FACTORS ASSOCIATED WITH COLONOSCOPY DURATION AT RSUP PROF. DR. I.G.N.G. NGOERAH IN 2025

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Abstract

Colonoscopy is a key diagnostic and therapeutic procedure for colorectal diseases. With increasing procedural volume, colonoscopy duration has become an important operational parameter in endoscopy unit management. Although clinical indications and service models are assumed to influence procedure time, real-world evidence regarding determinants of colonoscopy duration remains limited, particularly in low- and middle-resource settings. This study aimed to evaluate whether One Day Care (ODC) status, examination purpose (surveillance vs. diagnostic), and malignancy status are associated with colonoscopy duration. A retrospective cross-sectional study was conducted using secondary data from a single-operator endoscopy unit at RSUP Prof. Dr. I.G.N.G. Ngoerah between January and November 2025. All eligible cases were included using total sampling (n = 133). Colonoscopy duration (minutes) was analyzed using the Mann–Whitney test and multiple linear regression ($p < 0.05$; 95% CI). The median colonoscopy duration was 35 minutes (mean 41.8 ± 32.3 minutes). In univariate analysis, ODC procedures were significantly shorter than non-ODC procedures (30 vs. 40 minutes; $p = 0.033$). No significant differences were observed based on malignancy status ($p = 0.247$) or examination purpose ($p = 0.101$). In the multivariable analysis, no independent predictors of colonoscopy duration were identified. Basic clinical categorization and service model were not independently associated with colonoscopy duration in this real-world cohort. These findings suggest that unmeasured workflow dynamics or system-level factors may influence procedural time beyond simple clinical stratification.

Keywords: colonoscopy duration; one day care; malignancy; surveillance colonoscopy; endoscopy efficiency

INTRODUCTION

Colonoscopy is a lower gastrointestinal endoscopic procedure widely used for both diagnostic and therapeutic purposes and remains the gold standard for evaluating and managing most colorectal diseases (Latos et al., 2022). With the increasing burden of gastrointestinal disorders, the demand for colonoscopy services has risen substantially, placing greater pressure on endoscopy unit capacity (Latos et al., 2022). In the hospital setting, this growing procedural volume necessitates not only high-quality care but also efficient and measurable service management.

Endoscopy unit efficiency has become an important aspect of healthcare management, as it directly affects patient flow, resource utilization, and procedural scheduling (Almeida et al., 2016; Hudson et al., 2025; Tewani et al., 2022). Observational studies have demonstrated that endoscopy efficiency is influenced by multiple time-related components, including variability among operators and teams, as well as factors not fully captured by routine documentation systems (Tan et al., 2022). These findings underscore that the "time dimension" in endoscopic services is multifactorial. Although some components of efficiency extend beyond the procedure itself, procedure duration remains a key operational indicator because it directly impacts service capacity and scheduling (Adepoju et al., 2022; Yao et al., 2022).

Beyond operational considerations, colonoscopy duration should also be examined in relation to procedural indication (Gordon et al., 2024; Ma et al., 2026). Indications for

colonoscopy are generally categorized into diagnostic and surveillance purposes. Surveillance colonoscopy plays a crucial role in colorectal cancer prevention through the detection and management of premalignant lesions, making it a clinically significant indication (Pinsky & Schoen, 2020). Differences in examination purpose may result in variations in procedural approach and mucosal evaluation patterns, potentially contributing to differences in procedure duration. Quality improvement studies analyzing procedure time have reported that screening and surveillance colonoscopies may have different time profiles compared to purely diagnostic procedures (Jain et al., 2016).

In addition to procedural indication, malignancy status represents a relevant clinical factor in colonoscopy, as it is associated with lesion characteristics and the extent of evaluation required during the procedure. Studies evaluating colonoscopy indications in elderly populations have demonstrated associations between certain clinical indications and malignant findings, highlighting the clinical importance of malignancy within the endoscopic assessment process (Ofluoğlu, 2023). Although the direct relationship between malignancy and procedure duration may vary across populations and healthcare settings, malignancy status may conceptually influence procedural dynamics and time variability.

