Incorporating a Detailed Case Log System to Standardize Robotic Colon and Rectal Surgery Resident Training and Performance Evaluation

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OBJECTIVE: This study was designed to evaluate a novel case log used as part of a standardized robotic colon and rectal surgery resident training program.

DESIGN: This observational study describes a detailed procedure log developed to standardize training of residents in robotic colorectal surgery. The procedure log tracks resident total case numbers and execution of specific steps of eleven colorectal procedures. Case log data were accumulated and analyzed to assess resident progress.

SETTING/PARTICIPANTS: The study includes colon and rectal surgery residents during the 2016-2017 academic year. The national Colon and Rectal Surgery Robotic Training Program was developed and implemented during the 2010-2011 academic year in response to increasing adoption of robotic-assisted colorectal surgery. This program evolved to include online modules, dry lab exercises, simulation and cadaveric courses.

RESULTS: Forty of 93 residents in 54 colon and rectal surgery programs participated in the case log system and the comprehensive training program. Residents participated as console surgeon in an average of 28 cases (range 1-115). Sixty-five percent of participating residents performed ≥20 complex colorectal cases as console surgeon. Of the 1080 operations entered, the three most frequently performed procedures were low anterior resections (n = 360, 33.3%), sigmoid resections (n = 172, 15.9%), and right colectomies with intracorporeal anastomosis (n = 138, 12.8%). Residents with 10 or more robotic cases had a 27% increase in cases as console surgeon and a 28% decrease in cases completed as bedside assistant. Experience and progression to the console varied by resident and by program.

CONCLUSION: This detailed standardized case log system provides comprehensive assessment of resident experience that allows preparation for a robotic colon and rectal surgery practice after fellowship. As adoption of the robotic approach for colon and rectal cases continues to increase, novel methods that evaluate teaching methods and resident progress warrant further study. (J Surg Ed 76:1022−1029. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: Colorectal, Robotic, Minimally invasive, Residency training, Robotic course, Case log

COMPETENCIES: Patient Care, Practice-Based Learning and Improvement, Systems-Based Practice

INTRODUCTION

The adoption of robotic-assisted surgery for colorectal diseases has increased significantly in recent years.[1−5] In response to this increase, the national Colon and Rectal Surgery Robotic Training Program (CRSRTP) was conceived and implemented in the 2010-2011 academic year and is currently sponsored by the Association of Program Directors for Colon and Rectal Surgery

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(APDCRS). The original curriculum was a two-step pathway that started with basic training consisting of online modules, didactic instruction, an animate lab, dry lab exercises, and simulation. Beginning in 2016, a second advanced course that included cadaveric training with low anterior resections and ascending colectomies was offered later in the academic year to those who met console criteria at their training institution after the basic course.

Resident course experience data is formally presented annually by one of the authors (AB) at the annual APDCRS meeting. Program Director feedback at this meeting resulted in offering the 2nd advanced cadaver course to all colon and rectal surgery residents. Concurrently, one of the authors (MS) developed a procedure case log system to allow more comprehensive standardized evaluation of the resident course experience and to more effectively track resident progress in an effort to better prepare the resident for robotic colorectal surgery after graduation. The current training program reported in this study no longer includes a trip for first-step basic training with an animal lab and didactics. Instead, online community instruction, online videos, webinars, and simulator training are all done at the resident home location (Figs. 1 and 2). The procedure case log system reported in this study then tracks resident progress leading up to the 2nd step advanced cadaver course later in the academic year.

The purpose of the study was to assess the impact of this novel procedure case log system on robotic resident training.

METHODS

A detailed online procedure case log system was developed and implemented during the 2016-2017 academic year. This procedure log provided data that included total number of cases performed and execution of specific steps of eleven colorectal procedures.

At the beginning of the academic year, each colon and rectal surgery resident participating in the CRSRPT course was provided with a unique resident identifier and the website link to be used for logging cases. After every robotic procedure, the resident was responsible for logging cases via a brief online survey. The first page of the survey documented the resident name, unique identifier, program, attending surgeon, date of operation, and the procedure name (Fig. 3).

