Cost of open and laparoscopic distal gastrectomy: surgeon perceptions versus the reality of hospital spending

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Accepted Jan. 23, 2018; Early-released Oct. 1, 2018

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DOI: 10.1503/cjs.014817

Background: Rising health care costs have led to increasing focus on cost containment and accountability from health care providers. We sought to explore surgeon awareness of supply costs for open and laparoscopic distal gastrectomy.

Methods: Surveys were sent in 2015 to surgeons at 8 academic hospitals in Toronto who performed distal gastrectomy for gastric adenocarcinoma. Respondents were asked to estimate the total cost, type and number of disposable equipment pieces required to perform open and laparoscopic distal gastrectomy. We determined the accuracy of estimates through comparisons with procedural invoices for distal gastrectomy performed between Jan. 1, 2011, and Dec. 31, 2015. All values are in 2015 Canadian dollars.

Results: Of the 53 surveys sent out, 12 were completed (response rate 23%). Surgeon estimates of total supply costs ranged from $500 to $3000 and from $1500 to $5000 for open and laparoscopic cases, respectively. Estimated supply costs for requested equipment ranged from $464 to $2055 for open cases and from $1870 to $2960 for laparoscopic cases. Invoices for actual equipment yielded a mean of $821 (standard deviation $543) (range $89–$2613) for open cases and $2678 (standard deviation $958) (range $835–$4102) for laparoscopic cases. Estimates of total cost were within 25% of the median invoice total in 1 response (9%) for open cases and 3 (27%) of those for laparoscopic cases.

Conclusion: Respondents failed to accurately estimate equipment costs. The variation in true total costs and estimates of supply costs represents an opportunity for intraoperative cost minimization, efficient equipment selection and value-based purchasing arrangements.

Contexte : En raison de l'augmentation des coûts des soins de santé on attend des professionnels qu'ils mettent davantage l'accent sur les restrictions budgétaires et l'imputabilité. Nous avons voulu vérifier à quel point les chirurgiens sont conscients du coût des fournitures utilisés dans les cas de gastrectomie distale ouverte et laparoscopique.

Méthodes : Des questionnaires ont été envoyés en 2015 aux chirurgiens de 8 hôpitaux universitaires de Toronto qui pratiquent la gastrectomie distale pour l'adénocarcinome de l'estomac. On demandait aux participants d'estimé le coût total, le type et le nombre de fournitures jetables requises pour une gastrectomie distale ouverte et laparoscopique. Nous avons déterminé l'exactitude des estimations en comparant les factures pour les interventions de gastrectomie distale effectuées entre le 1er janvier 2011 et le 31 décembre 2015. Toutes les valeurs sont présentées en dollars canadiens.

Résultats : Parmi les 53 questionnaires envoyés, 12 sont revenus complétés (taux de réponse 23 %). Les estimations des chirurgiens pour le coût total des fournitures allaient de 500 $ à 3000 $ et de 1500 $ à 5000 $ pour les interventions ouvertes et laparoscopiques, respectivement. Le coût estimé des fournitures pour l'équipement nécessaire variait de 464 $ à 2055 $ pour les interventions ouvertes et de 1870 $ à 2960 $ pour les interventions laparoscopiques. Les factures soumises pour les équipements réellement utilisés ont été en moyenne de 821 $ (écart-type 543 $) (éventail 89 $–2613 $) pour les interventions ouvertes et de 2678 $ (écart-type 958 $) (éventail 835 $–4102 $) pour les interventions laparoscopiques. Les estimations des coûts totaux se situaient à plus ou moins 25 % du montant total médian des factures dans 1 réponse (9 %) pour les interventions ouvertes et dans 3 réponses (27 %) pour les interventions laparoscopiques.

Conclusion : Les participants n'ont pas été en mesure d'estimer avec exactitude le coût des fournitures. Cet écart entre les coûts totaux réels et estimés représente une occasion de réduire les coûts peropératoires, de sélectionner les équipements de façon efficiente et de conclure des contrats d'achat en fonction de la valeur.

Consistent increases in spending within the health care sector are a common concern globally.[1] Budgetary constraints and increased administrative oversight of medical procedures have been explored and adopted as one means of controlling the rising costs of care. These interventions, however, have been practically and morally challenging to implement since decisions are at times arbitrary, and no perfect system of allocation of health care resources has been devised.[2] To mitigate these challenges and contain costs, health care systems have strived to become more efficient in providing services at all levels of funding. To this end, because physicians are important purchasing agents of health care services and supplies, their knowledge of system costs and their participation in cost control have been essential, with care providers being increasingly held accountable for containing medical costs.[3] In the United States alone, physician-controlled costs are estimated to constitute almost $400 billion of waste annually.[4,5] As such, improved efficiency of physician-controlled costs represents a tremendous opportunity to improve health care systems across the globe.

