Changing the admission process for elective surgery: an economic analysis

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This study compared the costs of an inpatient elective surgical admission process with an outpatient based same day admission programme in patients undergoing laparoscopic cholecystectomy. The effect of this process change on annual surgical volume and case flow (number of procedures performed per surgical bed) in the year before the initiation of same-day method (1989/90) and subsequent to the widespread use of the process (1992/93), was also assessed. Costs incurred by 53 patients who underwent preoperative anaesthetic and surgical assessment as outpatients and were admitted as an outpatient on the day of surgery (SD Group) were compared with those incurred by 11 patients who entered hospital on the day before surgery and underwent anaesthetic and other assessments as inpatients (IP Group). Nursing, radiology, laboratory, operating room, rehabilitation and clinic costs were obtained for each patient. The remaining costs were not amenable to individual attribution and were assigned to each group as a percentage of the allocated costs. The cost per case in the SD Group was $360 less than in the IP Group, reflecting decreased nursing costs incurred by the SD Group. Between the period 1989/90 and 1992/93, the number of surgical beds declined 15.7%; however, surgical volume decreased by only 5.4%. Total case flow improved by 12.2%, that for elective and non-elective surgery increasing by 14.1% and 9.5%, respectively. Elective surgery, where same day admission was used, showed the greatest improvement in case flow. We conclude that a same day admission process reduces cost and serves to enhance hospital productivity.

Cette étude compare pour la cholécystectomie laparoscopique les coûts générés par la chirurgie réglée du patient hospitalisé avec ceux du patient ambulatoire. Elle évalue aussi les effets de ce changement de technique sur le volume chirurgical annuel et le débit chirurgical (nombre d'interventions par lit) pour l'année antérieure à l'initiation de la technique ambulatoire (1989–90) et celle qui a suivi sa propagation (1992–93). On a comparé les coûts générés par 53 patients dont l'évaluation pré-anesthésique et chirurgicale avait été réalisée dans le service de consultations externes et admis à l'hôpital le jour même de la chirurgie (groupe SD) avec les coûts générés par onze patients admis la vielle de l'intervention pour ces mêmes évaluations (groupe IP). Les coûts des soins infirmiers, de la radiologie, du laboratoire, des salles d'opérations, de la réhabilitation et des cliniques ont été obtenus pour chaque patient. Les autres coûts non imputables aux individus eux-mêmes, ont été assignés à chaque groupe en pourcentage des coûts alloués. Les coûts du groupe SD étaient de 360$ inférieurs à ceux du groupe IP, ce qui reflète la baisse des coûts des soins infirmièrs encourus dans le groupe SD. Entre les périodes 1989–90 et 1992–93, le nombre des lits chirurgicaux a baissé de 15,7% alors que le volume chirurgical ne diminuait que de 5,4%. Le débit total s'est amélioré de 12,2%, alors que la chirurgie non urgente et la chirurgie urgente augmentaient respectivement de 14,1% et de 9,5%. Dans les cas d'admission de même jour, la plus grande augmentation du débit chirurgical a été pour la chirurgie non urgente. Nous concluons que l'admission le jour de la chirurgie réduit les coûts et augmente la productivité hospitalière.

Key words
ANAESTHESIA: pre-admission, assessment;
SURGERY: admission.

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In North America, preoperative anaesthetic and surgical assessment of elective surgical patients on an outpatient basis combined with admission of the patient to hospital as an inpatient on the day of surgery is widely practiced.[1,2] This form of admission, termed same-day surgery, has become routine and has replaced, in large measure, the traditional method of admission of surgical patients, whereby patients entered hospital on the day before elective surgery and underwent anaesthetic and other assessments as inpatients, staying overnight in the hospital. Costs incurred by patients admitted the day before an operation, even for procedures as invasive as cardiac surgery, are frequently not covered by third-party payers