Survey page 2 consisted of checklists for critical operative segments that a resident must execute to properly perform 11 common colorectal procedures (Fig. 4). These operations included low anterior resection, ascending colectomy with intracorporeal and extracorporeal anastomosis, segmental colectomy with intracorporeal and extracorporeal anastomosis, total colectomy, abdominoperineal resection, ventral rectopexy, rectopexy, colostomy takedown, and sigmoid colectomy. Every step done by the resident was documented with a checkbox. Page 3 consisted of case summation. The resident documented the percent of the procedure performed as the bedside assistant and console surgeon

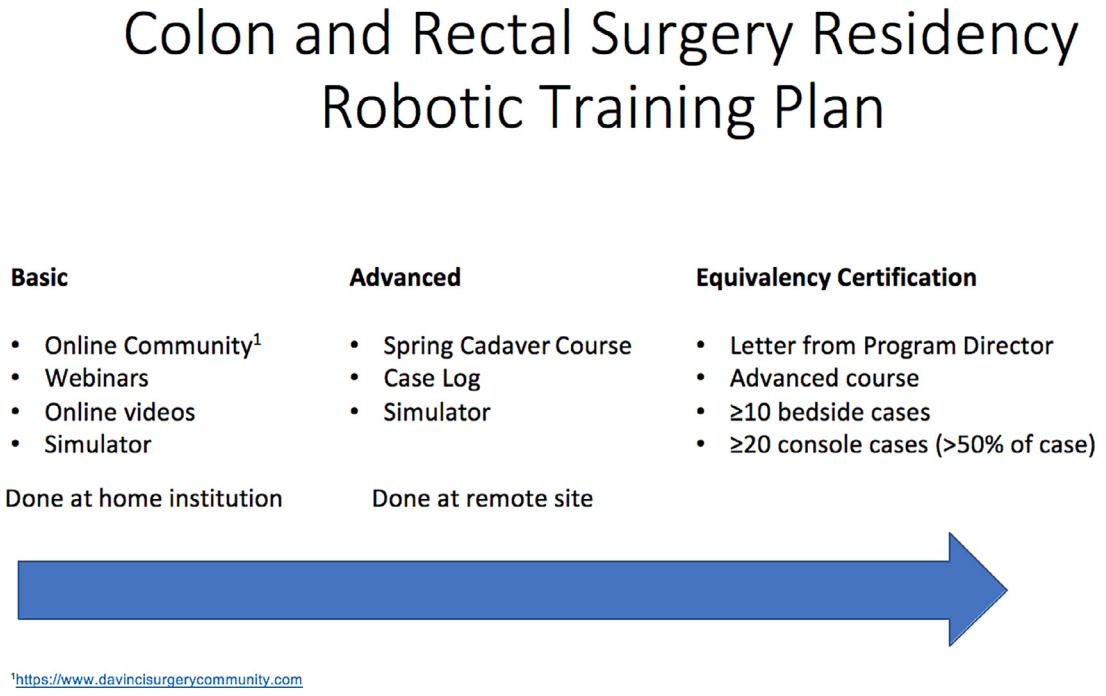


FIGURE 1. Colon and rectal surgery resident training plan.

APDCRS[1] Robotic Colorectal Surgery Training Pathway

Completion required to qualify for the Advanced Course

1. *da Vinci*® Technology Online Modules (www.davincisurgerycommunity.com):
   - documented completion of interactive online modules covering basic design and operation of the da Vinci® system

2. *da Vinci*® Technology Overview In-Service and Skills Simulation:
   - in-person overview of the system and sign off conducted at the hospital by an Intuitive clinical sales representative
   - completion of Skills Simulator modules as defined by the APDCRS with a score of 90% (or completion of console skills drills for those without a simulator)
     - Thread the Rings
     - Matchboard 1
     - Camera Targeting 1 and 2
     - Energy Switching 1
     - Suture Sponge 1

3. Participation in 3 surgeon-led webinars:
   - subjects may include procedural tips/tricks, troubleshooting, complex cases, advanced technology use, career development

4. Enter all robotic cases into the case log system provided by the APDCRS.

5. Participation in 5 da Vinci Cases as console surgeon
   (entered in APDCRS case log by the Advanced Course Application deadline)

6. Participation in the Advanced Course

7. Participants completing the above requirements, 20 Console Cases and 10 Bedside-assist cases may be eligible for a Training Certificate issued by Intuitive Surgical after verification letter by their program director. Case participation is defined as having completed over 50% of a case as a console surgeon or bedside assist as defined by the APDCRS Program Directors.

[1]Association for Program Directors in Colon and Rectal Surgery

FIGURE 2. APDCRS robotic colorectal surgery training pathway.

