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On Time and Target: Evaluating Colonoscopy Performance and Learning Curves in Coloproctology Residents

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Abstract

Colonoscopy is an essential procedure in colorectal cancer screening and treatment, and high-quality exams are crucial for maximizing diagnostic efficacy. Technical proficiency in colonoscopy is a key factor for the quality of the procedures and, so, for patient safety. This study analyzes the colonoscopy learning curve of coloproctology residents, using cecal intubation time as a metric. Cecal intubation time was analyzed in 216 exams performed by first- and second-year coloproctology residents at a university hospital in Rio de Janeiro/RJ, over a period of 10 months. The results revealed a learning curve with a significant reduction in cecal intubation time over the course of the training, particularly in first-year residents, who began their training in an environment with more frequent exams. These results align with earlier studies, emphasizing the importance of repetitive practice for developing the technical skills needed for competent colonoscopy.

The findings of this study demonstrate that conducting between 100 and 150 colonoscopies suggests a suitable benchmark for achieving competence in this procedure.

Keywords

- colonoscopy
- traineeship
- academic training
- colorectal surgery
- colorectal cancer

Introduction

Colorectal cancer is one of the leading causes of cancer mortality, constituting ~10% of all malignant tumors.[1–3] Colonoscopy is the gold standard examination for early detection and prevention, allowing the identification and removal of precancerous lesions.[1,3,4] This procedure requires high technical proficiency and demands rigorous training for medical specialists to ensure patient safety and ideal outcomes.[1]

Physicians undergo rigorous training to acquire the necessary skills needed for safe and accurate colonoscopy performance. Colonoscopy quality assessment considers factors such as complete visualization of the colon, also known as the cecal intubation rate (CIR), detection of polyps and adenomas, called adenoma detection rate (ADR), and procedure duration, also referred to as cecal intubation time (CIT), ensuring comprehensive and efficient examinations for accurate diagnosis and appropriate treatment.[5–8] CIT measures the elapsed time until cecal intubation and does not have an

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established value in the literature, ranging from ten to over 60 minutes.[2,4,6,9,10]

Given that coloproctologists are among the professionals qualified to perform this procedure, specialized training for residents in this area is indispensable. However, the learning curve to achieve proficiency in performing this examination is not yet well defined in literature. Research in this area is scarce, and there is still a lack of consensus on the minimum number of examinations needed to achieve competence in performing colonoscopies.[2,3,5,6,11] Understanding the process for residents to acquire the skills needed for this examination is essential to improve training programs and ensure the development of qualified professionals.

This study aims to analyze the learning curve of coloproctology residents to achieve mastery in performing competent colonoscopy examinations and to find factors that influence the acquisition of these skills. In this way, it may be possible to refine resident training and, finally, improve patient care.

Methods

This work was conducted in the form of a cross-sectional and non-randomized observational study, with the collection of CIT data from colonoscopy exams performed by residents in coloproctology at the Pedro Ernesto University Hospital (HUPE/UERJ), in Rio de Janeiro/RJ. Data was collected prospectively between November 2023 and August 2024 using a standardized data collection form prepared by the researcher.

Data collection form:

Time Control
1. Exam date: __/__/__
2. Patient: _____-_____
3. Medical Record: _____
4. Start time: ___: ___
5. Arrival at the last segment: ___: __
6. End of exam: ___: ___
7. Reason for not reaching the cecum: ◯ Loop ◯ Adhesion ◯ Poor preparation ◯ Patient instability ◯ Other: _____
8. Observation:

Source: Author's archive

The inclusion criterion was exams performed by coloproctology residents in the period during the study timeframe, in which the following times were noted: start of the exam, arrival at the cecum, and end of the exam. As for exclusion criteria, we excluded exams where any of the three time points could not be recorded.

