wuxi People's Hospital Affiliated to Nanjing Medical University; Mianyang Central Hospital; and Longgang Central Hospital.

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United States. Specifically, in average-risk populations aged ≥ 50 years, the ADR in China is 19.55% (10 and 23.87% for women and men, respectively)^[5,6], whereas in the United States the ADR is 25% (20% and 30%).^[2]

Nevertheless, among all measurements, the ADR remains the most important indicator of colonoscopy quality.^[7] The guidelines of both the American Society for Gastrointestinal Endoscopy (ASGE) and the Chinese Society of Digestive Endoscopy (CSDE) are based largely upon retrospective evaluations, and in general, are indeed valuable to ensure quality control. However, their application for determining the quality of the colonoscopy, as performed by the individual operator, under all conditions, may be limited.

It has been extensively reported that the ADR of the operating colonoscopist is associated with both the CWT and the quality of bowel preparation.^[8] The expertise or experience of the operating endoscopist may be equally important in adenoma detection.^[9] Therefore, the current quality control guidelines for colonoscopies should be modified with consideration of the quality of bowel preparation and the level of experience of the endoscopist. A colonoscopy of high quality should also be defined by the polyp recovery rate, adverse complications, and comfort and tolerability reported by the patients.^[10–12]

The universal guideline requirement of a minimum 6-minute CWT remains controversial, as the time required may actually vary according to the bowel preparation and the experience level of the individual operator. A longer CWT is associated with greater discomfort, procedure-related adverse complications, higher cost, and tediousness. Yet, if the CWT is shortened, colorectal lesions could be missed. Thus, it may be more appropriate to stratify the quality control standards according to the quality of bowel preparation and the level of experience of the individual colonoscopist.^[11]

The present retrospective multi-center study investigated the association between CWT and quality of the individual colonoscopy, with considerations of both the experience level of the colonoscopist and the quality of the bowel preparation. The quality of the colonoscopy was defined by the ADR. The findings of this study may improve the quality control of the individual opportunistic screening colonoscopy.

2. Methods

2.1. Patients, data collection, and ADR database construction

The study protocol was approved by the Research Ethics Committee of the participating hospitals. The demographic, endoscopic, and pathological data of 16,951 patients who underwent opportunistic screening colonoscopies between September 2009 and September 2011 were reviewed. The patients screened for CRC were either referred from a general practitioner, or were self-referrals due to gastrointestinal symptoms; a massive screening program for CRC has not yet been implemented in China. The colonoscopies were conducted at 4 hospitals in China, at various levels of care and expertise.

Patients who met the following criteria were retrospectively enrolled: age >20 years; complete histopathological examinations and well-documented colonoscopy records; no endoscopic dye spraying for the entire colon; with clear images of the cecum, appendix orifice, and ileocecal valve; and photographs of the rectum taken during colonoscopy withdrawal. Excluded from the

study were patients with incomplete files, or with a medical history of any of the following: polyposis syndrome; CRC; inflammatory bowel disease; partial colonic resection; or incomplete cecum intubation.

Data were collected from the enrolled patients. For entry into the ADR database, the colonoscopies fulfilled the following criteria: cecal intubation achieved; performance of an opportunistic screening colonoscopy; the operating colonoscopist had performed at least 100 intact colonoscopies in the database; and among repeat colonoscopies, only the first or initial colonoscopy was considered.

2.2. Analysis of data from individual colonoscopies

Independent factors such as the experience level of the operating colonoscopist, quality of bowel preparation, and mean CWT for negative colonoscopies were analyzed for associations with ADR. The experience of each colonoscopist was categorized into 4 levels according to the individuals' accumulated number of performed colonoscopies, that is, the sum of all colonoscopies conducted before and during this study: <500 , 500 to 999, 1000 to 1999, or ≥ 2000 .

The quality of bowel preparation was evaluated by the operating colonoscopist and was graded according to established criteria, as previously reported by Lee et al^[2], on 4-point modified Likert scale. Specifically, the quality of bowel preparation was defined as excellent (minimal or no solid stool and only clear fluid requiring suction), good (collections of semi-solid debris that were subsequently cleared by washing/suction), or poor (with solid or semi-solid debris that could not be cleared effectively). Bowel preparations that were graded excellent or good were considered adequate; poor bowel preparations were inadequate.