in the USA.[3] While intuitively such an alteration in admission policy should result in substantial savings, few studies have attempted to quantify these savings[4] or detail the changes in surgical practice that occur as a consequence of such "cost-reduction" intiatives. At the University of Alberta Hospitals (UAH) patients scheduled for same-day surgical admission are assessed preoperatively at a preadmission clinic (PAC) and return to the same location on the day of surgery to be admitted to a same-day admission surgical unit (SDASU) where they are prepared for surgery. Both the PAC and SDASU share the same staff and operate in a combined manner as an outpatient unit. Patients admitted on the day before surgery are admitted to an inpatient surgical unit and remain in hospital overnight. This study compared the hospital-associated cost of a same-day surgical admission with the inpatient approach and assessed the effect of this process change on surgical volume and case flow (number of procedures performed per open surgical bed).

Methods

Sixty-four patients undergoing laparoscopic cholecystectomy admitted to hospital on the day of their surgical procedure (SD group) or admitting to hospital on the day before surgery (IP group) over a three-month period, were studied. Laparoscopic cholecystectomy was chosen as the representative surgical procedure as it was frequently performed (14% of general surgical PAC/SDASU volume during the period under study) and involved the implementation of standardized treatment protocols. Only patients who were discharged on the day following their operation were included in the analysis. Thus, all patients studied had an equivalent postoperative length of stay in hospital. The study period corresponded with the introduction of the same-day method of admission for patients presenting for laparoscopic cholecystectomy and thus during this time patients were being admitted both on the day of surgery and on the day before surgery, allowing direct comparison between the two methods of patient admission. Thereafter, all patients presenting for laparoscopic cholecystectomy were admitted via the PAC/SDASU.

Individual nursing costs incurred by the study patients when present in the hospital as inpatients were retrospectively calculated from each individual patient's resource consumption profile, a term describing an accounting method developed at the UAH. This methodology uses the Rush-Medicus patient classification nursing workload measurement system to estimate the amount of nursing time spent caring for an individual patient,[5] and apportions, in a patient-specific manner, the appropriate percentage of the aggregate cost incurred by the nursing unit in which the patient is located. Nursing cost data recorded, therefore, includes the direct and indirect labour and supply costs related to nursing duties. An itemized listing of laboratory and radiology tests performed on patients in the study was obtained by retrospective chart review and costs calculated using price schedules developed at the UAH, which reflected the true cost of performing each test, inclusive of labour, supplies and overhead. The rehabilitation medicine and the operating room areas used a modification of the costing system described for estimating nursing costs. These data represented 55% of the total inpatient cost. The remaining costs (food, utilities, overhead) were not amenable to individual allocation due to the limitations of the hospital accounting system and were apportioned as a ratio to the allocated costs. Assignment of unallocated costs in proportion to allocated costs was indicated in the case of variable costs such as food and utilities, since the consumption of such resources is probably highly correlated with allocated variable costs such as nursing. In the case of true fixed costs (e.g., administration), the assignment in proportion to variable costs represents common accounting practice.

The average cost per patient of operating the PAC/SDASU was added to the inpatient costs for those in the SD group and included a sessional fee for physicians assessing patients in the PAC, nursing labour and supply costs and clerical and support staff costs. Admission using the same-day method, allowed identification of patients unsuitable for surgery before admission as an inpatient, and also prevented inpatient admission of a patient whose procedure was cancelled on the day of surgery. Consequently, the percentage of all patients screened in the PAC during the period of the study and judged medically unsuitable for elective surgery and the percentage of patients admitted to the SDASU but cancelled on the day of, or the night before, scheduled surgery were calculated. The SD group costs were adjusted to reflect the net savings related to cancellations, multiplied by the probability of cancellation either at the time of the PAC or SDASU visit. The results of the representative sample were extrapolated to the all patients admitted using the same-day method during the subsequent year (1992/93) and the total estimated annual cost saving calculated.