The work team for performing the colonoscopy was composed of a resident doctor, a preceptor doctor, and a nursing technician. The data collection was recorded manually by the technician, in which the start time of the exam was noted right after the introduction of the device through the anus. The exams were performed by the residents with preceptor assistance as needed, if necessary, and then the time of arrival at the cecum and the end of the exam were verbally informed to the technician to record the new time on the form.

After collection, the data was entered into a spreadsheet, allowing for its treatment, separation by year of residency and by month, with calculation of the median, enabling the formation of a boxplot graph of time over the months in the analyzed period. In addition, an epidemiological analysis of the population undergoing the collected exams was performed, evaluating sex and age.

The residents were divided into two groups, R2 and R1, according to the year in which they began their training. The R2 residents began training in March 2022, while the R1 residents began in March 2023.

Results

A total of 216 colonoscopy exams conducted between November 2023 and August 2024 were analyzed, recording the cecal intubation times (CIT). Of these, 106 exams reached the cecum. In 110 cases, the terminal ileum was reached. In total, 527 colonoscopy exams were performed during this period.

The distribution of exams was obtained per month and year of residency, as seen in ►**Table 1**:

Analyzing the data from the R2 residents, the ►**Graph 1** was obtained:

This group had 61 CITs recorded during the analyzed period, with a total of 244 exams performed. The following distribution of medians was observed:

- November/2023 (initial): 11 minutes
- December/2023 (50 exams): 23 minutes
- March/2024 (100–150 exams): 15 minutes
- June/2024 (200 exams): 16.5 minutes
- August/2024 (final): 19 minutes

About the data from the R1 residents, the ►**Graph 2** was constructed.

With 155 CITs recorded and 283 exams performed, the following distribution of time was observed:

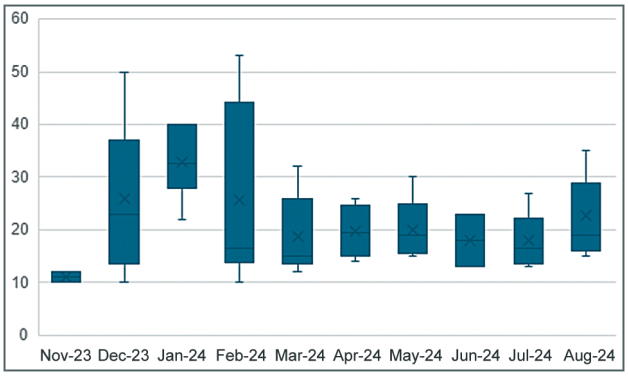
- November/2023 (initial): 34.5 minutes
- December/2023 (50 exams): 29 minutes
- March/2024 (100–150 exams): 31.5 minutes
- June/2024 (200 exams): 22 minutes
- August/2024 (final): 17 minutes

Finally, the epidemiological characterization of the population undergoing the exams showed a higher prevalence of females (156 women, representing 72.2% of the population), with a median age of 59 years (mean 57.5 years). The age group with the highest representation in our population was 60 to 79 years, including 104 patients (48.1%). The distribution of sex and age data is observed in the following tables. ►**Tables 2** and **3**

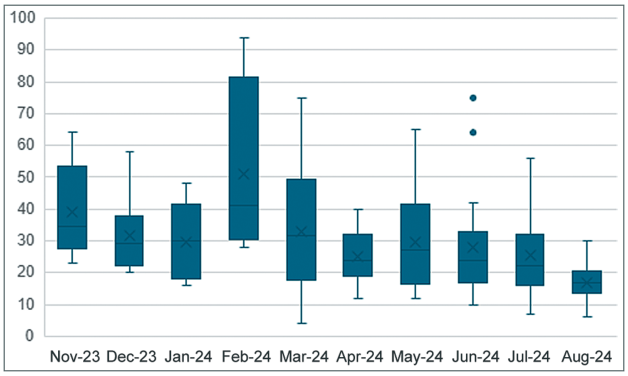
Table 1 Distribution of resident exams per month

Month	Number of CITs - R2	Number of Exams - R2	Number of CITs - R1	Number of Exams - R1
November/23	2	21	5	18
December/23	8	30	12	40
January/24	6	30	5	14
February/24	14	48	4	6
March/24	5	26	12	33
April/24	4	24	15	29
May/24	5	12	26	34
June/24	2	16	25	37
July/24	8	17	22	39
August/24	7	20	29	33
Total	**61**	**244**	**155**	**283**

Source: Author's archive.



