

# The role of endoscopic computer simulator in assessing the quality level of endoscopists

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**Abstract.** Objective: The main objective of this study is to evaluate the ability of computer simulators in assessing the skills and the level of performance of practicing endoscopists. Material and method: We calculated the cecum intubation rate (CIR) of 7 experienced endoscopists. Afterwards, the group performed procedures on the endoscopy computer simulator SIMBIONIX GI Mentor II. They didn't have previous experience with endoscopy simulators. Using the average values of the variables produced on the simulator we tried to identify possible correlations with their CIR. Results: Our research proved a strong link between cecal intubation rate (on real cases) and the performance on the SIMBIONIX simulator. The most important correlation was made with the results from Endobubble game which measures mostly manual dexterity. Conclusion: In conclusion we can affirm that computer simulators may become an useful tool for the assessment of endoscopic skills and may be used, in the future, as a part of the credentialing process for endoscopists.

**Key Words:** endoscopy simulator, skill assessment, cecal intubation rate.

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## Introduction

Presently, worldwide there is an increasing interest regarding the quality of medical services in gastroenterology. There is a common desire to implement rules for best practices among gastroenterologists in general and endoscopists in particular. Evidence-based care should always be at the base of these regulations. The public demand for assuring quality had risen from alarming reports about medical errors (Cohen 2015). In USA, two articles published in 2000 and 2001 had a defining role which led to a key focus on areas of underperformance in many fields of medicine (Kohn 2000; Institute of Medicine, Committee on Health Care in America 2001). Since then it was generated a great demand for accurately determining and assessing the quality of the services endoscopists provide.

A high quality medical service is defined by an increased likelihood of desired health outcomes for an individual or population and by being consistent with the current professional knowledge (Chassin 1998). The quality of health service can be measured by comparing the performance of an individual or a group of individuals with an ideal or a benchmark (Chassin 1998). A quality indicator is often reported as a ratio between the incidence of correct performance and the opportunity for correct performance, or as the proportion of interventions that achieve a predefined goal (Petersen 2011). American Society for Gastrointestinal Endoscopy has published, first in 2006 and last updated in 2015, a proposed set of quality indicators for the main endoscopic procedures (Cohen 2015). The indicators were graded on the strength of the supporting evidence. Quality indicators were divided into 3 time periods: preprocedure, intraprocedure and postprocedure. ASGE has established sets of

indicators that are common for all endoscopic interventions (ex: appropriate indication, informed consent, assessment of risk factors, sedation plan, photodocumentation, complete procedure report etc.) and indicators that are specific for each procedure. Intraprocedural indicators proposed by ASGE for colonoscopy are:

- frequency with which the procedure note documents the quality of preparation (recommended > 98% of cases)
- frequency with which the bowel preparation is adequate to allow the use of recommended surveillance or screening intervals (rec >85%)
- cecal intubation rate for all examinations should be > 90% (with photography!)
- cecal intubation rate for screening examinations should be >95%
- frequency with which adenomas are detected in asymptomatic, average-risk patients (screening) should be >25% (>30% men, >30% women)
- frequency with which withdrawal time is measured (>98%)
- average withdrawal time in negative-result screening colonoscopies (>6 minutes)
- frequency with which biopsies are obtained (chronic diarrhea, inflammatory bowel diseases)
- frequency with which endoscopic removal of polyps (<2 cm) is attempted before surgical referral (>98%)

One of the most relevant quality indicators for colonoscopy and consequently for endoscopy skills in general is the cecal intubation rate. This process is defined as the passage of the tip of the colonoscope to a point proximal to the ileocecal valve so that the entire cecum is visualized. Cecal intubation rate is an important quality metric and is relatively easy to measure. It makes intuitive sense to assess cecal intubation as a marker of “complete”

colonoscopy, especially in light of the failures of colonoscopy in the right colon. All colonoscopies should be counted in determining the cecal intubation rate except procedures aborted because of inadequate bowel preparation or because of severe colitis and cases planned for the treatment of a known stricture or large polyp. Effective endoscopists should be able to intubate the cecum in >90% of all cases and >95% of cases when the indication is screening a healthy adult (Cohen 2015). Cecal intubation rate can become a useful tool for demonstrating ones ability to perform endoscopy at proper standards of care.