The ADRs were determined for colonoscopies overall at each level of experience of colonoscopists, and further stratified by quality of bowel preparation. These analyses were also conducted after adjustments of the ADR for gender and age. Fitting curves were created to determine the CWT at 20% ADR according to the individual colonoscopist's experience level and the quality of bowel preparation.^[13] In this study, 20% of ADR was used, mainly because the prevalence of colorectal adenoma in an average-risk Chinese population is lower than that of the United States^[6,14]. There are no established colonoscopy quality indicators, including ADR in China and other Asian countries.^[5,6,15] In addition, a 25% ADR was originally established as a reference standard for asymptomatic screening patients aged over 50 years.^[16]

2.3. Statistical analysis

Statistical analyses were performed using SPSS Statistics 17.0 software (IBM, Armonk, NY). Numerical and categorical data are presented as mean \pm standard deviation (SD) and percentage, respectively. A P value $<.05$ was considered statistically significant.

With the adenoma detection database as we established before this study, all possible factors affecting ADR were identified using a univariate regression model. The significant factors were subsequently put into a multivariate logistic regression model, which revealed multiple procedure-related independent factors, including bowel preparation, experience level of colonoscopists, and colonoscopy withdrawal time (CWT). We also followed the major guidelines or consensuses for quality control of gastrointestinal endoscopy, that bowel preparation, experience level of colonoscopists, and colonoscopy withdrawal time (CWT) are the

main factors affecting ADR and quality of endoscopy. To achieve the objective of this study with a special emphasis on assessing these 3 main factors of interest on the quality of individual colonoscopy and calculate an individualized colonoscopy withdrawal time in an individual colonoscopy, the bowel preparation, experience level of an operating colonoscopist were stratified into different levels, and the different combinations of these 3 variables of interest were made in this study.

Colonoscopists' experience, the cleanness of the bowel preparation, and CWT could affect the individual ADR and adjusted ADRs, and were further analyzed by linear or rank correlation, chi-squared and variance analyses.

The individual adjusted ADR was calculated by logistic regression analysis and corrected for the confounding factors gender and age. The differences in ADRs or adjusted ADRs of the same colonoscopist at the specific level of experience, by quality of bowel preparation, were analyzed by repeated-measures analysis of variance. Linear regression analyses and curve fitting of the CWT and adjusted ADRs were further performed after stratifications for experience level and bowel preparation.

3. Results

3.1. Demographic and clinical characteristics of patients

The population of this retrospective study comprised 16,951 patients from 4 hospitals of different tiers (Table 1). The mean age of the patients was 45.7 years. There were 9500 men and 7451 women, and the difference in gender populations was statistically significant. Symptoms were present in the majority of patients (74.7% or 12,666/16,951) at the time of the first colonoscopy. In addition, proportions of the study subjects were identified to have a family history of adenoma (5.56% or 946/16,965), and CRC (1.54% or 261/16,951), as well as the presence of diverticulosis of the colon (3.77% or 639/16,951).

3.2. Association between colonoscopist's experience and ADR

It was first determined whether the experience of the colonoscopist correlated with the ADR (Table 2). After generation of a

row \times column table ($R \times C$), the ADRs of the colonoscopists ranged from 7.9 to 25.6% (mean, 16.8%). According to the rank correlation analysis, the ADRs of the colonoscopists varied significantly by experience level ($P < .001$) with a positive association between level of experience and ADR ($r = 0.695$; $P < .001$).

When ADRs were adjusted for patient age and gender, the adjusted ADRs ranged from 7.9 to 25.2% (mean, 16.1%; Table 2). The adjusted ADRs of the colonoscopists also varied significantly at different experience levels ($P < .001$) with a positive association between level of experience and adjusted ADR ($r = 0.523$; $P < .001$; Table 2).

Overall, both the ADR and adjusted ADR of colonoscopists who had performed ≥ 500 colonoscopies were significantly higher than that of colonoscopists who had performed < 500 (Table 2). Similarly, the non-adjusted ADR of colonoscopists who had performed ≥ 1000 colonoscopies was significantly higher than that of colonoscopists who had performed < 1000 . However, a colonoscopist required an experience of ≥ 2000 colonoscopies for the adjusted ADR to be significantly higher than that of colonoscopists who had performed < 1000 .