Beyond clinical factors, service delivery models may also influence procedural processes. One commonly implemented model in hospital settings is One Day Care (ODC), in which patients undergo the procedure and are discharged on the same day according to clinical criteria and institutional policy. From an operational standpoint, ODC may affect workflow organization and scheduling patterns and may theoretically be associated with differences in procedure duration or procedural conduct.

Despite existing literature addressing quality and efficiency in endoscopy services, evidence regarding factors associated with colonoscopy duration in routine clinical practice remains heterogeneous across institutions and healthcare systems (Tan et al., 2022; Jain et al., 2016). Local data in Indonesia specifically evaluating the relationship between ODC status, examination purpose (surveillance vs. diagnostic), and malignancy status with colonoscopy duration remain limited. Therefore, this study aimed to analyze the association between ODC status, examination purpose, and malignancy status with colonoscopy duration at RSUP Prof. Dr. I.G.N.G. Ngoerah in 2025 from January to November 2025.

Therefore, the primary objective of this study is to analyze the association between ODC status, examination purpose (surveillance vs. diagnostic), and malignancy status with colonoscopy duration at RSUP Prof. Dr. I.G.N.G. Ngoerah in 2025 from January to November 2025. The benefit of this research is to provide local, evidence-based insights that can inform endoscopy unit management, improve scheduling accuracy, and highlight areas for future quality improvement initiatives aimed at enhancing both clinical and operational efficiency.

RESEARCH METHOD

This study was an analytic observational study with a retrospective cross-sectional design using secondary data obtained from the endoscopy unit of RSUP Prof. dr. I.G.N.G. Ngoerah. The data source consisted of medical records of patients who underwent colonoscopy between January and November 2025, including endoscopic procedure datasets documented in the hospital recording system. The study aimed to analyze factors associated with colonoscopy duration, particularly based on clinical indication grouping, examination purpose (surveillance

vs diagnostic), and One Day Care (ODC) status.

The study population included all patients who underwent colonoscopy during the specified period. A total sampling technique was applied, in which all cases meeting the inclusion criteria were included in the analysis. The inclusion criteria comprised l patients undergoing colonoscopy for either diagnostic or surveillance purposes with complete records of procedure duration and main study variables. Exclusion criteria included non-colonoscopy procedures, duplicate or unverifiable records, and cases with missing or invalid duration data. After data cleaning and verification, a total of 133 colonoscopy cases met the criteria and were included in the final analysis.

The dependent variable was colonoscopy duration, expressed in minutes. Duration was defined as the time interval between the start and completion of the colonoscopy procedure as recorded in the medical record or endoscopy log system. The main independent variables included ODC status (ODC vs non-ODC), purpose of colonoscopy (surveillance vs diagnostic), and clinical indication (malignancy, inflammatory, structural, functional, and normal findings), which were further categorized into malignancy and non-malignancy groups for analytical purposes.

To minimize procedural variability that could influence procedure duration, the study was conducted under relatively homogeneous conditions. All colonoscopies were performed by the same operator, in the same endoscopy room, and using uniform endoscopic equipment and recording systems throughout the study period. Therefore, operator-related, environmental, and equipment-related factors were considered constant control variables, allowing observed variations in duration to more accurately reflect differences in patient clinical characteristics and indications.

Statistical analysis was performed in sequential stages, including univariate, bivariate, and multivariate analyses. Univariate analysis was used to describe baseline characteristics. Numerical variables, such as colonoscopy duration, were presented as median and interquartile range or mean and standard deviation according to data distribution. Categorical variables were presented as frequencies and percentages. Bivariate analysis was conducted using the Mann–Whitney U test or Kruskal–Wallis test, depending on the number of independent variable categories. Multivariate analysis was performed using multiple linear regression to identify factors independently associated with colonoscopy duration. A p-value < 0.05 was considered statistically significant. Ethical approval was obtained from the institutional review board, and all patient data were anonymized to ensure confidentiality.

