Effect of Doctor's and Assisting Nurse's Years of Experience on Polyp Detection Rate: A Retrospective Cohort

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ABSTRACT

Background: Polyp detection rate (PDR) is a convenient quality measure indicator. Many factors influence PDR, including the patient's background, age, referral (ambulatory or hospitalized), and bowel cleansing.

Objectives: To evaluate whether years of professional experience have any effect on PDR.

Methods: A multivariate analysis of a retrospective cohort was performed, where both patient- and examiner-related variables, including the experience of doctors and nurses, were evaluated. PDR, as the dependent variable was calculated separately for all (APDR), proximal (PPDR), and small (SPDR) polyps.

Results: Between 1998 and 2019, 20,996 patients underwent colonoscopy at a single center. After controlling for covariates, the experience of both doctors and nurses was not found to be associated with APDR (odds ratio [OR] 0.99, 95% confidence interval [95%CI] 0.98–1.00, $P = 0.15$ and OR 1.03, 95%CI 1.02–1.04, $P < 0.0001$, respectively). However, after 2.4 years of colonoscopy experience for doctors, and 9.5 years of experience for nurses, a significant increase in APDR was observed. Furthermore, results revealed no association for PPDR and SPDR, as well.

Conclusions: Years of colonoscopy experience for both doctors and assisting nurses were not associated with APDR, PPDR, and SPDR. In doctors with 2.4 years of experience and nurses with 9.5 years of experience, a significant increase in APDR was observed.

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KEY WORDS: assistant nurse, colonoscopy, nurse, polyp detection rate (PDR), quality indicator

Colonoscopy is recommended as a screening option for the prevention of colorectal cancer by national organizations [1,2]. The success of this procedure depends in part on the reliable detection and removal of benign polyps that are precursors to malignant lesions [3,4]. Current quality-of-care guidelines recommend that endoscopists should detect polyps in approximately 25–30% of men and 15–20% of women based on multiple cross-sectional studies of the prevalence of polyps in the general population [5].

In addition, there has been extensive recent investigation into factors that predict polyp detection. Polyp prevalence is greater in males than females and increases with age in both genders [6-8]. For optimal polyp detection, physicians must have appropriate training and experience in colonoscopy and polypectomy and must maintain their endoscopy skills [9-14]. During the procedure, adequate bowel preparation with complete mucosal visualization is ideal, the cecum must be reached, and several studies have highlighted the importance of colonoscope withdrawal time sufficient to carefully examine the colon [15-17]. It has not been shown, however, whether the experience of the gastrointestinal endoscopy doctor or nurse attending the procedure is associated with polyp detection. However, it has been our clinical experience that all aspects of the procedure may be facilitated by an experienced doctor or nurse.

As most endoscopy reporting systems do not routinely incorporate histological assessment, adenoma detection rate (ADR) reporting is a cumbersome task. PDR has therefore been adopted as a surrogate marker for ADR.

The aim of this study was to determine whether the experience of either doctors or nurses in gastrointestinal endoscopy is associated with the odds of polyp detection during screening colonoscopy. Findings could have implications for staff training, procedure efficacy, and colonoscopy quality assessment.

PATIENTS AND METHODS

We performed a retrospective cohort analysis of colonoscopies conducted by attending doctors together with assistant nurses in adult patients at the Hillel Yaffe Medical Center from the years 1998 to 2019.

Patient demographic information, time of examination, and referring agent, as well as presence, location, and number of polyps identified per colonoscopy were recorded. Demographic information was limited to age in years at the time of colonoscopy and gender. Experience of doctors or nurses was calculated in years for each, from the first colonoscopy in which they participated until the date of the index examination. The gender of the doctor and nurse was also noted.