3.3. Association between the colonoscopist's experience and ADR by quality of bowel preparation

When the ADRs, or adjusted ADRs, were stratified by the quality of bowel preparation, there were significant differences according to the experience of the colonoscopist (Table 2). When the bowel preparation was excellent, the ADR, or adjusted ADR, of colonoscopists at the 500 to 999 level was significantly higher than that of colonoscopists with < 500 .

For bowel preparations that were only good or poor (i.e., not excellent), the colonoscopist had to have performed ≥ 1000 in order for the non-adjusted ADR to be significantly higher than that of colonoscopists with < 500 . When the bowel preparation was considered good, the ADR of colonoscopists who had performed ≥ 1000 was significantly higher than that of colonoscopists who had performed < 1000 . However, if the preparation was poor, an experience of > 2000 procedures was

Table 1
Demographic and clinical characteristics of the patients by hospital.

		Hospital*				Total	P
		1	2	3	4		
Patients, n		8053	4604	2698	1596		
Age, yr Mean (SD)		45.0 (12.8)	45.0 (12.8)	44.6 (13.1)	46.0 (14.2)	45.7 (13.0)	<.001
Gender	Male	4515	2538	1491	956	9500	.008
	Female	3538	2066	1207	640	7451	
Symptom†	Yes	5238	3968	2086	1374	12666	<.001
	No	2815	636	612	222	4285	
Family history of adenoma	Yes	461	238	130	117	946	.003
	No	7592	4366	2568	1479	16005	
Family history of CRC	Yes	183	46	13	19	261	<.001
	No	7870	4558	2685	1577	16690	
Diverticulosis of colon	Yes	270	193	87	89	639	<.001
	No	7783	4411	2611	1507	16312	

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† "Yes" indicates the presence of at least one of the following symptoms: abdominal discomfort or pain, diarrhea, constipation, changes in stool frequency and shape, weight loss, and blood in the stool. "No" is the absence of symptoms.

Table 2
ADR, adjusted ADR, and CWT according to colonoscopist experience and quality of bowel preparation.

		Number of past colonoscopies performed by the colonoscopist			
		<500	500–999	1000–1999	≥2000
ADR	Excellent	12.1 ± 4.8 (6.3–23.0)	20.0 ± 7.7 (7.5–30.5)*	20.3 ± 5.0 (12.2–26.1)*	22.8 ± 8.1 (13.9–37.6)*
	Good	14.6 ± 5.4 (4.5–21.1)	16.5 ± 5.3 (3.5–26.8)	20.5 ± 3.9 (13.2–26.7)*,†	22.8 ± 6.6 (15.7–40.5)*,†
	Poor, inadequate	7.1 ± 3.4 (4.3–14.3)	8.9 ± 7.7 (1.3–35.7)	12.5 ± 4.9 (6.5–21.1)*	13.4 ± 3.9 (7.2–21.3)*,†
	Overall	12.0 ± 3.3 (7.9–18.4)	15.6 ± 2.5 (9.9–18.8)*	18.6 ± 2.3 (15.1–23.7)*,†	20.8 ± 3.8 (15.2–25.6)*,†
ADR, adjusted ‡	Excellent	11.9 ± 4.1 (6.3–19.7)	17.6 ± 7.5 (5.1–28.7)*	19.0 ± 5.9 (10.0–26.6)*	20.3 ± 6.6 (10.3–33.4)*
	Good	14.7 ± 5.4 (4.5–21.8)	15.7 ± 4.5 (3.5–23.5)	17.7 ± 3.8 (9.6–24.0)	19.3 ± 5.2 (7.4–27.6)*
	Poor, inadequate	7.7 ± 3.8 (4.3–15.6)	8.5 ± 6.7 (1.3–30.4)	11.3 ± 5.3 (4.5–20.4)	11.5 ± 4.0 (6.1–17.0)
	Overall	12.0 ± 2.9 (7.9–16.6)	15.4 ± 3.0 (9.5–20.2)*	17.5 ± 2.7 (14.2–24.2)*	18.8 ± 4.9 (11.4–25.2)*,†
CWT	Excellent	4.6 (3.2–6.8)	4.4 (3.5–6.9)	4.8 (3.2–6.5)	4.2 (2.1–6.1)
	Good	4.7 (3.8–8.7)	4.7 (2.5–7.2)	4.7 (3.1–6.1)	4.2 (2.8–6.6)
	Poor, inadequate	4.9 (4.0–8.6)	5.6 (4.5–7.0)	5.7 (3.1–6.5)	5.2 (2.8–6.5)
	Overall	4.8 (3.2–8.7)	4.8 (2.5–7.2)	5.0 (3.1–6.5)	4.4 (2.1–6.6)

* $P < .05$ cf. <500; † $P < .05$ cf. 500 to 999; ‡ adjusted for age and gender.

required for the difference in ADR to achieve at least this level of significance.