RESULTS AND DISCUSSION

A total of 133 colonoscopy procedures were analyzed. The overall mean procedure duration was 41.8 ± 32.3 minutes, with a median of 35 minutes (range 5–275). Based on ODC status, 43 procedures (32.3%) were performed under the One Day Care scheme, and 90 (67.7%) were non-ODC. The ODC group had a shorter median duration compared to the non-ODC group (30 vs 40 minutes). Regarding malignancy status, 86 procedures (64.7%) involved patients with malignancy and 47 (35.3%) without malignancy. The median duration was 35 minutes in the malignancy group and 40 minutes in the non-malignancy group. For procedure indication, 97 procedures (72.9%) were diagnostic, and 36 (27.1%) were surveillance. Surveillance procedures showed a shorter median duration than diagnostic procedures (30 vs

40 minutes). Overall, descriptive analysis demonstrated a tendency toward shorter procedure duration in the ODC and surveillance groups.

Table 1. Baseline Characteristics of the Study Population

Variable	n (%)	Mean ± SD (min)	Median (IQR)	Min–Max
Overall	133 (100)	41.8 ± 32.3	35 (—)	5–275
ODC status				
Non-ODC	90 (67.7)	45.66 ± 35.66	40 (31)	7–275
ODC	43 (32.3)	34.35 ± 22.26	30 (20)	5–150
Malignancy status				
Non-malignancy	47 (35.3)	46.45 ± 40.83	40 (30)	10–275
Malignancy	86 (64.7)	39.57 ± 26.47	35 (21)	5–150
Procedure indication				
Diagnostic	97 (72.9)	43.97 ± 34.28	40 (28)	5–275
Surveillance	36 (27.1)	36.69 ± 25.90	30 (17)	10–150

Bivariate analysis using the Mann–Whitney U test demonstrated a significant difference in colonoscopy duration between the ODC and non-ODC groups. The median duration was 30 minutes in the ODC group and 40 minutes in the non-ODC group ($U = 1493.0$, $Z = -2.133$, $p = 0.033$), indicating shorter procedure time in ODC cases. No significant difference was observed based on malignancy status, with median durations of 35 minutes in the malignancy group and 40 minutes in the non-malignancy group ($U = 1776.0$, $Z = -1.157$, $p = 0.247$). Similarly, surveillance procedures had a median duration of 30 minutes compared to 40 minutes in diagnostic procedures; however, this difference did not reach statistical significance ($U = 1423.5$, $Z = -1.638$, $p = 0.101$).

Table 2. Comparison of Colonoscopy Duration Across Clinical Variables

Variable	Group	Median (IQR)	U (Z)	P-value
ODC status	ODC (n = 43)	30 (20) min	1493.0 (-2.133)	**0.033**
	Non-ODC (n = 90)	40 (31) min		
Malignancy status	Malignancy (n = 86)	35 (21) min	1776.0 (-1.157)	0.247
	Non-malignancy (n = 47)	40 (30) min		
Procedure indication	Surveillance (n = 36)	30 (17) min	1423.5 (-1.638)	0.101
	Diagnostic (n = 97)	40 (28) min		

- *Data are presented as median (interquartile range).*
- *Comparisons were performed using the Mann–Whitney U test.*
- *Statistical significance was set at $p < 0.05$.*

Multivariable linear regression analysis was performed to evaluate the independent association between ODC status, malignancy status, and procedure indication with colonoscopy duration. The overall regression model demonstrated a low explanatory capacity ($R = 0.187$; $R^2 = 0.035$; adjusted $R^2 = 0.012$), indicating that the included variables accounted for only a small proportion of the variability in procedure duration. The overall model was not statistically significant ($F = 1.553$; $p = 0.204$).

After adjustment for malignancy status and procedure indication, ODC status was no longer significantly associated with colonoscopy duration ($\beta = -9.743$ minutes; 95% CI −21.926 to 2.440; $p = 0.116$). Although the direction of the coefficient remained consistent with the bivariate findings, the confidence interval crossed zero, suggesting that the observed difference may be influenced by procedural or clinical factors not captured in the current model. Similarly, malignancy status ($\beta = -4.283$ minutes; 95% CI −16.344 to 7.778; $p = 0.484$) and surveillance indication ($\beta = -3.655$ minutes; 95% CI −16.783 to 9.474; $p = 0.583$) were not independently associated with procedure duration.