Graph 1 Median cecal intubation time curve for R2 residents. Source: Study data.



Graph 2 Median cecal intubation time curve for R1 residents. Source: Study data.

Table 2 Distribution of age range/age

Age Range	Total (%)
0–19	1 (0.5)
20–39	17 (7.9)
40–59	91 (42.1)
60–79	104 (48.1)
80–100	3 (1.4)

Source: Author's archive.

Table 3 Distribution by sex

Sex	Total (%)
Female	156 (72.2)
Male	60 (27.8)

Source: Author's archive.

Discussion

Colonoscopy is the gold standard examination for colorectal cancer screening and diagnosis, essential for its prevention and effective treatment. Therefore, we can infer that the quality of colonoscopy procedures has a direct impact on the population's health.[1–4] The present study aimed to evaluate the learning curve of coloproctology residents, based on the variable of cecal intubation time (CIT), aiming to observe the main factors that influenced this time and, thus, improve teaching methods. For this, a comparison was made between the residents, divided into two groups according to the start of their residency, and performing at least four exams per week.

In addition to determining proficiency in the examination, the quantification of time data is important for the logistical planning of exam scheduling and for adapting the work environment to perform the procedures. This allows for more accurate estimates of the medication and staffing needs required for the efficient operation of the endoscopy sector.[9]

Considering that the temporal data was not consistently collected in all the exams performed, we chose to relate the numbers obtained from CIT with the accumulated number of exams performed throughout each month. This approach allowed us to analyze the progression of the temporal results found in relation to the total volume of procedures, rather than relying on a precise, but inconsistently recorded, timeline. In addition, we set up strategic milestones in some months, depending on the number of exams accumulated by the residents. The first milestone was November/2023, the

beginning of the study. The second milestone was in December/2023, when residents had performed approximately fifty exams. The third milestone was established in March/2024, with residents having performed between 100 and 150 exams. The fourth milestone was in June/2024, when the sum of accumulated exams exceeded 200 for each group of residents. Finally, the last milestone was in August/2024, at the end of the study period.

The analysis of the 216 exams revealed that in 106 cases the cecum was reached, and in 110 patients the terminal ileum was examined.

It is described in the literature that one of the factors that most predicts a difficult exam is female sex,[3–5,9,10,12] which may be a confounding factor in the data analysis, since most of the patients in the study are women. Older age is also related to a technically more difficult exam.[3–6,9,10,12,13] In the study, the mean age was 57 years, but most patients were in the 60 to 79 age group, which may also interfere with the results.

Some authors define CIT as the main item to be evaluated during learning[11]; however, there is no established consensus on a cutoff value, with references determining between 4 and 10 minutes[4,6,9] and others suggesting 10 to 20 minutes.[2,10]

It was observed that at the end of the study, the median time for all groups fell within the 10–20-minute range (19 minutes for R2 and 17 minutes for R1).

Analyzing the data from the R2 residents, a consistent time curve (CIT) was obtained, with the respective median times: in the first milestone it was 11 minutes, increasing to 23 minutes in the second milestone, 15 minutes in the third, 16.5 in the fourth and, at the end, with 19 minutes as the median CIT. It is important to point out that, despite the experienced residents, R2, having started their training nine months before the beginning of the study, they performed colonoscopy exams with a significantly lower frequency in this period - approximately two exams every two weeks. These initial exams were not included in the analysis. Therefore, at the beginning of data collection, these residents already had a certain level of training in colonoscopy, but with a limited number of exams performed and with significant intervals between training sessions (biweekly), especially compared with the CIT of new R1 residents, based on the same quantitative milestone of exams performed, less than 60 exams in total.