Polyp location was described as proximal or distal depending on the polyp's relationship to the splenic flexure. Small polyps were defined as polyps ≤ 5 mm in size, as evaluated by the examiner. Time of colonoscopy (time segment) was divided into morning (8:00–15:00) and afternoon (15:00–21:00). PDR was defined as the number of patients with at least one polyp divided by the number of screening colonoscopies.

Excluded were patients who did not achieve complete cecal intubation, indication of emergency including gastrointestinal bleeding, or obstruction. Age was limited to patients older than 18 years of age. Only colonoscopies with a bowel preparation of good and excellent (score 0 and 1, respectively) according to the average of Boston Bowel Preparation Scale [18] were included.

The primary aim of our study was to evaluate whether doctor's or nurses' experience could influence PDR for all polyps, including proximal and small ones.

STATISTICAL ANALYSIS

Descriptive statistics in terms of mean, standard deviation, and percent were calculated for all parameters in the study. Differences between quantitative parameters according to occurrence of polyp, occurrence of APDR, PPDR, and SPDR were evaluated by *t*-test. A multivariate logistic regression model was calculated to find the independent parameters which can predict APDR, PPDR, and SPDR, separately. A receiver operating characteristic (ROC) curve was employed to describe the relationship between sensitivity and the false positive rates for doctors and nurses experiences for PDR. $P < 0.05$ was considered significant. Statistical analyses were performed using IBM Statistical Package for the Social Sciences statistics software, version 25 (SPSS, IBM Corp, Armonk, NY, USA).

RESULTS

Data on patient characteristics, procedures, and examiners are summarized in Table 1. In total 20,996 patients underwent colonoscopy, of whom 46.5% (n=9,741) were females, with a mean age of 61.4 ± 14.32 years. Colonoscopies were performed by seven different attending doctors (two females and five males), and seven nurses (five females, two males), one of each in every examination. Most colonoscopies (58%, n=12,087) were performed in the afternoon. The majority (89%, n=18,649) were performed in an ambulatory setting. Mean doctor experience was 7.87 ± 4.6 years, and the nurses, 10.1 ± 5.6 years. Among doctors (by procedure), 92% were female and only 8% of the nurses were male.

UNIVARIATE ANALYSIS

In univariate analysis, results differed slightly by predictor. With APDR we found that all variables were associated with PDR, including patient's gender, age, time segment, referral, doctor and nurses experience, and doctors' gender. Nurse's gender was an exception ($P = 0.052$). For PPDR, only doctor experience had

Table 1. General characteristics, n=20,996

Characteristic	Value
Patient gender	
Female	9741 (46.5%)
Male	11,225 (53.5%)
Age, in years	61.4 ± 14.317
Time segment	
Afternoon	12,087 (58%)
Morning	8879 (43%)
Referral	
Hospitalized	2317 (11%)
Ambulatory	18,649 (89%)
Doctor gender*	
Female	4343 (21%)
Male	16,623 (79%)
Nurse gender*	
Female	19,349 (92%)
Male	1617 (8%)
Doctor experience, years	7.87 ± 4.6
Nurses experience, years	10.1 ± 5.6

*By examination

no association. In SPDR, lack of association included referral and gender of both doctor and nurse [Table 2].

MULTIVARIATE ANALYSIS

In multivariate analysis, to identify predictors of PDR (all, proximal, and small), factors with significant impact including patient age, gender, time segment, and referral of procedure as well as experience and gender of doctors and nurses were entered in a stepwise logistic regression model. Results are presented in Table 3.

APDR

Years of experience for doctors as well as referral (ambulatory or hospitalized) were not significantly associated with detection of APDR, while association with all other variables was significant. Any increase in patient age improved the possibility of polyp incidence (OR 1.03, 95%CI 1.02–1.03, $P < 0.0001$). Male patients had a higher probability of polyp detection (OR 1.44, 95%CI 1.35–1.5, $P < 0.0001$). For time segment, patients hospitalized in the morning had a higher possibility of polyp detection compared to patients hospitalized in the afternoon (OR 1.27, 95%CI 1.18–1.37, $P < 0.0001$). An increase in a nurse's experience improved the probability of polyp detection (OR 1.03, 95%CI 1.02–1.04, $P < 0.0001$). Female doctors had a higher probability of polyp detection (OR 1.45, 95%CI 1.32–1.59, $P < 0.0001$). However, female nurses had lower probability of detecting a polyp (OR 0.74, 95%CI 0.64–0.85, $P < 0.0001$).