3.4. Analysis of colonoscopist CWT and ADRs

We subsequently analyzed the CWT according to the levels of the colonoscopist's experience (Table 2). The mean CWT at the various experience levels were as follows: <500, 4.8 (3.2–8.7) minutes; 500 to 999, 4.8 (2.5–7.2) minutes; 1000 to 1999, 5.0 (3.1–6.5) minutes; and ≥2000, 4.4 (2.1–6.6) minutes. The regression analyses revealed a significant link between ADRs, or adjusted ADRs, to CWT at the different levels of the colonoscopist's experience ($r = 0.525, 0.616, P < .001$).

The above data were further analyzed according to the quality of bowel preparation. The ADRs, and adjusted ADRs, were significantly associated with CWT when the quality of bowel preparation was excellent ($r = 0.370, P = .007; r = 0.379, P = .006$) or good ($r = 0.438, P = .001; r = 0.479, P < .001$). However, when the bowel preparation was poor, neither ADRs nor adjusted ADRs were associated with CWT ($r = 0.077, r = 0.230, P > .05$).

Furthermore, the mean ADR or adjusted ADR of all the colonoscopists under conditions of excellent and good bowel preparation were 19.2% (17.6%) and 18.6% (16.8%), respectively, and thus comparable ($P = .616, P = 0.473$, respectively). However, when the bowel preparation was poor, the mean ADR (adjusted ADR) was 10.5% (9.7%). These were significantly lower compared with the rates for excellent and good bowel preparation performed by the same individual colonoscopists ($P < .001$).

We then combined the data for excellent and good bowel preparations into one category (adequate) and compared it with the poor (inadequate) category (Table 3). Based on the linear regression analysis, under conditions of adequate bowel preparation, there was a significant association between the CWT and adjusted ADR at each level of experience of the colonoscopist. Specifically, for colonoscopists who had performed ≥2000, 1000 to 1999, 500 to 999, and <500 colonoscopies, the mean CWT to achieve an adjusted ADR of 20% was 4.2, 5.7, 6.1, and 8.7 minutes, respectively (Fig. 1A–D).

However, no level of experience of the colonoscopist could overcome the handicap of an inadequate bowel preparation, and even those who had performed ≥2000 colonoscopies would not

reach an ADR of 20% (Table 3). Based on the linear regression analysis, under conditions of inadequate bowel preparation there was a significant association between the CWT and adjusted ADR at experience levels of >1000 performed colonoscopies. The mean CWTs to achieve adjusted ADRs of 15% at experience levels 1000 to 1999 and ≥2000 were 6.3 and 6.2 minutes, respectively (Fig. 2A–B). There was no significant correlation between CWT and adjusted ADR when the level of experience was <1000 colonoscopies.

4. Discussion

There has been rapid progress in the development of colonoscopic technologies in recent years. However, randomized trials have shown no unequivocally positive effect on the ADR that could be associated with these advances.^[17] The present study is the first to incorporate both the quality of the bowel preparation and the colonoscopists' level of experience into the analysis of the ADR, including ADRs adjusted for patient's age and gender. The major novel findings of the present study are summarized as follows. First, the ADR was significantly and positively associated with the level of experience of the colonoscopist, and the significance of the association held even after variations in bowel preparation were incorporated into the analysis. Second, under conditions of excellent or good bowel preparation, colonoscopists who had performed >1000 colonoscopies required a CWT of less than 6 minutes to achieve an ADR of 20% or higher (4.2 min for operators at the ≥2000 level). Operators with <1000 colonoscopies required more than

Table 3
Association between CWT and adjusted ADR when bowel preparation is stratified as adequate (excellent or good), or inadequate (poor)*.

