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Assessing complications from the use of trailer operating rooms in single-staged renovations

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ABSTRACT

Renovations of an operating room can result in compromised care and loss of revenue. The objective of this study is to determine if Trailer Operating Rooms (TOR) are associated with increased complication rates and/or decreased productivity during renovations of Main Operating Rooms (MOR). Exposure was defined as MOR or TOR. Veterans Affairs Surgical Quality Improvement Program (VASQIP) observed and expected counts of perioperative morbidity and mortality were compared. Complication rates, from a prospective database, and case volume between TOR and MOR were analyzed. Mortality was higher for vascular surgery in TOR vs. MOR but not in any other specialties. Higher all-cause morbidity was noted in two of the nine surgical specialties in the TOR period. There was no significant difference in rates of surgical site infection (SSI) or venous thromboembolism (VTE) between groups. The average total cases per month was significantly higher in MOR compared to TOR (326.8 ± 49.6 vs. 275.1 ± 22.9, $p < 0.001$) as were the VASQIP eligible cases (183.7 ± 28.4 vs. 155.0 ± 14.6, $p < 0.001$). TORs are efficient and safe for providing continuity of surgical care during renovation or emergency. Further studies are required to assess whether the decrease in case load is truly attributable to the mobile platform.

1. Introduction

Renovation of hospital operating rooms (OR) is essential to meet regulatory changes and improve patient care with state-of-the-art surgical technology. Although the requirement for renovation may be realized, the decision of whether or not to undergo construction is complex and multifaceted with both clinical and financial implications. Consensus must be met on whether to carry out these renovations in stages or all at once. Additionally, hospital administrators must decide whether to continue providing care during the renovations, which can be exceptionally challenging.[1] Nonfunctional operating rooms due to construction may result in losses of revenue,

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referrals, and/or staff. The potential to avoid these losses by providing ongoing care during construction must be weighed against possible complications that may arise, most notably increased infection rates or substandard patient care.[2,3]

Once a need is identified, various options exist for renovation.[4,5] A staged renovation may be attempted, but exposure to environmental hazards such as dust, vibration, and auditory disturbances may threaten patient care.[5] Other options include complete shutdown of services, or rental of facilities from a neighboring hospital, however this presents several challenges in terms of costs, staffing, and continuity of care. Finally, the use of mobile units may be considered. Medical Unit Self-Contained Transportable (MUST) OR modules or Deployable Medical Systems (DEPMEDS) are mobile medical facilities that were initially designed for military use, but have been applied for use in fixed facility renovation projects since the 1980s.[4,6–9] There is scarce literature on the outcomes of procedures performed in these facilities; published data focuses mostly on design of the units and "lessons learned."

In 2010, the Bruce W. Carter Department of Veterans Affairs (VA) Medical Center faced an aging operating suite with problems ranging from environmental challenges to small size without room to accommodate state-of-the-art equipment. The decision was made to proceed with a one-stage renovation. This was accomplished with a third type of mobile unit. Locally referred to as Trailer Operating Rooms (TOR), our center partnered with the Mobile Medical International Corporation (MMIC) to obtain Mobile Surgery Units™ and continued to provide surgical care in these operating suites, located in mobile trailers docked to a central corridor that was fully connected to the main facility. We performed 9346 operations from August 2010 to May 2013 in the TORs, which are state licensable, Joint Commission accredited, and CMS certifiable.[10] They have been employed in several Veterans Affairs Medical Centers (VAMC) for renovation, emergency coverage, and over-capacity needs (Table 1), in addition to use in numerous non-VA affiliated centers. In total, the Miami VAMC required five mobile surgery units and one staff unit to meet demand. The approximate cost for each mobile surgical unit was $75,000 per month and $39,000 per month for the staff unit. Renovations were completed in May 2013 with transition to the newly renovated Main Operating Rooms (MOR).

To our knowledge, no prior study has evaluated outcomes in patients undergoing surgery in TORs. It is reasonable to assume that certain complications, such as surgical site infections (SSI) and venous thromboembolism (VTE), may be higher in patients operated in a TOR. We hypothesize that the incidence of SSI and VTE are similar in patients operated in TORs and MORs. Furthermore, we hypothesize that case volume would be minimally affected.

2. Methods

2.1. Part 1-VASQIP data

This study was approved by the Bruce W. Carter VA Medical Center Institutional Review Board as a quality improvement initiative. The VA Surgical Quality Improvement Program (VASQIP) Annual Surgery Reports were obtained for fiscal years (FY) 2008–2014 at our institution. VASQIP measures quality of surgical outcomes through the collection of data from all Veterans Health Administration facilities and reporting of comparative risk-adjusted postoperative outcomes.[11,12] TORs were used from August 2010-May 2013. The TOR period was defined as FY 2011 and 2012 (October 1, 2010-September 30, 2012) for Part 1 of the study. The MOR time period was used as the control group and included two years before and one year after the TOR period: FY 2008, 2009, and 2014 (October 1, 2007-September 30, 2009 and October 1, 2013-September 30, 2014). The reason for this methodology was by sandwiching the TOR period we hoped to reduce any other potential confounders such as changes in staffing or equipment.

Thirty-day VASQIP observed and expected counts of perioperative morbidity and mortality for each specialty were compared with the χ^2 (chi-square) goodness of fit test with continuity correction using the SAS v9.3 statistical software (SAS Institute, Cary, NC).

2.2. Part 2 – local perioperative occurrence data

2.2.1. Data source and patient population

De-identified morbidity data was reviewed for FY 2011–2013 from a prospectively collected perioperative occurrence database, which is maintained by VASQIP-trained quality improvement nurses. Date of procedure, date of complication, surgical specialty, surgeon, complication type, and outcomes were recorded.

2.2.2. Study design

A retrospective cohort design was used to compare the TOR and MOR complication rates. Two separate rates were calculated for each time period. Overall rates were calculated by dividing the number of complications by total cases performed during that time period. VASQIP-eligible case rates were calculated by dividing the number of complications by the number of VASQIP eligible cases performed during that time period. The primary outcome was development of postoperative SSI. Secondary outcomes were rates of any complication, rates of VTE, as well as average number of cases performed per month.

2.2.3. Variable definition

For Part 2 of the analysis, TOR time was defined as October 1, 2010-May 31, 2013 (32 months) and MOR was the following 16 months (June 1, 2013-September 30, 2014). The variable "Any Complication" consisted of 29 recorded complication types (Table 2). Primary complications of interest included SSI (defined by previously established criteria,[13]) and VTE (confirmed with imaging diagnosis of deep vein thrombosis and/or pulmonary embolism) as identified in the postoperative occurrence database, since these types of complications might reasonably be assumed to be higher in mobile operating units. Postoperative complications were defined as any complication occurring within 30 days of surgery. These were subdivided into early ($\leq$ 14 days) and late (15–30 days) complications.