Table 2. Univariate analysis for APDR, PPDR, and SPDR

	APDR			PPDR			SPDR		
	No (n=16,556)	Yes (n=4410)	P-value	No (n=18,947)	Yes (n=2019)	P-value	No (n=18,656)	Yes (n=2310)	P-value
Patient gender									
Female	8605 (52%)	2620 (59%)	< 0.0001	9974 (53%)	1251 (62%)	< 0.0001	9853 (53%)	1372 (59%)	< 0.0001
Male	7951 (48%)	1790 (41%)		8973 (47%)	768 (38%)		8,803 (47%)	938 (41%)	
Patient age	60.34 ± 14.6	65.48 ± 11.78	< 0.0001	60.8 ± 14.3	67.5 ± 11.2	< 0.0001	61.0 ± 14.4	64.65 ± 11.8	< 0.0001
Time segment									
Afternoon	9933 (60%)	2154 (49%)	< 0.0001	11,245 (59%)	842 (42%)	< 0.0001	10,857 (58%)	1230 (53%)	< 0.0001
Morning	6623 (40%)	2256 (51%)		7702 (41%)	1177 (58%)		7799 (42%)	1080 (47%)	
Referral									
Hospitalized	1736 (10.5%)	581 (13%)	< 0.0001	2011 (11%)	306 (15%)	< 0.0001	2056 (11%)	261 (11%)	0.68
Ambulatory	14,820 (89.5%)	3829 (87%)		16,936 (89%)	1713 (85%)		16,600 (89%)	2049 (89%)	
Doctor gender									
Female	3366 (20%)	977 (22%)	0.008	3978 (21%)	365 (18%)	0.002	3840 (21%)	503 (22%)	0.18
Male	13,190 (80%)	3433 (78%)		14,969 (79%)	1654 (82%)		14,816 (79%)	1807 (78%)	
Nurse gender									
Female	15,310 (93%)	4,039 (92%)	0.052	17,524 (93%)	1825 (90%)	0.001	17,205 (92%)	2144 (93%)	0.34
Male	1246 (7%)	371 (8%)		1423 (7%)	194 (10%)		1451 (8%)	166 (7%)	
Doctor experience, years	7.82 ± 4.6	8.10 ± 4.6	< 0.0001	7.9 ± 4.7	7.8 ± 4.5	0.35	7.8 ± 4.7	8.7 ± 4.4	< 0.0001
Nurse experience, years	9.99 ± 5.6	10.6 ± 5.7	< 0.0001	10.1 ± 5.6	10.5 ± 5.7	0.002	10.0 ± 5.6	11.1 ± 5.7	< 0.0001

APDR = all polyp detection rate, PPDR = proximal polyp detection rate, SPDR = small polyp detection rate

PPDR

Except for a patient's gender and the referral, all other variables were significant and could predict PPDR. An increase in patient's age correlated with an increase in PPDR (OR 1.03, 95%CI 1.03–1.04, *P* < 0.0001). Male patients had more of a possibility for PPDR (OR 1.54, 95%CI 1.40–1.69, *P* < 0.0001). Patients hospitalized in the morning were positively associated with PPDR compared to patients hospitalized in the afternoon (OR 1.58, 95%CI 1.43–1.76, *P* < 0.0001). An increase in doctor's years of experience lowered the chance of PPDR (OR 0.98, 95%CI 0.97–0.1, *P* = 0.01). A nurse's years of experience was associated with greater PPDR (OR 1.02, 95%CI 1.01–1.03, *P* = 0.001). Female nurses had significantly less PPDR (OR 0.73, 95%CI 0.60–0.89, *P* = 0.005) compared with male nurses.