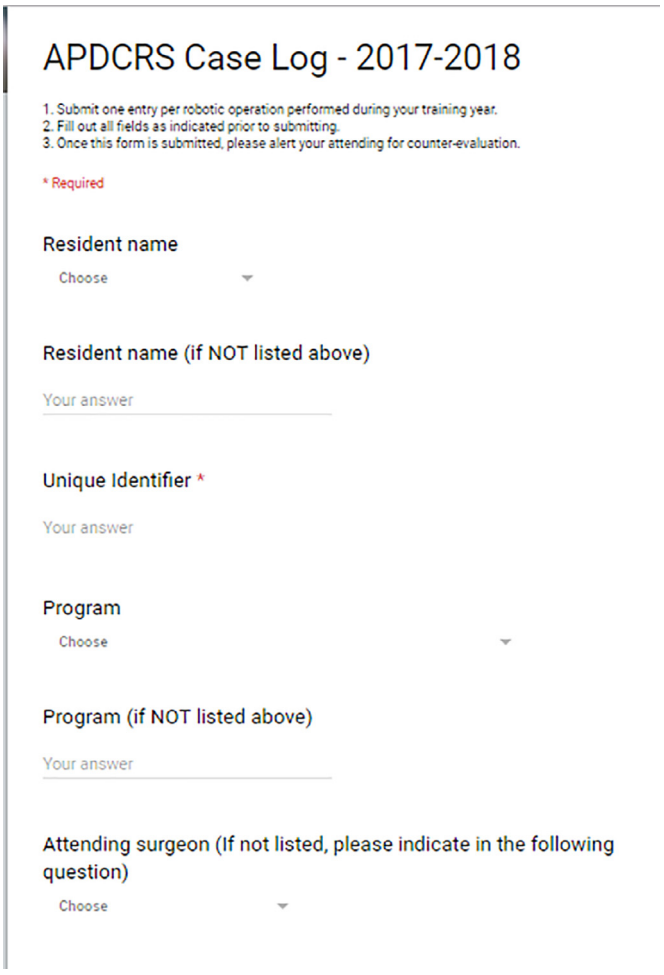
(Fig. 5). The website case log information was linked to an online Google Sheet (Alphabet, Inc., Mountainview, CA) that could be used to compile data.

These procedure case log data were used to calculate case type frequency and distribution, console and bedside assist experience, and proportion of checklist operative steps performed for the ascending colectomy with extracorporeal anastomosis. For the purposes of this study, console surgeon was defined as the resident performing >50% of the case at the console.

RESULTS

During the 2016-2017 academic year, 26 of the 54 Accreditation Council for Graduate Medical Education accredited colon and rectal surgery residency programs that included 40 (43.0%) of 93 residents participated in the CRSRTP case log system. There were 1118 operations logged during the year. Residents indicated that 745 (66.6%) were operations in which they performed >50% of the procedure as the console surgeon. Analysis of individual trainee experiences revealed that 26 of 40 (65%) residents performed 20 or more robotic procedures as console surgeon. Residents participated in a mean of 28 cases and median number of 25 cases as the console surgeon with experiences ranging from 1 to 115 cases.

The three most frequently performed procedures were low anterior resections (n = 373, 33.3%), sigmoid resections (n = 181, 16.2%), and ascending colectomies with intracorporeal anastomosis (n = 137, 12.3%). Other, less frequently performed operations included abdominoperineal resection (n = 105, 9.4%), ascending colectomy with extracorporeal anastomosis (n = 55, 4.9%), colostomy takedown (n = 16, 1.4%), rectopexy (n = 70, 6.3%), segmental resection with extracorporeal (n = 45, 4.0%) and intracorporeal anastomosis (n = 44, 3.9%),


APDCRS Case Log - 2017-2018

1. Submit one entry per robotic operation performed during your training year.
2. Fill out all fields as indicated prior to submitting.
3. Once this form is submitted, please alert your attending for counter-evaluation.

* Required

Resident name

Choose

Resident name (if NOT listed above)