Table 3. Adjusted Associations Between Clinical Variables and Procedure Duration

Variable	β (Unstandardized)	95% CI	p-value
ODC (vs Non-ODC)	-9.743	-21.926 to 2.440	0.116
Malignancy (vs Non-malignancy)	-4.283	-16.344 to 7.778	0.484
Surveillance (vs Diagnostic)	-3.655	-16.783 to 9.474	0.583

R	R^2	Adjusted R^2	F (df=3,129)	p-value
0.187	0.035	0.012	1.553	0.204

- *Dependent variable: Colonoscopy duration (minutes).*
- *β represents the unstandardized regression coefficient.*
- *Reference categories: Non-ODC, Non-malignancy, Diagnostic procedure.*

In this study, the median colonoscopy duration was 35 minutes, with a mean of 41.8 ±32.3 minutes. The noticeable difference between the median and the mean, along with the relatively large standard deviation, suggests a non-normal distribution with substantial variability across procedures. This pattern indicates the presence of a subset of prolonged cases that increased the overall mean duration. Therefore, the median value likely provides a more representative estimate of the typical procedural time in this cohort.

Most procedures were performed for diagnostic purposes (72.9%), and a majority of patients had malignancy (64.7%). This distribution reflects the characteristics of a tertiary referral hospital, where colonoscopy is frequently utilized for confirmation and evaluation of suspected pathology rather than population-based screening. A hospital-based study in Indonesia similarly reported that colonoscopy is commonly performed for suspected inflammatory bowel disease and colorectal malignancy rather than routine screening, supporting the referral-driven profile observed in this study (Aisy & Zulkarnaini, 2023).

Regarding the service model, 32.3% of procedures were conducted under a One Day Care (ODC) scheme. In Indonesia, ODC is regulated as a structured hospital service model allowing selected patients to undergo procedures with same-day discharge based on predefined clinical and administrative criteria (Kemenkes RI, 2019). International guidelines similarly recognize colonoscopy as a predominantly ambulatory procedure, with same-day discharge

considered standard practice for appropriately selected patients (Early et al., 2018).

However, not all colonoscopy cases are suitable for outpatient management, particularly those requiring extended monitoring, significant comorbid stabilization, or complex therapeutic intervention. The coexistence of ODC and non-ODC procedures in this cohort therefore appears consistent with structured tertiary-level clinical practice. Overall, the univariate findings demonstrate considerable variability in colonoscopy duration and reflect a predominantly diagnostic, referral-based patient population. Bivariate analysis demonstrated a statistically significant difference ($p = 0.033$) between the ODC group (median 30 minutes) and the non-ODC group (median 40 minutes), with ODC patients exhibiting a shorter procedural duration. In this context, ODC status serves as a clinical surrogate for the outpatient population, while non-ODC status represents the hospitalized inpatient cohort.

Although studies specifically comparing ODC status with colonoscopy duration remain limited, these findings are congruent with broader literature identifying the inpatient setting as a predictor of prolonged procedures. This difference is most likely influenced by bowel preparation quality (Tantinam et al., 2025). ODC patients are generally more independent in adhering to dietary instructions and laxative regimens at home. Moreover, regular physical mobility at home may enhance intestinal peristalsis, thereby optimizing bowel cleansing (Cui et al., 2024). In contrast, non-ODC patients often experience limited physical mobility, use medications that affect intestinal motility, and present with comorbid conditions that compromise the effectiveness of bowel preparation.

Inadequate bowel preparation may necessitate on-site lavage with water through the colonoscope channel, directly prolonging the cecal intubation time (CIT). Apart from bowel preparation, patient status and differing comorbidity profiles also contribute to variations in colonoscopy duration. ODC patients tend to have better overall health profiles, whereas non-ODC patients are generally less physically active, which may result in prolonged colonic transit time (Krygier & Enns, 2008; Frazzoni et al., 2021). In patients with complex comorbidities, endoscopists are typically more cautious when maneuvering the instrument to minimize the risk of cardiovascular complications or perforation, consequently extending the procedural time.