Credentialing is the review of evidence that a prospective endoscopist has proper licensure, education, adequate training to qualify them for privileges at an institution (Cotton 2009). The role of new technology for skills assessment has the potential to transform this process. Computer simulators have the potential for current skills demonstration without patient risk and in a time-efficient manner (Cotton 2009; Rodney 1998). An essential question in the simulator field is the applicability of skills demonstration on simulators to performance on real endoscopy. If good correlation of performance assessment on computer simulators with supervised evaluations on real examination can be established, there will be a great impulse for wider dissemination of simulators.

The main objective of this study is to evaluate the ability of computer simulators in assessing the skills and the level of performance of practicing endoscopists. The secondary objectives are to analyze the performances on a virtual reality simulator of experienced endoscopists who had no previous experience with this type of equipment.

## Material and methods

We calculated the cecum intubation rate (CIR) of 7 experienced endoscopists from Regional Institute of Gastroenterology and Hepatology "Prof. Dr. Octavian Fodor", Cluj-Napoca, Romania. The group consisted of seven practicing doctors with a range from 5 to 12 years of experience in endoscopy. The approval of the Ethics Commission of the "Iuliu Hatieganu" University of Medicine and Pharmacy Cluj-Napoca was obtained and an informed consent was signed by each participant included in the study after a clear explanation of the required procedures. From the evaluation were excluded the colonoscopies performed with poor bowel preparation. We also excluded the colonoscopy cases with stenosis (benign or malignant) which made progression impossible and the cases with suspected acute flares of inflammatory bowel disease or diverticulitis. After applying the exclusion criteria we determined CIR of the last 150 colonoscopies performed by each doctor.

In the second phase of the study the group performed procedures on the endoscopy computer simulator SIMBIONIX GI Mentor II. The simulator is provided with 2 types of games for developing manuality, each with 2 levels of difficulty and modules for esogastroduodenoscopy (20 cases), colonoscopy (30 cases), rectosigmoidoscopies (20 cases), emergency upper GI bleedings (10 cases), endoscopic retrograde cholangiopancreatography (20 cases) and diagnostic endoscopic ultrasound examinations (linear and radial). Each of the 7 doctors had to complete 5 of the most difficult cyberscopy games (Endobubble level 2) and afterwards had to perform, during the same session, 3 virtual colonoscopies of the same type (Module I, case 2).

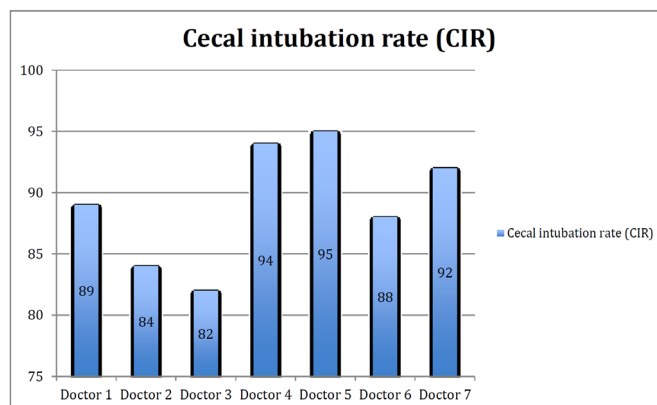


Figure 1. Cecal intubation rate for the 7 participants

After each game session we noted for every participant:

- successful balloon pops ratio - in %
- average time between balloon pops - in seconds
- total time to finish the level
- the number of times the walls were touched

After each colonoscopy we noted:

- total time of the procedure
- time to reach cecum
- the number of times the lumen view was lost
- the number of times the endoscope moved too fast
- the number of times an excessive loop was formed
- % of time spent with clear view
- % of time the patient was in pain
- % of the mucosal surface that was examined
- efficiency of screening as calculated by the simulator (an evaluation that combines indicators of the dexterity of the trainee and quality of the procedure). Consequently our aim was to analyze the correlations between the performances on real life cases and those produced on the simulator.