In an attempt to assess the effect of the same-day method of admission on surgical activity, the number of surgical beds and the number of elective and non-elective procedures performed in the year prior to the initiation of same-day method (1989/90) and subsequent to the widespread use of the process (1992/93) were calculated, giving a measure of surgical case flow (number of surgical procedures performed per open surgical bed).

TABLE I Mean (SD)

	SD group	*IP group*
Number of men	9	4
Number of women	44	7
Age (yr)	43.66 (14.18)	55.82 (14.97)
Weight (kg)	75.56 (17.94)	73.04 (19.80)
Time in surgery (hr)	2.00 (0.54)	1.98 (0.60)
Time in recovery (hr)	1.11 (0.42)	1.22 (0.38)
Postop. length of stay (days)	1	1
Inpatient length of stay (days)	1	2
ASA Score 1-2	50	6
ASA Score 3-4	3	5

Statistics

The null hypothesis that the difference in cost between the two admission processes was zero was tested using the Smith-Satterthwaite test for comparing means from normal distributions with potentially different variances.[6] The calculations of case flow changes for elective and non-elective procedures are valid only under the assumption that the share of elective and non-elective surgical procedures were constant. Over the period studied, this was the case.

Results

Patient age, weight, duration of surgery, and length of stay in the recovery room were as shown in Table I. The IP group contained one ASA class four patient (a quadriplegic) and patients in this group tended to have higher ASA classification. Nevertheless, the duration of surgery, length of time in the recovery room and time of discharge from hospital was similar in both groups. Cost per patient attributable to the SD group were less than those attributable to the IP group, even in the absence of savings realized by preventing inpatient admission of patients subsequently cancelled either for medical or other reasons (Table II). Two percent of patients assessed in the PAC during the study period had their surgery cancelled because they were deemed unfit to undergo anaesthesia and surgery. Five percent of patients scheduled for admission to the SDASU had their planned procedure cancelled on the day of, or the night before, surgery (primarily due to emergency surgery preempting elective surgery). Adjusting the SD group costs to reflect cancellation savings on inpatient costs, decreased the costs in the SD group by a further $19.95 (Table II), a cost advantage per patient for the SD group of 18%. A total of 2071 patients were admitted using the same-day admission process in 1992/93 resulting in an estimated annual saving in 1992/93 of approximately $758,767 (Table III).

Between the period 1989/90 and 1992/93, the number of surgical beds declined 15.7% but surgical volume decreased by only 5.4% (Table IV). Case flow overall improved 12.2%, with that for elective surgery increasing by 14.1%, while case flow in non-elective procedures grew by 9.5%.

TABLE II Mean (SD)

		SD group	*IP group*
Patients		53	11
Nursing ($)		171.69 (71.10)	441.42 (154.35)
Rad ($)		11.84 (22.18)	37.33 (28.87)
Lab		21.48 (34.36)	22.65 (16.60)
Rehab		0.00 (0.00)	3.52 (11.15)
OR		569.90 (147.09)	605.52 (95.24)
PAC		145.00	0.00
Unallocated		752.66	908.55
Total		1672.57 (252.98)	2018.99 (413.97)
Mean difference	346.42		
Cancellation adjustment	19.95		
Adjusted mean difference	366.38		

TABLE III Sensitivity of potential cost savings to alternative utilizations

Patients	*Potential savings*
2071	$758,767
3500	$1,282,321
5000	$1,831,886

TABLE IV Surgical case flow

	1989/90	*1992/93*
Surgery unit beds	468	428
Open surgery unit beds	420	354
Total procedures	17861	16897
Non-elective procedures	7123	6573
Elective procedures (including SD)	10738	10324
SD procedures	0	2071
SD share of elective procedures (%)	-	20.1
Case flow		
Total case flow (procedures/open bed)	42.5	47.7
Total case flow improvement (%)	-	5.5
Non-elective case flow	17.0	18.6
Non-elective case flow improvement (%)	-	1.8
Elective case flow	25.6	29.2
Elective case flow improvement (%)	-	7.9