In contrast to the significant effect observed with respect to patient care status, bivariate analysis of malignancy status demonstrated a non-parallel pattern in this study. The median colonoscopy duration in the malignancy group (35 minutes) did not differ significantly from that of the non-malignancy group (40 minutes), with a p-value of 0.247. Current international quality indicators, including those from the American College of Gastroenterology and the American Society for Gastrointestinal Endoscopy, do not define total colonoscopy duration as a primary quality benchmark. Instead, emphasis is placed on withdrawal time and lesion detection rates. Therefore, the absence of a significant difference in total procedure time between malignancy and non-malignancy groups in this study is consistent with the notion that overall colonoscopy duration is influenced more by procedural complexity and technical factors than by malignancy status alone (Rex et al., 2024).

The observation that the malignancy group exhibited a slightly shorter median duration than the non-malignancy group may be explained by several procedural considerations. In cases where a tumor mass is clearly visible (malignancy-positive), the endoscopist can often proceed directly to lesion identification, tissue sampling (biopsy), and localization without the

need for prolonged search for subtle lesions.

Furthermore, advanced malignancies may present with high-grade stenosis, which can preclude further advancement of the scope and lead to a truncated and thus shorter procedural time for safety reasons. Conversely, in the non-malignancy group that frequently consists of diagnostic cases with nonspecific symptoms, the operator is required to perform a more meticulous and comprehensive examination across all colonic segments. This finding is consistent with the study by Anderson et al., which reported that efforts to exclude potential abnormalities in colonoscopies with normal findings often require a more extensive mucosal inspection compared with cases in which a clearly identifiable pathological lesion is detected early during the examination (Anderson et al., 2001).

Consistent with the findings for malignancy status, which did not demonstrate a significant impact on colonoscopy duration, the procedural indication likewise showed a similar pattern. Although descriptively the median duration for surveillance colonoscopy was shorter (median 30 minutes) compared with diagnostic colonoscopy (median 40 minutes), this difference did not reach statistical significance in the bivariate analysis ($p = 0.101$). This observation aligns with the study by Jain et al., which reported that surveillance colonoscopies required a median of 2.41 minutes longer than diagnostic procedures ($p = 0.01$) (Jain et al., 2016).

Theoretically, diagnostic colonoscopy may require more time because it is performed to investigate unexplained clinical symptoms and often necessitates multiple biopsies or a more extensive mucosal evaluation, whereas surveillance procedures are generally more focused on previously identified pathological areas. The lack of statistical significance in the present study may be attributable to the application of uniform procedural standards by endoscopists within the institution, resulting in a relatively consistent level of inspection thoroughness regardless of the examination indication.

In the multivariate analysis, ODC status was not independently associated with colonoscopy duration ($B = -9.74$ minutes; 95% CI −21.93 to 2.44; $p = 0.116$). Furthermore, the overall regression model was not statistically significant ($F = 1.553$; $p = 0.204$), with an R^2 of 0.035, indicating that ODC status, surveillance indication, and malignancy status collectively explained only a small proportion of the variability in procedure time. The loss of statistical significance after adjustment suggests that the shorter duration observed in the unadjusted analysis was likely influenced by confounding factors. In routine clinical practice, patients selected for One Day Care are typically those with stable clinical profiles and anticipated lower procedural complexity. Therefore, ODC status may function as a surrogate marker of case selection rather than a direct technical determinant of procedure duration.

Quality standards in colonoscopy emphasize that procedural performance is largely determined by technical and operator-related factors. The British Society of Gastroenterology guidelines highlight key performance indicators such as adequate bowel preparation, cecal intubation rate, adenoma detection rate (ADR), and colonoscopy withdrawal time (Rees et al., 2016). The recommendation of a minimum mean withdrawal time for negative procedures underscores the relationship between inspection technique and procedural dynamics. These indicators reflect procedural complexity and endoscopist technique rather than administrative care models.

Similarly, the European Society of Gastrointestinal Endoscopy (ESGE) performance

measures identify bowel preparation quality, ADR, appropriate polypectomy technique, and other technical indicators as central determinants of colonoscopy quality (Kaminski et al., 2017). While these guidelines do not directly evaluate procedure time as an outcome, they emphasize procedural elements that inherently influence the technical conduct and potential duration of colonoscopy. From an operational perspective, efficiency in endoscopy units is influenced by multifactorial components, including operator variability, team dynamics, and workflow processes (Tan et al., 2022). Their findings support the concept that procedural time in real-world practice reflects an interaction between technical and systemic factors rather than a single administrative classification such as ODC status.