Statistical analysis was performed using MedCalc Statistical Software version 15.8 (MedCalc Software bvba, Ostend, Belgium; <https://www.medcalc.org>; 2015). Student t test and Pearson correlation were used. A p values <0.05 was considered statistically significant.

## Results

Cecal intubation rates for the 7 doctors are presented in Figure 1. We calculated the averages (mean) for all the parameters included in the study for every participant and then the average values for the whole group. The average rate for CIR in the group was 88.±5%. Average rate for successful balloon pops was 52±16%, for total time to finish the level mean was 95±8 s, average time between balloon pops was 5±2.8 s. The mean values for the whole group for the indicators analyzed during virtual colonoscopies were: total time of the procedure 5.25±1.2 minutes, time to reach cecum 2.6±1.2 minutes, % of the examined mucosal surface 74±4.3%, % of time spent in clear view 86±6,5%, % of time the patient was in pain 4±1.8% and the efficiency of screening 80±6%.

Using the average values of the variables included in the study we tried to identify possible correlations. We noted the most important correlations were between CIR and the doctors performances on the Endobubble-level 2 game. We found that CIR is positive correlated with statistical significance to the rate for successful balloon pops (p=0.004, r=0.915) and negative correlated

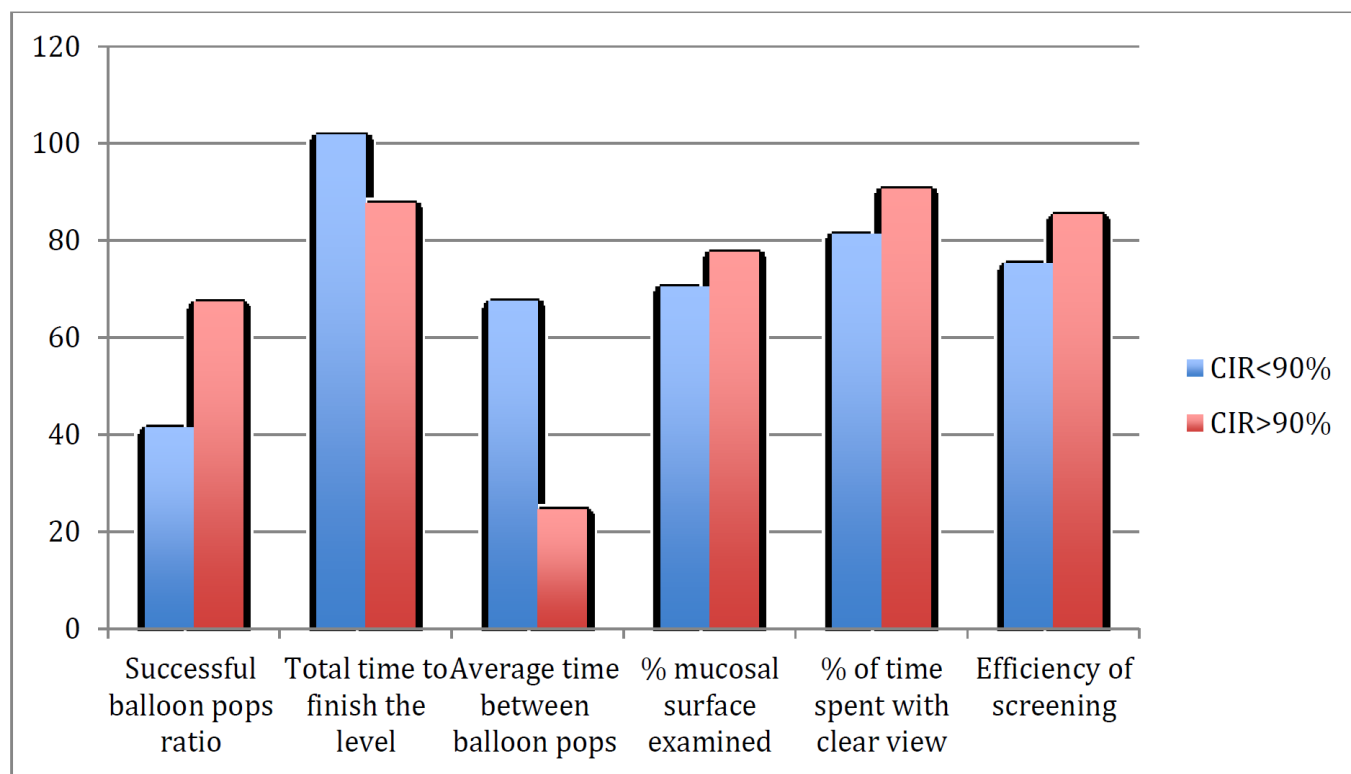


Figure 2. Comparison performances between the two subgroups

to the total time to finish the level ( $p=0.019$ ,  $r=-0.837$ ) and the time between balloon pops ( $p=0.001$ ,  $r=-0.952$ ).

We also noted that there is a tendency for correlation between CIR and some of the parameters from the virtual colonoscopy but without statistical significance when analyzing the whole group: between CIR and the total time of the colonoscopy ( $r=0.385$ ), CIR and excessive loop formation ( $r=0.645$ ), CIR and the percentage of the mucosal surface examined ( $r=0.464$ ), CIR and the percentage of time spent in clear view ( $r=0.568$ ), CIR and the percentage of time the patient was in pain ( $r=-0.626$ ), CIR and the efficiency of screening ( $r=0.473$ ).

We know from the literature that an important landmark in achieving the desired level of quality in colonoscopy is a cecum intubation rate greater than 90% (Rex DK 2006). In our group of endoscopists 4 out of 7 had a CIR lower than 90%. We divided the main group in 2 subgroups consisted of 3 doctors with an average CIR >90% and 4 doctors with the average CIR <90%. We calculated their mean values as presented in Figure 2. We then, used t-test to analyze the parameters. The results indicated a statistical significant difference between the two subgroups regarding: successful balloon pops ratio ( $p=0.017$ ), total time to finish the level ( $p=0.016$ ), average time between balloon pops (0.030), percentage of mucosal surface examined (0.012) and efficiency of screening (0.013). The parameter percentage of time with clear view was very close to statistical significance ( $p=0.069$ ).

