IVEY | Publishing

W15166

VANDERBILT UNIVERSITY MEDICAL CENTER: ELECTIVE SURGERY SCHEDULE

Lauren E. Cipriano, Vikram Tiwari, Warren S. Sandberg, and Gregory S. Zaric wrote this case solely to provide material for class discussion. The authors do not intend to illustrate either effective or ineffective handling of a managerial situation. The authors may have disguised certain names and other identifying information to protect confidentiality.

Variation in daily surgical case volume (the number of surgeries to be performed) was a major problem for large multispecialty medical centres, such as the Vanderbilt University Medical Center (VUMC) in Nashville, Tennessee. Surgical staff schedules for VUMC's 55 adult operating rooms (ORs) were made weeks in advance, but the final number of surgeries to be performed was only known with precision the day the surgeries were performed. By then, it was often too late to make significant changes in the already scheduled staffing. Knowing the expected surgical volume a few weeks in advance would allow the OR managers to adjust staffing to better match the demand and plan for any contingencies.

HEALTH CARE ANALYTICS

Decreasing reimbursements for medical services from government agencies and commercial insurance companies, coupled with increasing pressure to keep investing in the latest advances in medical technologies, had forced health care systems to find innovative ways to increase efficiencies. As a result, they began to utilize the tools of statistics and management science to improve staff and appointment scheduling; human resource planning; supply purchasing and inventory management; process flow, such as the organization of emergency room departments; and capacity planning, such as determining the number of neonatal intensive care beds needed.

The momentum for using analytical techniques to solve health care delivery problems was also propelled by the availability of vast amounts of data. In the previous decade, health care systems around the world had invested heavily in information technology (IT) and decision support systems (DSS), with the aim of making the delivery of care efficient, safe and patient-centered. Data for every transaction for every patient encounter was recorded and was readily accessible by querying hospitals' databases. However, most health care systems were now realizing that more data did not equal better decision making! People specifically trained to sieve through the enormous amounts of data, manipulate it using analytical and statistical techniques and present it cogently to an audience not well-versed with those methods were needed.

VUMC had state-of-the-art IT systems across the entire enterprise; in the perioperative arena, this included the preoperative patient holding area, the intra-operative areas consisting of the operating theatres and the post-operative care units. All surgical scheduling was computerized and the standardized patient and surgeon information needed to schedule a surgery was recorded at the time of scheduling.

Leadership at VUMC's ORs wondered whether the vast amounts of data related to building the elective surgery schedule from a few weeks prior to the day of surgery could be used to predict the final number of surgeries performed. The Finance Department used historical data and simple seasonal year-on-year growth rates to develop monthly budgets. With these estimates, it was able to predict the final volume for the month within plus or minus 5 per cent; however, it did not predict the daily volume. Realizing the limitations of such techniques to predict daily volume, the OR leadership decided to seek help from someone who could use more advanced analytical techniques.

Ajay (AJ) Bose was charged with the task of improving predictions of the daily surgical case volume to improve surgical and ancillary staff scheduling. Bose had just started a newly created position as the director of Surgical Business Analytics at VUMC. Since the operating rooms were a source of demand on many other hospital systems, he knew that if he could provide accurate predictions of the number of surgeries to be performed on a given day early enough, many other stakeholders in the hospital would also benefit.

VANDERBILT UNIVERSITY MEDICAL CENTER: PERIOPERATIVE

VUMC's Department of Surgery, Department of Anesthesia and Perioperative Services managed 55 adult ORs across five sites. Elective (non-emergency) surgeries, primarily performed on weekdays, represented 94 per cent of weekday surgery cases. Surgeons booked elective surgeries several weeks in advance and right up until the day before surgery. Approximately 6 per cent of total cases were unscheduled. These cases were added to the schedule within 15 hours before the start of the day of surgery. These "add-on" cases were often urgent or emergency cases and so must be accommodated into the schedule. The weekday average adult surgery volume (elective and add-on cases) was approximately 116 with a standard deviation of 18. Swings of 30 or more cases between nearby weekdays were common (see Exhibit 1).

Surgery support and ancillary services — nurses, orderlies, anesthesiologists, the recovery room (PACU), pathology, radiology and sterile cart services — were staffed based on the monthly expected number of surgeries (provided by the finance department), assuming that surgeries would occur equally across all weekdays in a month. Based on the number of surgeries performed each day for the past 48 weeks, Bose was able to confirm that the finance department monthly projections were highly accurate, but the daily projections left much to be desired (see Exhibit 2).