Your answer

Unique Identifier *

Your answer

Program

Choose

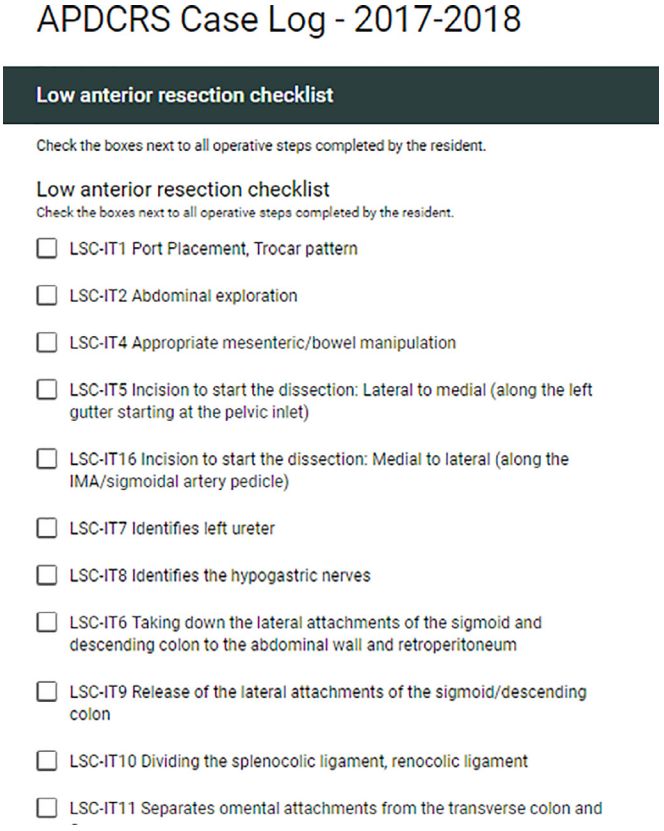
Program (if NOT listed above)

Your answer

Attending surgeon (If not listed, please indicate in the following question)

Choose

FIGURE 3. Online case Log – Page 1.


APDCRS Case Log - 2017-2018

Low anterior resection checklist

Check the boxes next to all operative steps completed by the resident.

Low anterior resection checklist

Check the boxes next to all operative steps completed by the resident.

- LSC-IT1 Port Placement, Trocar pattern
- LSC-IT2 Abdominal exploration
- LSC-IT4 Appropriate mesenteric/bowel manipulation
- LSC-IT5 Incision to start the dissection: Lateral to medial (along the left gutter starting at the pelvic inlet)
- LSC-IT16 Incision to start the dissection: Medial to lateral (along the IMA/sigmoidal artery pedicle)
- LSC-IT7 Identifies left ureter
- LSC-IT8 Identifies the hypogastric nerves
- LSC-IT6 Taking down the lateral attachments of the sigmoid and descending colon to the abdominal wall and retroperitoneum
- LSC-IT9 Release of the lateral attachments of the sigmoid/descending colon
- LSC-IT10 Dividing the splenocolic ligament, renocolic ligament
- LSC-IT11 Separates omental attachments from the transverse colon and

FIGURE 4. Online case Log – Page 2.

total colectomy (n = 37, 3.3%), and ventral rectopexy (n = 55, 4.9%).

When assessing the first 5 and last 5 cases performed, those residents that performed ≥10 cases had a 27% increase in the number of cases as console surgeon during the first 5 cases and a 28% decrease in the number of cases as bedside assist during the last 5 cases when compared to those who performed <10 cases (Fig. 6). Experience and progression to console surgeon varied by resident and by program without an identifiable pattern.

The proportion of each operative segment performed by the residents was reviewed for the ascending colectomy with extracorporeal anastomosis procedure (Table 1). "Medial to lateral dissection" was the most infrequently performed step followed by "division of the ileocolic vessels." The most frequently performed operative segments were "port placement," "facilitation of visualization of the ileocolic pedicle," and "mobilization of the ascending colon from the retroperitoneum and duodenum."

DISCUSSION

This analysis of a novel case log system designed to assess colon and rectal surgery resident robotic experience demonstrates that this system provides useful information about resident participation in complex colorectal cases. It enables focused preparation for robotic colon and rectal surgery after residency and planning of future courses. Sixty-five percent of participating residents performed ≥20 complex colorectal cases as console surgeon and the most frequently performed procedures were low anterior resections (33.3%), sigmoid resections (16.2%), and ascending colectomies (12.3%). Residents who logged more than 10 cases had more console surgeon cases compared to bedside assistant cases as the training year progressed. Evaluation of "ascending colectomy with extracorporeal anastomosis" operative segments suggested that residents do not perform medial to lateral mobilization and division of the ileocolic vessels as frequently as other parts of the procedure. This may be due to the higher level of skill required for these critical operative segments and risk for bleeding with dissection of the ileocolic vessels. It may also be related to the comfort level of the staff surgeon guiding the resident through these parts of the operation. However, overall results

