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Teaching speed in the operative theatre: Should case duration benchmark efficiency in general surgical residency programs?

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ABSTRACT

Background: Training surgical residents remains an important mission of academic medical centers. Today, financial pressures guide improved operating room (OR) efficiency and theoretically may affect surgical education. There is no current benchmark with regards to operative time and surgical cases involving General Surgical Residents.

Study design: 971 laparoscopic surgical cases were reviewed for total operative time, closing time, length of stay and 30-day readmission rates. *T*-test of means and regression analyses were done involving surgical times and point in time during the academic year of the surgical program to gauge whether efficiency improvements exist in the program. Regressions were also done comparing surgical times (total operative and closing time to outcome measures: length of stay, 30-day readmission, and log cost).

Results: Residents had significantly longer procedure times compared to the year prior to commencement of the program where attending surgeons operated without residents by mean *t*-test ($p < 0.05$). Length of stay increased as total operative time increased in 4 of the 6 category cohort of cases that general surgical residents were involved ($p < 0.05$). There was no improvement in closing time among residents throughout the academic year of their program nor when comparing successive program years.

There were strong and statistically significant correlations between total operative time and cost.

Conclusion: Resident participation contributes to increased procedure time and cost for common laparoscopic general surgical procedures. There is also a link between outcomes as measured by length of stay and total operative time. Consequently teaching and/or maintaining efficiency standards may be paramount to maintaining better outcomes. General surgical residency programs may consider benchmarking operative and/or closing times in guiding efficiency in their programs.

1. Introduction

In the current environment of cost containment in healthcare, hospitals and costly operating rooms use various metrics to optimize operating room efficiency and utility. Many hospital organizations put major emphasis on reduction of metrics such as overall operative time and turnaround time to maximize the utility and efficiency of operating rooms. "It is unclear whether faster is better or haste makes waste or similarly whether slower procedures represent a safe, meticulous approach or inexperienced dawdling."[1] Further, to date there is no known literature describing how this metric definitively relates to operative outcomes and/or if it improves over time in hospitals with General Surgical Residency programs where trainees are directly involved in surgical patient care. Additionally, there is a restriction on hours worked per week by surgical residents to 80 hours. In theory, faster cases could equate to higher case volume per resident where time restrictions on work apply. The Accreditation Council on Graduate Medical Education (ACGME) requires a minimum of 750 operative cases per resident as a requirement for completion of an accredited surgical residency program in the United States.[2] Yet, there is **no** current benchmark for efficiency with regards to operative procedure duration where General Surgical Residents are involved.

1.1. Background and significance

The total projected US population is expected to surpass 333,000,000 by 2020.[3] The proportion of elderly and total health

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expenditures will also continue to rise.[4] Consequently, the demand for healthcare providers will also increase. Training new physicians and starting new training programs will be imperative to sustain such a burden on the medical system. In fact, other sources have shown surgical residents do add expense to procedures through operative time.[5–7] Add to this challenge, the duty hour limits for residents in training set by the Accreditation Council for General Medical Education (ACGME) as capped at 80 hours per week.[8] Consequently, time management is of utmost importance in providing competent care but must be balanced with maximal clinical case contact to maximize learning of residents and care of patients.

In a competitive market economy, successful industries normally increase quality as they increase efficiency and decrease cost. In inflation-adjusted dollars, most manufactured products are better and less expensive than 30 years ago.[9] Medicine has been sheltered from normal market forces. Prior to the 1980s, the public and the media dared not question doctors' decisions.

As we enter a period where cost containment– with medicine now perceived as being comparable to other industries)- and time management considered essential since the US health care expenditure represents a large proportion of the gross domestic product (GDP),[10] the cost of training new physicians and implementing measures for monitoring, teaching and analysis of efficiency is paramount. At almost 18% of the gross domestic product (GDP), headed for 20% by 2020, the nation's increasing health care expenditures reduce the resources available for other worthy government programs.[11] Thus, obtaining cost savings even at the training level will be critical.