Taken together, the non-significant association between ODC status and procedure duration in this study aligns with the broader understanding that colonoscopy dynamics are predominantly driven by technical complexity and operator-dependent factors. The low R^2 further suggests the presence of residual confounding due to unmeasured variables such as bowel preparation quality, lesion burden, therapeutic interventions, and endoscopist experience.

Although the regression coefficient indicated an approximate 9–10 minute reduction in duration for ODC cases, the wide confidence interval crossing zero reflects substantial uncertainty. Therefore, this finding cannot be interpreted as evidence of a consistent independent effect but rather as a possible reflection of case selection characteristics not fully captured in the model.

This study has several limitations. First, its retrospective cross-sectional design limits causal inference and is subject to potential residual confounding. Second, the study was conducted in a single tertiary referral center with a single operator, which enhances internal consistency but may limit generalizability to other institutions with different operator profiles and workflow systems. Third, important procedural determinants such as bowel preparation quality, lesion burden, therapeutic interventions (e.g., polypectomy or endoscopic resection), withdrawal time, and sedation-related factors were not included in the regression model. The low explanatory power of the model ($R^2 = 0.035$) indicates that substantial variability in procedure duration remains unexplained and likely reflects unmeasured technical and system-level factors.

CONCLUSION

In this retrospective single-operator study, colonoscopy duration demonstrated considerable variability, with a median of 35 minutes. Although One Day Care (ODC) procedures were significantly shorter in bivariate analysis, ODC status, malignancy status, and examination purpose were not independently associated with procedure duration after multivariable adjustment. These findings suggest that, in routine clinical practice, colonoscopy duration is more strongly influenced by technical complexity and workflow-related factors than by basic clinical categorization or administrative care models alone. Future research should incorporate multicenter designs and include additional variables—such as endoscopist experience, bowel preparation quality, procedural difficulty, and team dynamics—to better elucidate the determinants of colonoscopy duration and improve operational efficiency.

REFERENCE

Adepoju, A. H., Austin-Gabriel, B., Eweje, A., & Collins, A. (2022). Framework for automating multi-team workflows to maximize operational efficiency and minimize redundant data handling. *IRE Journals, 5*(9), 663–664.

Aisy, A. R., & Zulkarnaini, A. (2023). Profil pasien endoskopi gastrointestinal di RSUP Dr. M. Djamil Padang tahun 2022. *Nusantara Hasana Journal, 3*(7), 141–155. https://doi.org/10.59003/NHJ.V3I7.1061

Almeida, R., Paterson, W. G., Craig, N., & Hookey, L. (2016). A patient flow analysis: Identification of process inefficiencies and workflow metrics at an ambulatory endoscopy unit. *Canadian Journal of Gastroenterology and Hepatology, 2016*(1), 2574076.

Cui, J., Xie, F., Yue, H., Xie, C., Ma, J., Han, H., et al. (2024). Physical activity and constipation: A systematic review of cohort studies. *Journal of Global Health, 14*, 04197. https://doi.org/10.7189/JOGH.14.04197

Early, D. S., Lightdale, J. R., Vargo, J. J., Acosta, R. D., Chandrasekhara, V., Chathadi, K. V., et al. (2018). Guidelines for sedation and anesthesia in GI endoscopy. *Gastrointestinal Endoscopy, 87*(2), 327–337. https://doi.org/10.1016/j.gie.2017.07.018

Frazzoni, L., Radaelli, F., Spada, C., Mussetto, A., Frazzoni, M., Laterza, L., et al. (n.d.). The diagnostic yield of colonoscopy in hospitalized patients: An observational multicenter study.

Gordon, M., Nigam, G. B., Sinopoulou, V., Al Bakir, I., Bateman, A. C., Din, S., Dolwani, S., Dhar, A., Faiz, O. D., & Hayee, B. (2024). Update from 2010 (standard operating procedure): Protocol for the 2024 British Society of Gastroenterology guidelines on colorectal surveillance in inflammatory bowel disease. *BMJ Open Gastroenterology, 11*(1).