		Number of past colonoscopies performed by the colonoscopist			
		<500	500–999	1000–1999	≥2000
Adequate	r	0.871	0.776	0.573	0.854
	P	.002	<.001	.032	.001
Inadequate	r	NS	NS	0.542	0.787
	P	NS	NS	.045	.004

* Linear regression analysis.
 NS=not significant

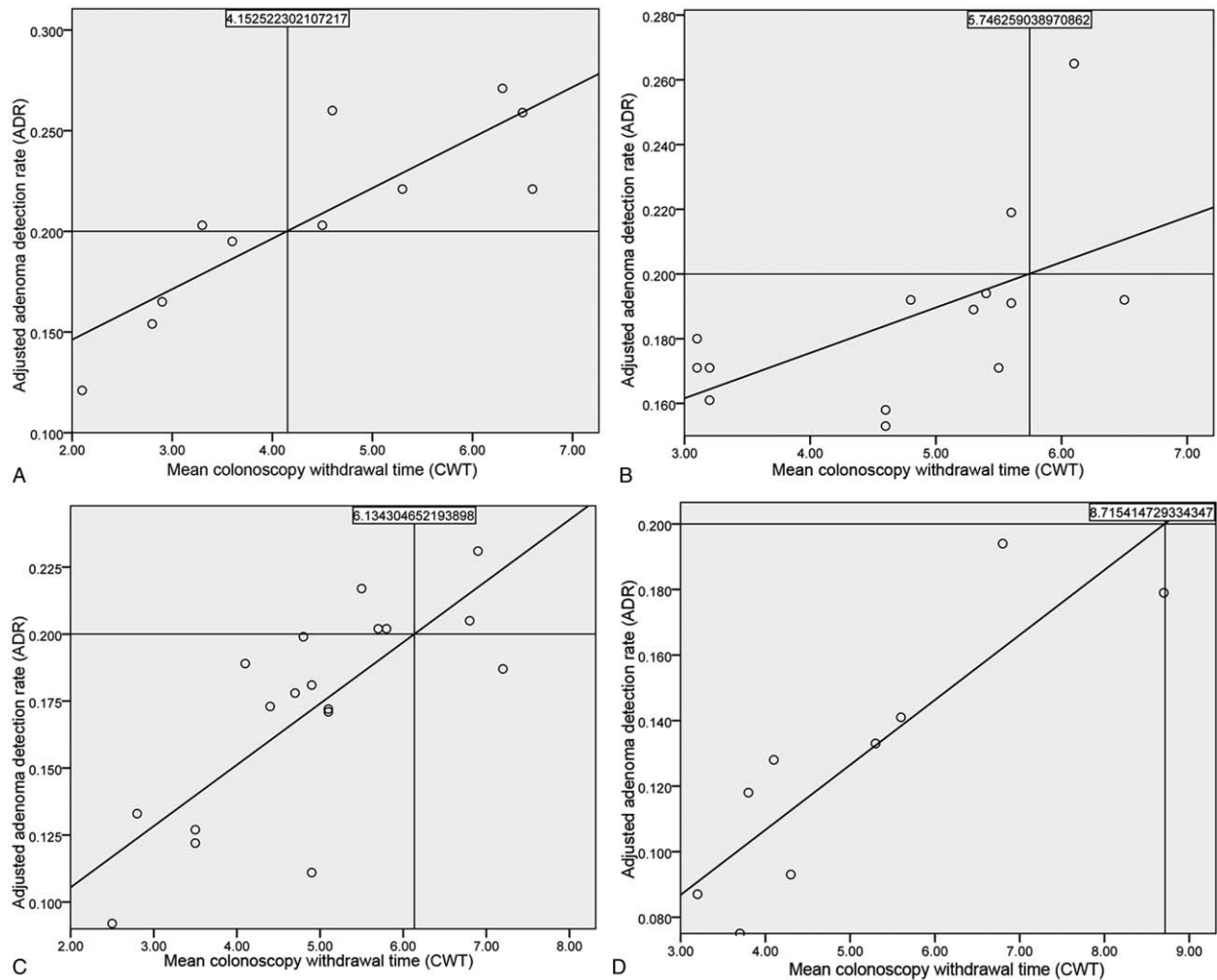


Figure 1. The mean CWT to achieve an adjusted ADR of 20% in colonoscopies under adequate bowel preparation performed by colonoscopists with various experience levels. (A) Highly experienced colonoscopists (≥ 2000 colonoscopies). Mean CWT was 4.2 minutes at adjusted ADR 20%; (B) Moderately experienced colonoscopists (1000–1999 colonoscopies). Mean CWT was 5.7 minutes at adjusted ADR 20%; (3) Colonoscopists with an experience level of 500–999 colonoscopies. Mean CWT was 6.1 minutes at adjusted ADR 20%; (D) Colonoscopists with an experience level of < 500 colonoscopies. Mean CWT was 8.7 minutes at adjusted ADR 20%.