SPDR

Apart from time segment, referral, and nurse's gender, all variables were significant and could predict SPDR. Any increase in a patient's age increased the chance of SPDR (OR 1.02, 95%CI 1.02–1.02, *P* < 0.0001). Male patients had an increased likelihood of SPDR compared to females (OR 1.37, 95%CI 1.25–1.50, *P* <

0.0001). Doctors' years of experience increased their probability for SPDR (OR 1.03, 95%CI 1.01–1.04, *P* = 0.001). An increase in nurses' years of experience increased their probability of SPDR (OR 1.03, 95%CI 1.01–1.04, *P* < 0.0001). Female doctors had an advantage in SPDR (OR 1.22, 95%CI 1.08–1.37, *P* = 0.001).

ROC ANALYSIS

Using a ROC model, we separately tested the relationship between years of experience of doctors and nurses relative to PDR by allocating a cutoff in time where a significant change in PDR took place.

APDR

- **Doctors' experience:** A cutoff of 2.4 years predicted a significant increase in APDR, 12.4% vs. 22.1%. When applying the same model on PPDR, *P* = 0.551, no cutoff of the years of experience effect could be found. For SPDR, doctors with years of experience of more than 6.8 years had a PDR of 13.0%, compared to < 6.8% years, with only 8.5%, *P* < 0.0001.
- **Nurses' experience:** Nurses with up to 9.5 years of experience in colonoscopy resulted in a PDR of 18.8% whereas in

Table 3. Multivariate analysis for APDR, PPDR, and SPDR

	APDR			PPDR			SPDR		
	OR	95%CI	*P*-value	OR	95%CI	*P*-value	OR	95%CI	*P*-value
Patient age	1.03	1.02–1.03	< 0.0001	1.03	1.03–1.04	< 0.0001	1.02	1.02–1.02	< 0.0001
Patient gender (ref: male)	1.44	1.35–1.54	< 0.0001	1.54	1.40–1.69	< 0.0001	1.37	1.25–1.50	< 0.0001
Time segment (ref: morning)	1.27	1.18–1.37	< 0.0001	1.58	1.43–1.76	< 0.0001	1.03	0.93–1.14	0.552
Department (ref: ambulatory)	1.08	0.96–1.21	0.187	1.13	0.98–1.31	0.096	1.08	0.93–1.26	0.317
Doctor experience	0.99	0.98–1.00	0.15	0.98	0.97–1.00	0.011	1.03	1.01–1.04	< 0.0001
Nurse experience	1.03	1.02–1.04	< 0.0001	1.02	1.01–1.03	0.001	1.03	1.01–1.04	< 0.0001
Doctor gender (ref: female)	1.45	1.32–1.59	< 0.0001	1.11	0.97–1.27	0.141	1.22	1.08–1.37	0.001
Nurse gender (ref: female)	0.74	0.64–0.85	< 0.0001	0.73	0.60–0.89	0.001	0.92	0.76–1.12	0.429

95%CI = 95% confidence interval, OR = odds ratio, APDR = all polyp detection rate, PPDR = proximal polyp detection rate, SPDR = small polyp detection rate

those with more than 9.5 years of experience, PDR increased to 23.1%, *P* < 0.0001.

PPDR

- **Doctors' experience:** The model did not converge *P* = 0.551.
- **Nurses' experience:** Nurses with experience of up to 16.5 years had a PPDR of 9.2%, while nurses with experience of more than 16.5 years had an increase of PDR to 11.8%, *P* < 0.0001.

