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Original Contribution

Lack of generalizability of observational studies' findings for turnover time reduction and growth in surgery based on the State of Iowa, where from one year to the next, most growth was attributable to surgeons performing only a few cases per week

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ABSTRACT

Study objective: Three observational studies at large teaching hospitals found that reducing turnover times resulted in the surgeons performing more cases. We sought to determine if these findings are generalizable to other hospitals, because, if so, reducing turnover times may be an important mechanism for hospitals to use for growing caseloads.
Design: Observational cohort study.
Setting: 116 hospitals in Iowa with inpatient or outpatient surgery from July 1, 2013 through June 30, 2015.
Subjects: Surgeons in Iowa, each with a unique identifier among hospitals.
Measurements: The independent variable was the number of inpatient and outpatient cases that each surgeon performed each week during the first fiscal year beginning July 1, 2013. The dependent variables were surgeons' number of inpatient and outpatient surgical cases, and intraoperative work relative value units (RVU's) for outpatient cases, during the second fiscal year.
Main results: The average hospital in Iowa had less than half of its growth from year 1 to year 2 in numbers of cases among surgeons who performed >2 cases per week in the baseline year (23.0% ± 2.5% [SE], $P < 0.0001$ comparing mean to 50%). Less than half the growth in RVU's was among those surgeons (18.1% ± 2.2%, $P < 0.0001$). The average hospital in Iowa had less than half of its growth in numbers of cases among surgeons who performed 2 or fewer cases per week at the hospital during the baseline year and >2 cases per week at other hospitals in the state during that year (24.4% ± 2.6%, $P < 0.0001$). Less than half the growth in RVU's was among those surgeons (21.3% ± 2.5%, $P < 0.0001$).
Conclusions: Most (≥50%) annual growth in surgery, both based on the number of total inpatient and outpatient surgical cases, and on the total outpatient RVU's, was attributable to surgeons who performed 2 or fewer cases per week at each hospital statewide during the preceding year. Therefore, the strategic priority should be to assure that the many low-caseload surgeons have access to convenient OR time (e.g., by allocating sufficient OR time, and assigning surgeon blocks, in a mathematically sound, evidence-based way). Although reducing turnover times and anesthesia-controlled times to promote growth will be beneficial for a few surgeons, the effect on total caseload will be small.

1. Introduction

Statistical tools have been developed for using each hospital's state or provincial database to identify opportunities for growth or to quantify such growth [1,2,3,4]. However, few studies have quantitatively examined what factors influence growth in hospitals' surgical caseloads. Available knowledge is principally about understanding decreases in hospital caseloads caused by the competitive effect of freestanding surgery centers [1,5,6,7].

Performing more cases was achieved in three observational studies at large teaching hospitals by reducing turnover times [8,9,10]. The studies' clinical interventions differed. One used an extra anesthesia provider to run an induction room [8]. The second used extra circulating nurses and anesthesia technicians to increase workflow among 4 adjacent

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operating rooms (ORs) [9]. The third used extra post-anesthesia care unit nurses, circulating nurses, and surgical technologists to run an extra, adjacent, OR [10]. The common finding of the 3 studies was that, among surgeons originally performing multiple cases per day, with reductions in turnover times, they performed more cases per day [8,9,10].

These studies have been scientifically useful for understanding perceptions of turnover times [11,12]. However, the generalizability of reducing turnover times as an important mechanism by which hospitals might achieve growth in surgical caseload remains unknown. Our recent observational findings suggest that these studies' approaches may not be widely applicable, because the experimental studies' results apply to the few high-volume surgeons [13]. We found that, averaging among hospitals in Iowa, 77% of the combinations of surgeon and hospital had only 1 or 2 cases per day [13]. Furthermore, 66% of the combinations of surgeon and hospital had only 1 or 2 cases per week [13]. These results prompted us to test the following 2 hypotheses.

Hypothesis #1. Surgeons with >2 cases per week account for a minority (<50%) of growth in hospitals' surgical caseloads.

If Hypothesis #1 were supported, there simply would be too few surgeons, who fill ORs for the entire workday with multiple cases, for turnover time reduction to be a mechanism for substantive surgical growth for hospitals' surgical suites. The findings of more cases achieved for high-caseload surgeons by reducing their operating rooms' turnover times [8,9,10] would be a mechanism for a minority of growth in surgical caseloads.