6 minutes to achieve this minimum ADR (8.7 mins for those at the < 500 level). Thirdly, when the bowel preparation was poor, no colonoscopist, with any level of experience (including ≥ 2000 colonoscopies) could accomplish an ADR of 20%. Thus, a poor bowel preparation may necessitate a repeat colonoscopy. These findings support that the required CWT should depend on the quality of the bowel preparation and the level of experience of the colonoscopist.

The success of a colonoscopy is associated with the colonoscopist’s ADR, and several quality improvement programs appear to influence this, positively.^[18] The present study provides an overview of potential factors that can be used to increase the operator’s ADR in routine clinical practice. In the interest of reducing the incidence and mortality of CRC, we propose that the CWT guideline should be tailored to the circumstances of the individual colonoscopy, and suggest an alternative approach to improving the ADR and overall quality of colonoscopies.

In the present study, a 20% ADR rate was used according to the CSDE’s recommendation for screening an average-risk

Chinese population aged 50 years and older. This is lower than the guideline of 25% recommended by the ASGE, because the rates of CRC prevalence and precancerous lesions are putatively lower in China compared with the United States. Our research here and that of others^[19–23] showed that the ADR, and ADR adjusted for patient’s age and gender, is significantly associated with the quality of bowel preparation and colonoscopists’ experience. Moreover, both the ADR and adjusted ADR were positively dependent on the colonoscopist’s level of experience, whether the bowel preparation was excellent, good, or poor. In addition, while various factors such as age, gender, colonoscopist’s experience, and bowel preparation can affect the final ADRs, the CWT may also affect the ADR significantly. Indeed, the specific CWT appears to depend on the bowel preparation and endoscopist’s experience.

According to the results of a colon cancer-screening program in the United States, the CWT needs to be at least 6 minutes; others have argued that 6 minutes would not be enough time for withdrawal.^[24] In this context, 6–10 minutes was considered the

proper CWT, without including the time for biopsy and polypectomy.^[25] Simmons et al^[26] reported that the polyp detection rates for CWT <7 minutes and ≥ 7 minutes were 44% and 76%, respectively, and concluded that 7 minutes should be the minimum to achieve a qualified polyp detection rate. Furthermore, a recent study has shown that the overall ADR and ADR for high-risk adenoma were significantly higher when the CWT was at least 8 minutes.^[27] For colonoscopists who were not so experienced, if the CWT was prolonged to 10 minutes, ADRs were significantly higher (for CWT ≥ 10 minutes, ADR was 32.3%; for <10 minutes, ADR was 9.5%).^[28]

This study has several notable strengths. First, a large-scale collection of data was collected from multiple participating endoscopy centers, with different care levels, on individual colonoscopies. The findings appear highly representative and reliable. Secondly, since the quality of the colonoscopy and colonoscopist's experience interact closely to influence the ADR, the operator's experiences were stratified by 4 levels based on the number of colonoscopies that they had performed, which were tracked throughout the entire study period. Thus, the analysis is an improvement over other studies. It was shown that when results of a colonoscopy are negative, such as without adenomas, the CWT of the individual colonoscopist varies according to the level of previous experience attained, including during the 2-year period of the study. Thus, it is more rational and reliable to consider the ongoing increase in experience over the long period of the study when analyzing the CWT of a colonoscopist. Finally, we also analyzed ADRs adjusted for patient age and gender, to investigate how the colonoscopist's experience, CWT, and patients' bowel preparation affect the rates of adenoma detection.