Potential Causes of Variability in the Daily Case Volume

Surgeons scheduled elective surgeries based on the urgency of the patient's needs and their own scheduling preferences. For example, most surgeons preferred to schedule surgeries earlier in the week and earlier in the day. In addition, Bose heard stories of entire surgical services (such as cardiothoracic, urology, neurology, etc.) scheduling no surgeries for a week to attend an academic meeting or a busy surgeon taking vacation, causing seemingly predictable low volume days. Often these events were surrounded by high volume days that strained resources. Anecdotally, high volume days were often attributed to the number of add-on cases, although no one had explored whether this was truly the main source of case volume variation.

Finalizing the Schedule

The elective surgery schedule was not finalized until 5 p.m. the day before. At the end of each day, the charge nurse reported the schedule for the next day to the administrative director, and preparation for the next day's cases began. If the number of cases booked was low, the administrative director might decide to close one or more operating rooms, and the charge nurse would ask some operating room nurses to take a paid holiday day rather than be overstaffed. If the number of cases booked was high, the administrative director might ask the charge nurse to call in extra operating room nurses and ask some nurses to stay late into overtime. If the charge nurse could not find the extra staff needed, some surgeries could be postponed into the evening (and served using overtime staff) and others might be cancelled.

Also at the end of each day, the number and type of surgeries to be performed the next day was reported to the surgical pathology unit, radiology department and PACU, and the number of surgical rooms that would be open was reported to the anesthesia department. Like operating room nursing staff, pathology, radiology and PACU staff could be asked to take paid holiday days on a low volume day or pick up an extra shift or work overtime on a high volume day. Generally, the anesthesia department planned for all operating rooms to be open, but if they were closed, anesthesiologists might be asked to take a "research day." Anesthesiologists spent approximately 10 to 20 per cent of their time on research and usually preferred to take several research days consecutively or to plan them concurrently with research project collaborators.

Finally, a very specific list of all sterile equipment needed for every booked surgery was sent to an off-site sterile cart processing centre. It began to assemble the sterile carts of all the supplies requested by each surgeon for each procedure at 7 p.m. the evening before, and the first trucks began to deliver carts at 3 a.m. Shipments of sterile carts arrived throughout the day, and used carts (containing reuseable supplies in need of washing and sterilization) were picked up and returned to the centre. On very high volume days, the centre could fall behind and carts might be delivered late; carts needing to be returned to the centre might also accumulate and be in the way. With enough notice, the centre could call in extra staff for high volume days, but on short notice (the day before) they were not always successful at finding staff to come in.

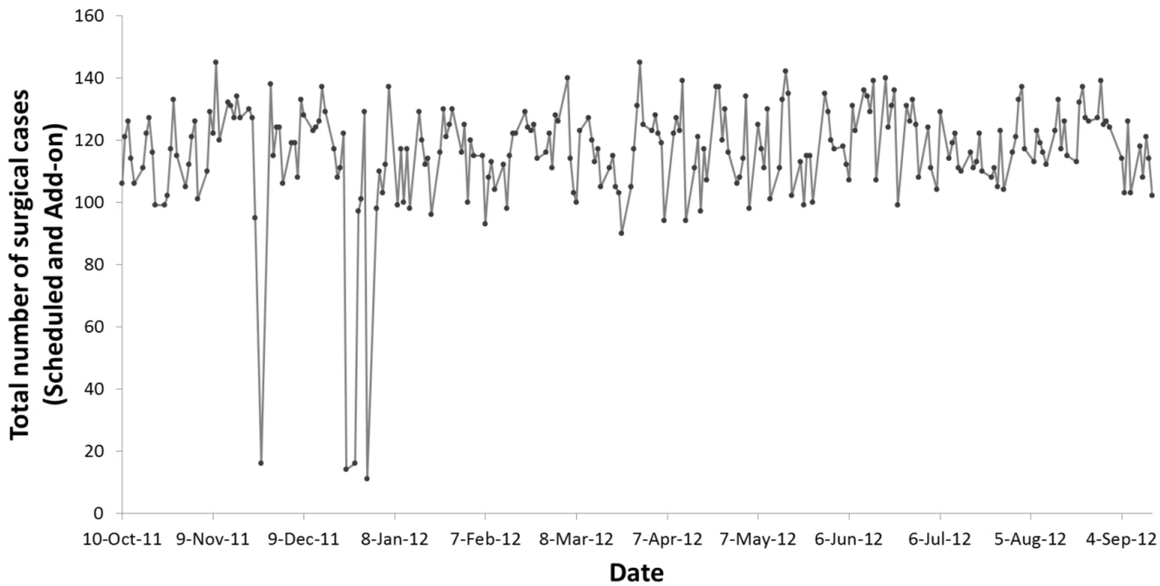
THE ELECTIVE SURGERY SCHEDULE DATA

For the past 48 weeks, the schedule clerk captured daily snapshots (that is, made a complete electronic backup in a data warehouse) of the developing elective surgical schedule, recording all surgeries booked for up to 30 days into the future. To ensure consistency, the snapshots were taken at exactly 4:30 p.m. each day when the OR schedule office closed. The full dataset had more than one million lines but included many duplicate observations as each booked surgery was included in every daily snapshot from the day it was first booked until the day before surgery occurred. Bose cleaned the data set by removing duplicates, removing weekends and removing data from the first 30 days (for which he did not have a full month of booking history). The remaining data set included 241 consecutive surgical days, each with 30 prior (calendar) dates of booking history (7,230 observations) (see Exhibit 3).