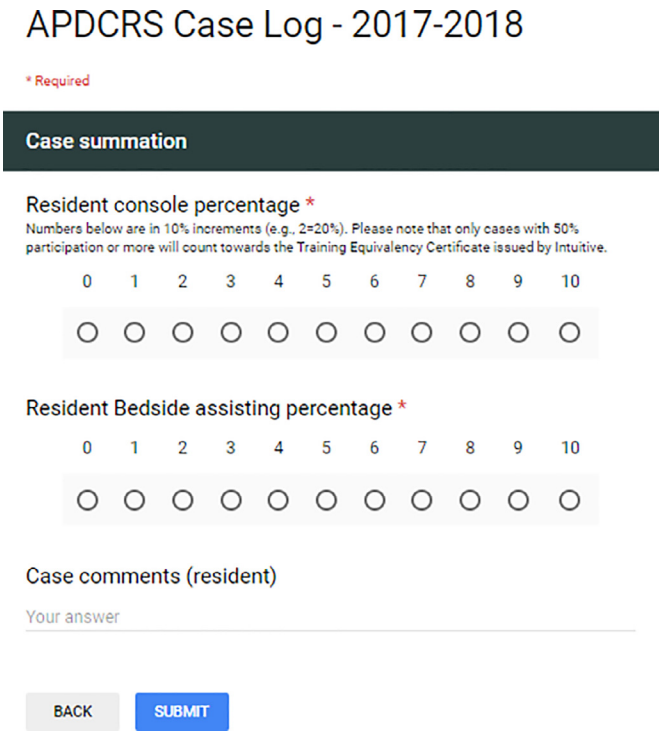


FIGURE 5. Online case Log – Page 3.

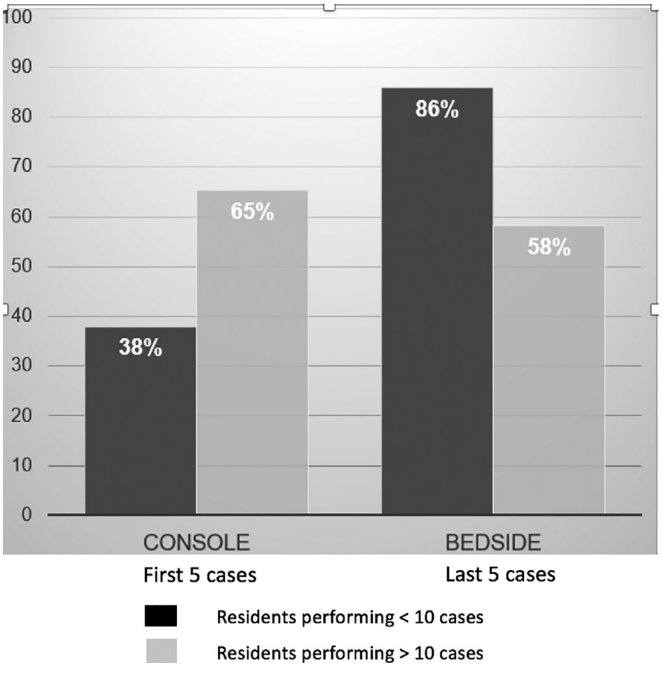


FIGURE 6. Console and bedside assist cases.

suggest that residents are performing the majority of the procedure.

As the adoption of robotic colorectal surgery continues to increase with concomitant increase in colorectal surgery training program resident participation, there is a need to critically evaluate the current program and implement dynamic changes to improve it based on reliable data. Program participation for the 2017-2018 academic year was close to 100%. This novel case log system provided an online reservoir for data collection and analysis not previously available for consideration. Upgrading the robotic case log system to include real time automated reports of procedure numbers and specific steps that may be deficient accompanied by video review may allow earlier implementation of effective changes in practice. This will also enable further improvements in future advanced CRSRTP courses. Further data on percent time on console may be available as well as the use of machine learning to determine resident progress.