The present study is limited in that, first, the CWT was calculated based on the time taken to withdraw the colonoscope from the cecum to the rectum. Second, some factors related to colonoscopic withdrawal techniques were not taken into account, as the information was not documented at the time. These include examination of the proximal sites of folds, flexures, and valves; satisfactory degree of colorectal distention with air insufflation; volume of liquid remaining in the colon after

aspiration^[23]; and bowel cleaning and suctioning of fluids. However, all the examiners in the participating 4 hospitals were required to practice a standardized protocol for colonoscopic withdrawal, and these technical factors probably did not affect the results significantly.^[29] Third, the study design was based on previous findings regarding the 3 major factors affecting ADR, and the major consensus regarding quality control of gastrointestinal endoscopy: bowel preparation, the experience level of colonoscopists, and CWT. We cannot exclude the possibility that error term variables do not correlate with any of these major variables. Fourth, we noticed that the inclusion criteria in terms of age and other risk factors are different between ours and previous studies^[12,30]. In fact, a range of risk factors for colorectal cancer have been identified, including positive family history of cancer of any type; hereditary non-polyposis colorectal cancer (HNPCC) family members aged 20 and older; individuals with FDRs of familial polyposis and colorectal cancer before the age of 50; unexplained positive fecal occult blood test; elevated serum CEA level, and many others^[31]. In China and many other countries, a massive screening program for colorectal cancer has not yet been implemented, opportunistic screening depends on individuals who request for screening or are recommended by their general physicians. As recently reported^[31], general physicians make a referral for opportunistic colonoscopy as they identified certain risk factors for colorectal cancer that include gastrointestinal symptoms in relation to colorectal cancer as we described in our study. Therefore, the criteria in opportunistic screening in terms of risk factors among their targeting population can vary in different studies.

5. Conclusions

To detect adenomas, colonoscopists of different levels of experience may legitimately differ from the standard guideline for CWTs. In particular, when the bowel preparation is good or excellent and the operator is highly experienced, a CWT less than 6 minutes may be adequate to achieve a satisfactory ADR of 20% or higher. However, when the bowel preparation is poor, a

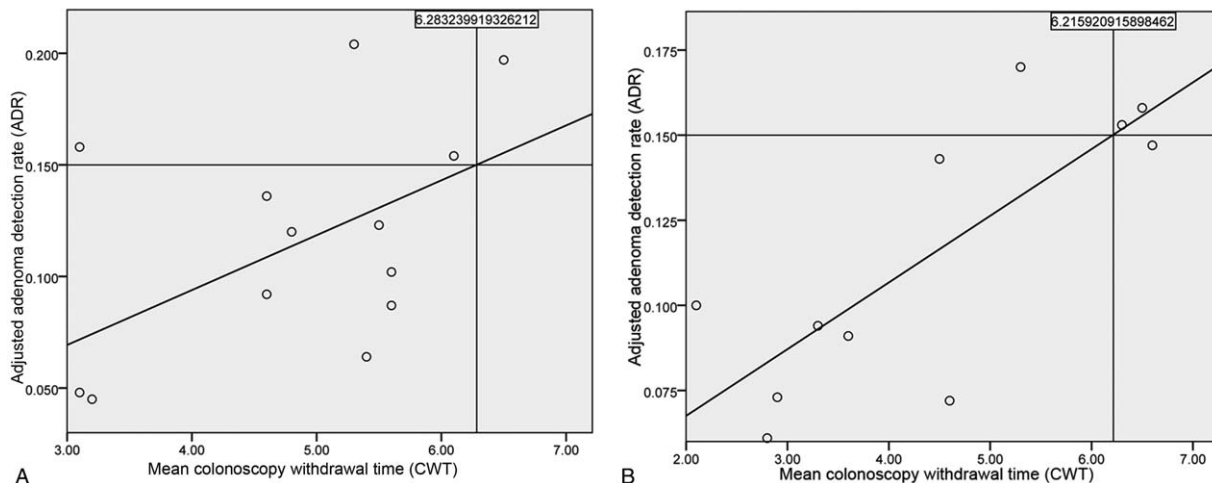


Figure 2. The mean CWT to achieve an adjusted ADR of 15% in colonoscopies under poor bowel preparation performed by highly and moderately experienced colonoscopists. (A) Highly experienced colonoscopists (≥ 2000 colonoscopies). Mean CWT was 6.2 minutes at adjusted ADR 15%; (B) Moderately experienced colonoscopists (1000–1999 colonoscopies). Mean CWT was 6.3 minutes at adjusted ADR 15%.

proper ADR cannot be attained by the colonoscopist, regardless of level of experience. These findings warrant confirmation in a prospective study, to improve the quality of endoscopy and patient care.

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