Hands-on surgical training is imperative for the operative success of future surgeons. Along with this long-term educational benefit, surgical residencies also raise concern about increasing hospital costs or diminished quality of patient care due to the residents' inexperience. For example, a study by the Tennessee Surgical Quality Collaborative (2015) found a significant correlation between operative time and complications.[12] To combat this inexperience and to ensure the best patient outcomes, much recent medical literature has been devoted to improving surgical residency programs. Largely, this literature has aimed to improve specific methods of operative training and educational techniques.[13,14]

There are far fewer studies focused on the financial impacts of the surgical training programs. Existing data pertain mainly to non-surgical residencies and present widely varied results. Further, no study to date describes using closing time (as part of the total operative time) to measure surgical residency program improvement with regard to efficiency and how this metric relates specifically to potential cost improvement in these programs.

Also, these operative metrics can be used to determine staffing needs when the duration of cases are prolonged. Could predicting operative time when implementing residency programs assist managers in staffing needs? Further, it can be argued that absolute operating room cost may not be captured when cases are potentially prolonged in order to accommodate training physicians due to the increase in system wide staffing needs (anesthesiologists, nursing, lab staff, patient care technicians, housekeeping, operations staff, pharmacy, recovery room staff, etc.). Moreover, the change in operative time may help to project staffing needs on a time and absolute manpower basis to provide safe and effective care outside of direct patient contact.

The aim of this study is to determine whether operative time and closing time has a relationship with patient outcome as measured by length of stay (LOS) and 30-day readmission. Further, the analysis shall also determine if closing time (time to close surgical wound – part of procedure that usually involves all surgical residents) improves as the General Surgical Residency Program at Cleveland Clinic Florida matures. (Cleveland Clinic Florida implemented a general surgical residency program in 2012.) The relationship of cost to operative time will also be analyzed. Metrics from this study will be taken from years 2011–2014 for laparoscopic procedures: appendectomies, cholecystectomies, and inguinal hernia repairs.

In 2013, the cost per minute of OR time was $195.47 per minute at this institution. Clearly, a reduction in total operative time (TOT) (or closing time, a component of TOT) per case would equate to lower cost per case. Further, this would suggest greater efficiency on an OR time: OR cost basis. This study will also link value (operative time to cost) and quality (operative time to outcome).

2. Methods

Patients who underwent laparoscopic general surgery procedures from 2011 to 2015 (appendectomy, cholecystectomy, inguinal hernia repair) at Cleveland Clinic Florida were identified using the electronic medical records. Patient records for laparoscopic appendectomies performed one year prior (2011) to the initiation of surgical residency program were utilized for comparison. IRB approval was granted for this analysis. All patient identifiers remained confidential in a HIPPA compliant manner. Patient demographics such as age (date of birth) and American Society of Anesthesiologists' physical status were collected along with length of stay (LOS) and 30-day readmission. The total operative time and closing time (time required to close the surgical wound) were also collected. The surgeon(s) of record for each procedure was recorded.

All data was pulled and sorted from EPIC (electronic patient medical record). Each record was transposed individually to Microsoft Excel and classified as per above. Each patient record was reviewed singularly for completeness and coded for analysis. The ASA Physical status was then pulled from a separate file and inputted into the corresponding classification for each patient. These metrics were analyzed using MS Excel V14 Data Analysis Package for regressions, logistic regressions and *t*-test of means. A total of 971 patient records were reviewed, transposed and deemed appropriate for analysis. Each case file was coded by patient record number, admission date, discharge date, American Society of Anesthesiologist (ASA) Physical status classification, total operative time (time the patient arrived in the operating room until the time patient left the operating room), closing time (time closure began until the time the patient left the operating room), and 30-day readmission. Each surgical case was stratified by year corresponding to age of the GSRP (including all residents no matter their matriculation year) to look for improvement in the program itself instead of each cohort year. Charge (cost) data for each surgery was available only for GSRP year 1, 2 and 3 and coded and analyzed respectively. Length of stay (LOS) was calculated as the difference between the admit date and discharge date and was available and coded for every year. The 30-day readmission was determined if a patient was readmitted to hospital within 30-day s post discharge of an operative procedure. This data was available for GSRP years 2 and 3 only and was coded and analyzed accordingly.

ASA physical classification for each procedure was analyzed by *t*-test to determine the population distribution stratified by program year for year-by-year comparison as well as by surgical procedure. Each comparison will be tested for statistical significance. Mean closing time for laparoscopic appendectomies was analyzed by *t*-test to determine if the difference in time amongst respective years (Pre-residency program year, Year 1, 2, 3) was significant. Data for laparoscopic appendectomies was the only procedure where metrics were available for pre and post residency