PREDICTING CASE VOLUME DEMAND

Bose needed to show that he could provide useful predictions of daily case volume. Could he develop a model based on the developing elective surgery schedule to predict daily demand? With what confidence could he make those predictions? How many days in advance could he make accurate predictions? Would the predictions be good enough to plan OR closures and reduce OR labour expenses by canceling shifts or shifting staff to other responsibilities or locations? To be useful, the tool he developed should be able to make actionable predictions. He knew that a success on this project could open the door to many more important analytics initiatives within the hospital.

EXHIBIT 1: ACTUAL NUMBER OF SURGERIES PERFORMED FOR WEEKDAYS BETWEEN OCTOBER 10, 2011 AND SEPTEMBER 14, 2012



Source: Company files.

EXHIBIT 2: MONTHLY ESTIMATED (FINANCE DEPARTMENT) AND ACTUAL CASE VOLUMES FOR OCTOBER 2011 TO OCTOBER 2012, INCLUDING WEEKDAYS, WEEKENDS AND HOLIDAYS

Month-Year	Budgeted	Actual	Difference (Actual-Budgeted)	% Difference compared to Budgeted	Absolute % Difference compared to Budgeted
Oct-11	2566	2575	9	0.4%	0.4%
Nov-11	2585	2690	105	4.1%	4.1%
Dec-11	2474	2535	61	2.5%	2.5%
Jan-12	2493	2603	110	4.4%	4.4%
Feb-12	2570	2576	6	0.2%	0.2%
Mar-12	2762	2783	21	0.8%	0.8%
Apr-12	2559	2654	95	3.7%	3.7%
May-12	2788	2834	46	1.6%	1.6%
Jun-12	2690	2809	119	4.4%	4.4%
Jul-12	2673	2626	– 47	–1.8%	1.8%
Aug-12	2924	3050	126	4.3%	4.3%
Sep-12	2610	2652	42	1.6%	1.6%
Oct-12	2976	3075	99	3.3%	3.3%
Average					2.5%

Source: Company files.

EXHIBIT 3: THE NUMBER OF SURGERIES SCHEDULED

The number of surgeries scheduled to be performed as of specific dates prior to the surgery date and the actual number of surgeries performed on the day of surgery for 48 weeks between October 10, 2011 and September 14, 2012. See supplemental case materials in Excel for complete data set.

		Number of surgeries scheduled in days prior to the surgery date											Actual
Surgery Date	Day of Week	T – 28	T – 21	T – 14	…	T – 7	T – 6	T – 5	T – 4	T – 3	T – 2	T – 1	Number of Surgeries*
10/10/2011	Mon	38	45	60		80	84	89	94	98	100	104	106
10/11/2011	Tue	35	47	65		89	92	95	99	99	99	114	121
10/12/2011	Wed	26	43	54		94	96	101	102	102	106	114	126
10/13/2011	Thu	28	48	65		91	94	94	94	97	98	103	114
10/14/2011	Fri	31	40	50		73	73	73	78	83	87	94	106
10/17/2011	Mon	41	56	65		80	86	85	86	92	96	102	111
10/18/2011	Tue	44	55	69		92	96	103	105	105	107	114	122
10/19/2011	Wed	32	40	62		87	89	96	96	96	102	119	127
10/20/2011	Thu	33	44	62		90	98	98	98	105	111	118	116
10/21/2011	Fri	20	32	48		61	61	61	69	72	70	88	99
10/24/2011	Mon	32	44	55		69	74	77	83	85	86	92	99
9/4/2012	Tue	23	36	51		80	84	92	105	106	106	116	114
9/5/2012	Wed	27	37	47		70	74	81	81	82	85	95	103
9/6/2012	Thu	23	42	70		99	105	105	105	106	108	119	126
9/7/2012	Fri	10	21	48		68	68	68	68	67	82	91	103
9/10/2012	Mon	33	49	68		86	91	97	101	103	109	110	118
9/11/2012	Tue	31	56	68		80	88	94	97	98	98	99	108
9/12/2012	Wed	39	49	69		88	96	99	99	100	104	115	121
9/13/2012	Thu	34	51	68		92	98	99	99	97	101	106	114
9/14/2012	Fri	27	41	63		76	76	77	78	81	86	101	102

** The actual number of surgeries includes all scheduled and add-on cases.*

Source: Company files.