TABLE 1. Operative Segments Performed by Resident for Ascending Colectomy With Extracorporeal Anastomosis

Procedure Step	Percent Performed
Port placement, Trocar pattern	96.23%
Manipulation of small bowel and mesentery to facilitate visualization of ileocolic pedicle	88.68%
Identification of ileocolic pedicle	79.25%
Begin medial to lateral dissection	58.49%
Dissection of ascending colon from retroperitoneum	79.25%
Division of ileocolic vessels	60.38%
Mobilization of hepatic flexure	77.36%
Mobilization of ascending colon mesocolon from the retroperitoneum and duodenum	81.13%
Exteriorization, bowel resection and anastomosis	79.25%

The current landscape of minimally invasive colorectal surgery is rapidly evolving. A retrospective study designed to detect change in robotic usage over time identified a 158% increase in robotic-assisted colorectal surgery from 2012 to 2015. When reviewed as a percent of all approaches, robotic surgery increased from 2.6% to 6.6% in this study.[4] Our group recently completed a survey of colon and rectal surgery residency graduates from 2013 to 2016 revealing that the adoption of minimally invasive surgery has significantly increased compared to previous studies. Colectomies were done by the laparoscopic approach in 56.4%, the hand-assisted laparoscopic approach in 15.6%, and 16.9% were robotic-assisted. For rectal resections, the distribution was 31.1% for the laparoscopic approach, 15.5% for the hand-assisted laparoscopic approach, and 39.2% for the robot.[5]

The CRSRTP case log system demonstrated rapid transition for some residents from bedside assist to console surgeon. Though our current data requires verification

FIGURE 7. Robotic training certificate.

with further studies, it reflects an overall increase in surgeon console experience for colon and rectal surgery residents. Though the median number of cases performed in this study was only 25, there was a 25% increase in cases performed as console surgeon between the first 5 to last 5 cases. It is possible that the robotic CRSRTP courses may be contributing to an increase in graduating colon and rectal surgery resident adoption of all minimally invasive options by incorporating formal robotic training into the fellowship curriculum.

This novel case log system may identify areas for improvement through systematic data collection facilitating changes in course structure. This may allow the colon and rectal surgery resident more effective progression through the learning curve. Previous studies of cumulative summation techniques designed to determine the number of cases required to attain robotic proficiency described initial learning, plateau, and mastery learning curve phases based on operative times.[6,7] A surgeon establishing a new robotics program requires an initial volume of 75 cases but once established, a shorter learning curve of only 25-30 cases for other surgeons in the program are necessary to achieve proficiency.[8,9] The robotic platform camera, instrument, and ergonomic advantages may allow a shorter learning curve when compared to laparoscopic surgery.[10,11] Twenty-six of the 40 residents in our study accumulated 20 or more cases as console surgeon. Learning is a life-long process and the data gathered with our procedure case log tool in conjunction with the CRSRTP course may allow residents to reach robotic proficiency sooner in their career than they would without these educational options.

The case distribution of the procedures logged by residents at their institution in this study may be a reflection of the advanced CRSRTP course experience focused on two procedures—low anterior resection and ascending colectomy with intracorporeal anastomosis. When assessing individual procedure segments, the resident and teaching surgeon can identify deficits in proficiency for specific segments of an operation. This may allow focused simulator and video training prior to and after surgery that supplement intraoperative adjustments based on these identified deficits.

This study has limitations. It is observational in format and it was not possible to establish a control group for comparison. The colon and rectal surgery residents in this study are select participants and the results may not be generalizable to others performing these operations. Furthermore, because data entry was voluntary and self-determined, there may be cases not included in the data set. In earlier years, the CRSRTP course was limited by inexperienced mentors at the resident home institution. That is clearly changing. Currently, there is still a wide variety of robotic experience amongst mentors and residents but the number of trained mentors capable of providing the resident with console time has increased. This study should therefore be considered a snapshot in time in the continuous evolution of robotic surgery and future case log and course changes will need to take this into consideration.

There will be other metrics and policies to consider as the program continues to evolve. Resident robotics assessment is a dynamic process with change based on new ideas and new literature that will likely be considered in the soon-to-be updated Accreditation Council for Graduate Medical Education Milestones 2.0 evaluation process.

The course was originally designed with a goal of an Equivalency Certificate at the successful completion of the program (Fig. 7). The American Board of Colon and Rectal Surgery does not currently endorse the Intuitive Equivalency Certificate. In addition, hospital requirements for proctored cases to establish privileges with or without the certificate vary considerably.

CONCLUSION

This standardized case log system provides comprehensive assessment of the colon and rectal surgery robotic resident experience that allows focused preparation after fellowship. These data will be used to make changes in future course structure that provide opportunities for improvement and potentially shorten the learning curve for colon and rectal surgery residents. In the perpetually evolving world of minimally invasive surgery, the case log and training program are valuable tools to empower future colon and rectal surgeons early in their careers. As adoption of the robotic approach for colon and rectal cases continues to increase, critical assessment of teaching methods and resident progress warrant further study.

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SUPPLEMENTARY INFORMATION

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jsurg.2018.12.011.