The data from R1 showed a curve with a reduction in time (CIT) between the first and second milestones (34.5 minutes to 29), evolving with apparent stabilization between the second and third milestones (29 minutes to 31.5) and, then, clearly decreasing from the following milestone until the end of the study (31.5 minutes to 22 and then to 17 minutes), showing a clear and constant evolution in the training of these professionals. It is interesting to note that, in this group, the curve definitively decreased from the third milestone, when the residents had performed between 100 and 150 exams, suggesting that this may be the approximate number of exams for initial competency.

There is currently no minimum number of exams established in the literature to determine the proficiency in colonoscopy of professionals in training. There is a wide variety of studies that try to determine this value, but without a consensus.[2,3,5,6,8] For example, the American Board of Surgery (ABS)[5] recommends fifty colonoscopy exams, while the Joint Advisory Group on Gastrointestinal Endoscopy in the United Kingdom (UK JAG)[5] proposes the number of 200 exams.

The learning curve in colonoscopy is individual, being influenced by several factors, such as the quality of the training program and supervision, in addition to the resident's personal aptitude and earlier experience.[4,10] Therefore, it is difficult to establish an exact number of procedures needed for all residents to acquire this competence.

The assistance of the preceptor during the procedures, especially in the more complex exams, and the absence of a defined maximum time for the resident's attempt to complete the exam, without the direct help of the preceptor, may have attenuated the performance differences between residents R1 and R2. This dynamic may have masked specific difficulties and underestimated the need for more training in certain techniques, such as loop reduction and polypectomy techniques.

As one of the most prevalent neoplasms in the world population, colorectal cancer represents an important public health condition, requiring high-quality colonoscopy exams for its early detection and treatment.[1–4]

The present study demonstrated a clear downward curve in cecal intubation time, particularly in residents who began their training in an environment with greater frequency and shorter intervals between colonoscopy exams. This indicates that consistency, in addition to the number of exams, plays a crucial role in developing skills for good examination performance. The observed data corroborates the specialized literature, which demonstrates the importance of repetitive practice to create proficiency in performing colonoscopy and its procedures.[5]

Data collection, which relies on manual notetaking during the procedure, is susceptible to biases, such as recording errors and omission of information. Dependence on data provided verbally by physicians and the restriction of the analysis to exams with complete time annotations may have introduced selection bias. In addition, the variability in the experience of the preceptors may also have influenced the results.

Due to the non-systematic nature of data collection, this study aims to provide a first overview of the challenges associated with managing colonoscopy procedure times within the HUPE Coloproctology Service, particularly in the context of resident learning. The results obtained should be interpreted with caution and cannot be generalized to other scenarios. This study serves as a basis for more rigorous future research to better understand and address these challenges.

Conclusion

The absence of consensus in the literature on the minimum number of exams to be performed during training[2,3,5] and the limitations of the present study reinforce the importance

of more research on the subject. In the present study, we observed a clear decrease in the curve when residents had around 100–150 exams, suggesting that this may be an adequate number to determine that the resident is developing proficiency.

It is hoped that this study will encourage the scientific community to deepen investigations, using more robust methodologies to evaluate the performance of residents in colonoscopy. The identification of factors that influence the learning curve and the development of tools to check the progress of residents are crucial to ensure the quality of procedures and patient safety.

Authors' Contribution

JCB: designed the study, collected and analyzed data, and wrote the manuscript; PCCJ: supervised the project, interpreted the data, and revised the manuscript; RGM: critically reviewed the final manuscript. All authors read and approved the final manuscript.

Data Availability Statement

The data that support the findings of this study are available from the authors upon reasonable request.

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Conflict of Interest

The authors report no conflict of interest.

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