Discussion

Altering the method of elective surgical admission from an inpatient to a same-day process reduced the cost of performing laparoscopic cholecystectomy during the period studied. Costs attributable to nursing care were lower in the SD group reflecting the decreased nursing requirements of patients assessed as outpatients and ad-

mitted to an inpatient unit only after surgery has been performed.[7] Cancellation subsequent to initial assessment for medical reasons or on the day of surgery due to emergency surgery preempting elective procedures was relatively common during the period under review, reflecting the difficulty of surgical scheduling in a tertiary care hospital. The sample size of the IP group was small. Greater numbers in both groups would have facilitated testing for the existence of scale economies (decreasing unit costs corresponding to volume increases) and estimation of the minimum efficient program size (where unit costs become constant). However, because of the rapid transition from the inpatient to the same-day surgery method of admission for laparoscopic cholecystectomy patients, this was not possible.

Ideally, in a comparison of two alternative processes designed to produce the same outcome, one should measure the cost of one process relative to the other and test the sensitivity of cost to different levels of utilization. Thus we would have compared the costs incurred before the patient entered the operating room, since from that point on the processes were equivalent. Unfortunately, the lack of available data necessitated comparison of average costs for both entire surgical processes, introducing additional variability to the calculation due to random factors affecting pre- and post-surgical costs. Secondly, 45% of total inpatient costs were unallocated, representing a mix of variable and fixed costs. Variable costs are incurred as an additional patient is treated and would be allocated to individual patients if accounting systems permitted. Fixed costs are costs incurred regardless of whether an additional patient is treated, and are allocated according to some arbitrary sharing formula, usually as a ratio to variable costs. Lack of data required that all unallocated costs be treated as fixed costs and allocated to the two processes according to the arbitrary sharing formula.

The case flow data show that the increase in inpatient bed availability arising from use of same-day admission, the development of and adherence to discharge criteria and enhanced placement of chronic patients,[8] offset almost entirely the effect of the reduction in the number of surgical beds during the period studied. The greater case-flow improvement in elective surgery, where the same-day process was employed, suggests that changing the method of surgical admission was an important independent factor in maintaining elective surgical volume.

This study highlights the difficulty of assessing the economic consequences of a change in clinical practice without detailed information on the costs of individual components of a hospital programme, and suggests that such data should be collected routinely. A same-day admission process, for elective patients, appears to be a practical and cost-effective alternative to inpatient admission the night before surgery. Furthermore, a reduction in the number of surgical acute care beds may not necessarily be associated with a parallel decrease in volume of surgical activity, but may spur the development of initiatives that increase productivity.

References

1 *Anderson RP, Guyton SW, Paull DL, Tidwell SL.* Selection of patients for same-day coronary bypass operations. J Thorac Cardiovasc Surg 1993; 105: 444–51.

2 *Collier PE.* Carotid endarterectomy: a safe cost-efficient approach. J Vasc Surg 1992; 16: 926–9.

3 *Anonymous.* Same-day surgical admission. American College of Cardiology Cardiovascular Surgery Committee. J Am Coll Cardiol 1993; 22: 946–7.

4 *Keithley J, Glandon GL, Llewellyn J, Berger B, Levin D.* The cost-effectiveness of same-day admission surgery. Nursing Economics 1989; 7: 90–3.

5 *Halloran EJ.* Nursing workload, medical diagnosis related groups, and nursing diagnoses. Res Nurs Health 1985; 8: 421–33.

6 *Freund JE, Walpole RE.* Mathematical Statistics, 4th ed. Englewood Cliffs: Prentice Hall, 1987.

7 *Finegan BA.* Preadmission and outpatient consultation clinics (Editorial). Can J Anaesth 1992; 30: 1009–11.

8 *Hamilton A, Norris C, Wensel R, Koshal A.* Cost reduction in cardiac surgery. Can J Cardiol 1994; 10: 721–7.