## Discussion

In our study group we observed an average cecal intubation rate per doctor that is in consistency with the values found in literature. In a study from UK published in 2013 were analyzed 17027 colonoscopies performed by 23 independent endoscopists and CIR varied from 79% to 97.8% with 5 doctors having CIR

below 90% (Ekkelenkamp 2013). The CIR in our group was between 82% to 95% for 4 doctors, which had values below 90%, suggesting that there is place for improvement in order to achieve the current standards in endoscopy.

Our study proved a correlation between the performances on real cases and those on virtual reality. Skills in real colonoscopies were highly correlated with the results from the simulator. Although existing data from literature is scarce there are some studies that have similar results. A study from 2007 evidenced the link between years of experience in endoscopy and the actual performance on a simulator whilst a bovine simulation model was used (Sedlack 2007). Another study evidenced the correlation between the number of real endoscopies performed in the past and the results from computer simulator practice (Grantcharov 2005). Our research proved a strong link between cecal intubation rate (on real cases) and the performance on the SIMBIONIX simulator. The most important correlation was made with the results from Endobubble game which measures mostly manual dexterity. CIR highly correlates with the rate for successful balloon pops, total time and time between balloon pops. By separating the cohort into two subgroups we evidenced the statistically significant difference between the performances on Endobubble but also on the simulated colonoscopies for endoscopists with CIR > 90% and those with CIR below 90%. The validity of our results may be limited by the number of doctors included in the study.

## Conclusion

In conclusion we can affirm that computer simulators may become an useful tool for the assessment of endoscopic skills and may be used, in the future, as a part of the credentialing process for endoscopists. Further studies in this direction are required. We are aware that the competence in endoscopy is not based

solely on manual dexterity and that quality in endoscopy requires also other areas of important knowledge.

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