SPDR

- **Doctors' experience:** Doctors with experience of up to 6.8 years, SPDR was 8.5%, while for those with experience of more than 6.8 years, PDR increased to 13.0% *P* < 0.0001.
- **Nurses' experience:** Nurses with experience participating in colonoscopy of up to 9.3 years had a PDR of 8.8%, compared to 13.0%, when they had more than 9.3 years of experience, *P* < 0.0001.

DISCUSSION

After controlling for covariates, the experience of both doctors and nurses was not associated with PDR. However, analysis by ROC model revealed that 2.4 years of experience for doctors and 9.5 years for nurses was associated with a significant increase in APDR.

To the best of our knowledge, this is the first study to evaluate the effect of years of experience on PDR. In the literature, the factors reported to be associated with PDR were mainly patient age, cecal withdrawal time, and bowel cleansing.

Patient's age though, had a small, yet significant association with APDR, PPDR, and SPDR (OR 1.03, 1.03, 1.02, respec-

tively). Similar results were observed for male patients, but with more notable ORs in all three outcomes (OR 1.44, 1.54, and 1.37). Studies addressing this issue have confirmed these results [6,7]. Colonoscopies performed in the morning were associated with higher PDR (OR 1.27, 1.58, and 1.03 for APDR, PPDR, and SPDR, respectively). This result is supported by a meta-analysis from 2018 published by Wu et al. [19] in which they found that endoscopists working full-day shifts are associated with a significant decrease in PDR in the afternoon. Bowel cleansing has been reported to be associated with PDR [20]. Thus, we found it of great importance to limit examinations to those with at least good preparation, which should cancel its confounding effect.

There are few studies examining the association between the experience of doctors, and there are even fewer that address the effect of nurses' experience.

In 2008, Dellon and associates [9] performed a retrospective analysis on 29 nurses to evaluate the effect of 6 months of experience. They demonstrated a PDR of 40.3% vs. 46%, with an OR of 1.26; a significant difference in favor of the experienced nurses [9]. The different methodology and the short period of time chosen might be responsible for the differences.

Assisting nurses may have a role in improving the quality of colonoscopies as an additional observer. A study by Hong et al. [20], demonstrated that observations by experienced nurses during colonoscopy improved polyp detection rates, even when performed together with an experienced doctor. PDR was found to be significantly higher in the participating nurse's group with 33% vs. only 41.9% in the single observer group [10]. Another recent study by Fu et al. [21], evaluated the correlation between different assistants with different ex-

periences (more than vs. less than 6 months), and the quality of the colonoscopy by several quality indicators, including PDR. Although assistance by an experienced nurse was shown to be superior in several quality indicators (including cecum arrival time, degree of pain, and overall satisfaction), no significant association with PDR was reported (OR 1.01, 95%CI 0.68–1.32, $P = 0.258$) [21].

Advantages attributed to female doctors and male nurses are of limited use due to the relatively small number of staff included in the study.

CONCLUSIONS

Where one would intuitively expect an association between staff experience and PDR, either positively due to added experience, or negatively due to burnout, our work demonstrated no additional benefit in staff experience in improving PDR.

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Capsule

A promising therapeutic strategy for treating fibrotic diseases

Tissue fibrosis is the culminating event of many human inflammatory diseases. Few antifibrotic therapies are available, and the cellular and molecular mechanisms driving fibrosis remain unclear. Using single-cell transcriptomics, **Odell** et al. found that skin from patients with diffuse cutaneous systemic sclerosis was enriched for dendritic cells (DCs) producing the epidermal growth factor receptor (EGFR) ligand epiregulin. DC production of epiregulin could be induced by type I interferon and promoted NOTCH-mediated extracellular matrix gene expression in fibroblasts. In mouse models of bleomycin-induced skin and lung fibrosis, an epiregulin-neutralizing antibody alleviated fibrosis. These results identify a role for epiregulin-producing DCs in maintaining fibrosis and suggest that blocking epiregulin's EGFR activity could be a promising therapeutic strategy for treating fibrotic diseases.

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