Hudson, J. L., Shaheen, N. J., & Arora, S. (2025). Optimizing scheduling efficiency and throughput in the endoscopy unit: Best practices and strategies to improve unit utilization. *Clinical Gastroenterology and Hepatology.*

Jain, D., Goyal, A., & Zavala, S. (2016). Predicting colonoscopy time: A quality improvement initiative. *Clinical Endoscopy, 49*(6), 555–559. https://doi.org/10.5946/ce.2015.110

Krygier, D., & Enns, R. (2008). The inpatient colonoscopy: A worthwhile endeavour. *Canadian Journal of Gastroenterology, 22*(12), 977. https://doi.org/10.1155/2008/576987

Latos, W., Aebisher, D., Latos, M., Krupka-Olek, M., Dynarowicz, K., Chodurek, E., et al. (2022). Colonoscopy: Preparation and potential complications. *Diagnostics, 12*(3). https://doi.org/10.3390/diagnostics12030747

Ma, R., Nasseri, Y., Wu, G., Zeller, M., Solis-Pazmino, P., Wetherell, J., Barnajian, M., Feinman, M., Felton, J., & Wolf, J. (2026). The importance of procedural indication in predicting operative time for elective robotic colon surgery. *Journal of Robotic Surgery, 20*(1), 370.

Ofluoğlu, C. B. (2023). Evaluation of colonoscopy indications and the association with malignancy in patients aged 75 and over. *Laparoscopic Endoscopic Surgical Science (LESS).*

Pinsky, P. F., & Schoen, R. E. (2020). Contribution of surveillance colonoscopy to colorectal cancer prevention. *Clinical Gastroenterology and Hepatology, 18*(13), 2937. https://doi.org/10.1016/j.cgh.2020.01.037

Tan, C. M., Bernstein, M., Raboud, J., Mannino, B., & Tinmouth, J. (2022). Efficiency in the endoscopy unit: Can we "turn around" room turnover? An observational quality improvement study. *Journal of the Canadian Association of Gastroenterology, 5*(4), e57. https://doi.org/10.1093/jcag/gwac005

Tantinam, T., Phoonkaew, T., Treeratanawikran, T., Kamoncharoen, P., Srimaneerak, E.,

Siripoonsap, M., et al. (2025). Comparative analysis of outpatient and inpatient bowel preparation for colonoscopy: Evaluating quality outcomes and identifying contributing factors. *Journal of Health Science and Medical Research, 43*(5), e20251170. https://doi.org/10.31584/jhsmr.20251170

Tewani, S. K., Tannous, G. C., Stier, M. W., Natal, E., & Vicari, J. (2022). Improving and driving efficiency in your endoscopy unit in the 21st century. *Clinical Gastroenterology and Hepatology, 20*(12), 2680–2683.

Yao, X., Almatooq, N., Askin, R. G., & Gruber, G. (2022). Capacity planning and production scheduling integration: Improving operational efficiency via detailed modelling. *International Journal of Production Research, 60*(24), 7239–7261.

Rex DK, Anderson JC, Butterly LF, Day LW, Dominitz JA, Kaltenbach T, et al. Quality Indicators for Colonoscopy. American Journal of Gastroenterology. 2024 Sep 1;119(9):1754–80. doi:10.14309/ajg.0000000000002972 PubMed PMID: 39167112.

Anderson JC, Messina CR, Cohn W, Gottfried E, Ingber S, Bernstein G, et al. Factors predictive of difficult colonoscopy. Gastrointest Endosc. 2001;54(5):558–62. doi:10.1067/mge.2001.118950 PubMed PMID: 11677470.

Rees CJ, Thomas Gibson S, Rutter MD, Baragwanath P, Pullan R, Feeney M, et al. UK key performance indicators and quality assurance standards for colonoscopy. Gut. 2016 Dec 1;65(12):1923–9. doi:10.1136/gutjnl-2016-312044 PubMed PMID: 27531829.

Michal Kaminski AF, Thomas-Gibson S, Bugajski M, Bretthauer M, Rees CJ, Dekker E, et al. Performance measures for lower gastrointestinal endoscopy: a European Society of Gastrointestinal Endoscopy (ESGE) Quality Improvement Initiative [Internet]. 2017. doi:10.1055/s-0043-103411