In our previous study, we also found that nearly all of the surgeons (98%) operated at only 1 hospital on days with at least 1 surgical case [13].

Hypothesis #2. Surgeons with ≤2 cases per week at one hospital, but >2 cases per week at other hospitals, accounted for a minority (<50%) of growth at the one hospital.

If this Hypothesis #2 were supported, then recruiting the high-workload surgeon at another nearby hospital to do many cases at your hospital would represent a small proportion of surgical growth at individual hospitals. If both of the 2 hypotheses were supported, then hospitals' strategic focus for growth should include providing easy OR access for surgeons with small caseloads on days that they operate.

2. Methods

The data studied were from the Iowa Hospital Association's (IHA) inpatient and outpatient data sets of all encounters at hospitals in the state of Iowa, excluding those related to behavioral health or management of human immunodeficiency virus infection. The University of Iowa Institutional Review Board determined that the project did not meet the United States regulatory definition of human subjects research. We studied combinations of surgeon, hospital, and four-week period among all 346,137 elective cases performed on a regular workday at one of the 116 hospitals in Iowa between July 1, 2013 through June 30, 2015 (Table 1) [14].

2.1. Data analyzed

Table 1 shows, in detail, the steps we followed to obtain the dataset that was analyzed. The following describes some context.

Each of the studied 258,723 outpatient surgical cases included at least one of the 3379 surgical Current Procedural Terminology (CPT) codes representing a major therapeutic procedure [15,16] with nonzero intraoperative work relative value units (RVU's) [17] and American Society of Anesthesiologists' anesthesia base [18]. For each of the cases, we identified the CPT code associated with the greatest number of RVU's and the total RVU's for the case. The corresponding Clinical Classifications Software category for that CPT code was obtained to create Table 2 [19].

Table 1
Methods to obtain the studied 346,137 cases from the Iowa Hospital Association Revenue File, Outpatient Database, and Inpatient Database.

# cases	Excluded	Description
339,582		All outpatient visits Monday July 1, 2013 through June 30, 2015 including a surgical Current Procedural Terminology (CPT) code with >0 intraoperative work Relative Value Units (RVU) and >0 American Society of Anesthesiologists' anesthesia base units [17,18]
	74,652	Limited to invasive (i.e., major therapeutic) procedure [15,16]
264,930		
	5337	Case performed on a weekend or holiday
259,593		
	870	Surgeon missing, with surgeon defined as the National Provider Identifier "of the physician with primary responsibility for performing the principal surgical procedure." Actual surgeon codes were blinded for analysis.
258,723		**Outpatient** cases analyzed (i.e., final sample size)
145,526		Iowa Hospital Association Inpatient Database searched for the surgeon having had 1 or more elective inpatient admissions at any hospital during included dates. An admission was considered to represent elective surgery if (1) the type of admission code was Elective, (2) the date of the principal procedure was the date of admission
	54,424	Limited principal procedure codes' International Classification of Diseases, Ninth Revision, Clinical Modification to those of major therapeutic procedures [15]
91,102		
	3688	Excluded weekends, holidays, or unlisted surgeon
87,414		**Inpatient** cases analyzed (i.e., final sample size)
346,137		Outpatient plus inpatient, elective surgical cases studied among the 116 hospitals in Iowa

We also identified the elective, major therapeutic inpatient surgical cases performed during the same 2 years as the outpatient dataset (Table 1) [16]. Inpatient surgical cases were coded using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) (i.e., there are no corresponding intraoperative RVU's). From the ICD-9-CM, we determined the Clinical Classifications Software category (Table 2) [20].

2.2. Calculation of independent variable: cases per week during the 1st year at each hospital

There were N = 3546 combinations of hospital and surgeon with at least 1 case during the 2nd of the 2 studied years. For each of these 3546 combinations of hospital and surgeon, we calculated for the 1st year the number of four-week periods during which each of these surgeons performed at least 1 case. The hospital and surgeon's cases during the 1st year at the hospital were divided by the sum of the number of workdays among the four-week periods for which the surgeon had at least 1 case. The product was multiplied by 5 to give the number of cases per week. If the surgeon performed zero (0) procedures at the hospital until the 2nd year, then the value used for the 1st year was set equal to 0 cases per week.

2.3. Calculation of the dependent variables

For each combination of hospital and surgeon, the increase in cases between the 1st and 2nd years was calculated using the difference in the number of cases during the 2nd year minus the number of cases