Physician knowledge of the cost of patient care is poor. Systematic reviews showed that only one-third of physician cost estimates were within 20%–25% of the true cost of pharmaceutical prices and of diagnostic and nondrug therapeutic interventions.[6,7] The use of operating rooms in particular has represented an important cost driver in public and private-payer health care systems, and procedure costs are not commonly known by the surgeons conducting them.[8–11] In addition, surgeons appear to have limited knowledge regarding the amount and costs of disposable supplies used in the operating room, which often results in waste of materials as supplies are opened and discarded, sometimes unused, after the operation.[12–14]

For many procedures, minimally invasive laparoscopic surgical approaches have gained popularity as a method of reducing the inpatient stay and expediting postoperative recovery.[15–22] These procedures have generally been associated with increased operative time and use of more disposable and expensive equipment compared to an open approach.[19] The additional cost borne in the operating room, however, has been usually offset by a decrease in length of stay and associated costs.[23,24]

Irrespective of technique, surgeons' perception of equipment costs for these procedures is unknown. We performed a study to explore physician knowledge of the equipment costs of open and laparoscopic procedures. This was determined by comparing estimates of total procedure costs and costs of surgeon-requested supply lists to actual invoiced supply costs.

Methods

Participants and survey

To determine surgeons' estimates of total costs and of requested equipment lists for each procedure, we sent a cross-sectional survey to general and thoracic surgeons at 8 academic hospitals in Toronto with experience performing distal gastrectomy for gastric adenocarcinoma. We identified potential respondents using publicly available information. The survey was conducted between August and October 2015.

We identified disposable equipment used for gastrectomy from operating room inventory lists. Supply lists included disposable gowns, towels, catheters, drainage bags, irrigation and smoke evacuation devices, staplers, energy devices, sutures and ligating clips. Pilot testing was conducted with 3 surgeons to ensure that a comprehensive list of supplies was generated before distribution of the survey.

We distributed the survey by email using the online FluidSurveys application. All potential respondents received a reminder email, and results were collected electronically.

Respondents were asked to estimate the total cost of disposable equipment for each procedure. We averaged surgeon estimates of total costs for procedures and calculated the differences between each surgeon's estimates for open and laparoscopic procedures.

Respondents were also asked to estimate the type and quantity of disposable surgical supplies required to perform open and laparoscopic distal gastrectomy. We multiplied quantity estimates by unit costs of supplies obtained from procedure invoices. In cases in which multiple costs were found for 1 item (typically owing to differences in purchasing agreements or the presence of multiple similar items on invoices), we used the median unit costs. We calculated ranges and means for open and laparoscopic procedures.

True procedure costs

We obtained procedure invoices from 2 academic hospitals in Toronto to determine the average number of supplies used per procedure, as well as the total costs of these supplies. Invoices were requested for all distal gastrectomy procedures performed between Jan. 1, 2011, and Dec. 31, 2015. We reviewed procedure details and excluded invoices if patients underwent resection for conditions other than gastric adenocarcinoma (e.g., gastrointestinal stromal tumours) or if there was evidence of multivisceral resection (e.g., colon, pancreas, liver). We calculated ranges and means from invoices obtained for open and laparoscopic procedures.

Accuracy of surgeon estimates

To determine the difference between estimated costs and actual expenses, we compared surgeon estimates of total procedure costs against the cost of requested supply lists, as well as the actual total costs from procedure invoices. We defined estimates of supply costs as "accurate" if the absolute value of the estimate was within 25% of the actual total procedure invoice costs.[6,25,26] All values reported are in 2015 Canadian dollars.

Results

Of 53 potential survey participants, 12 returned completed surveys (response rate 23%). Twelve surveys were completed for open gastrectomy, and 12 were completed for laparoscopic gastrectomy. Two respondents (17%) conducted only open procedures, and 4 (33%) conducted only laparoscopic cases; the remaining 6 respondents (50%) performed both types of procedure.

Cost estimates

Surgeon estimates of total procedure costs ranged from $500 to $3000 (mean $1223 [standard deviation (SD) $692]) for open cases and from $1500 to $5000 (mean $2191 [SD $1039]) for laparoscopic cases (Fig. 1, Fig. 2). The mean additional cost estimated for laparoscopic procedures was $968, with a range of $300–$2000.

The estimated cost of surgeon-requested supplies ranged from $464 to $2055 (mean $1088 [SD $439]) for open cases and from $1870 to $2960 (mean $2209 [SD $304]) for laparoscopic cases (Table 1).

True procedure costs

Actual total supply costs obtained from procedure invoices yielded a mean of $821 (SD $543) (range $89–$2613) for open cases and $2678 (SD $958) (range $835–$4102) for laparoscopic cases.

Accuracy of surgeon estimates

Surgeon estimates of the total cost of requested supplies were accurate in 5 responses (42%) for open cases and 8 responses (67%) for laparoscopic cases. Surgeon estimates of total cost were accurate in 1 response (9%) for open procedures and 3 responses (27%) for laparoscopic cases. Surgeons most often underestimated the total cost of laparoscopic cases, with 10 responses (83%) underestimating invoiced equipment costs.

Discussion

In this cross-sectional survey, we found that surgeons were generally unaware of the actual procedure costs associated with gastrectomy. Although overall accuracy was low, surgeons more accurately estimated the costs of supplies for laparoscopic procedures (27%) than for open procedures (9%). In addition, a relatively higher cost of disposable supplies was observed for laparoscopic procedures than for open operations.

Generally, the accuracy of physician estimates obtained in the current study was similar to findings from previous studies that found poor physician awareness of costs related to both pharmaceuticals and nonpharmaceutical

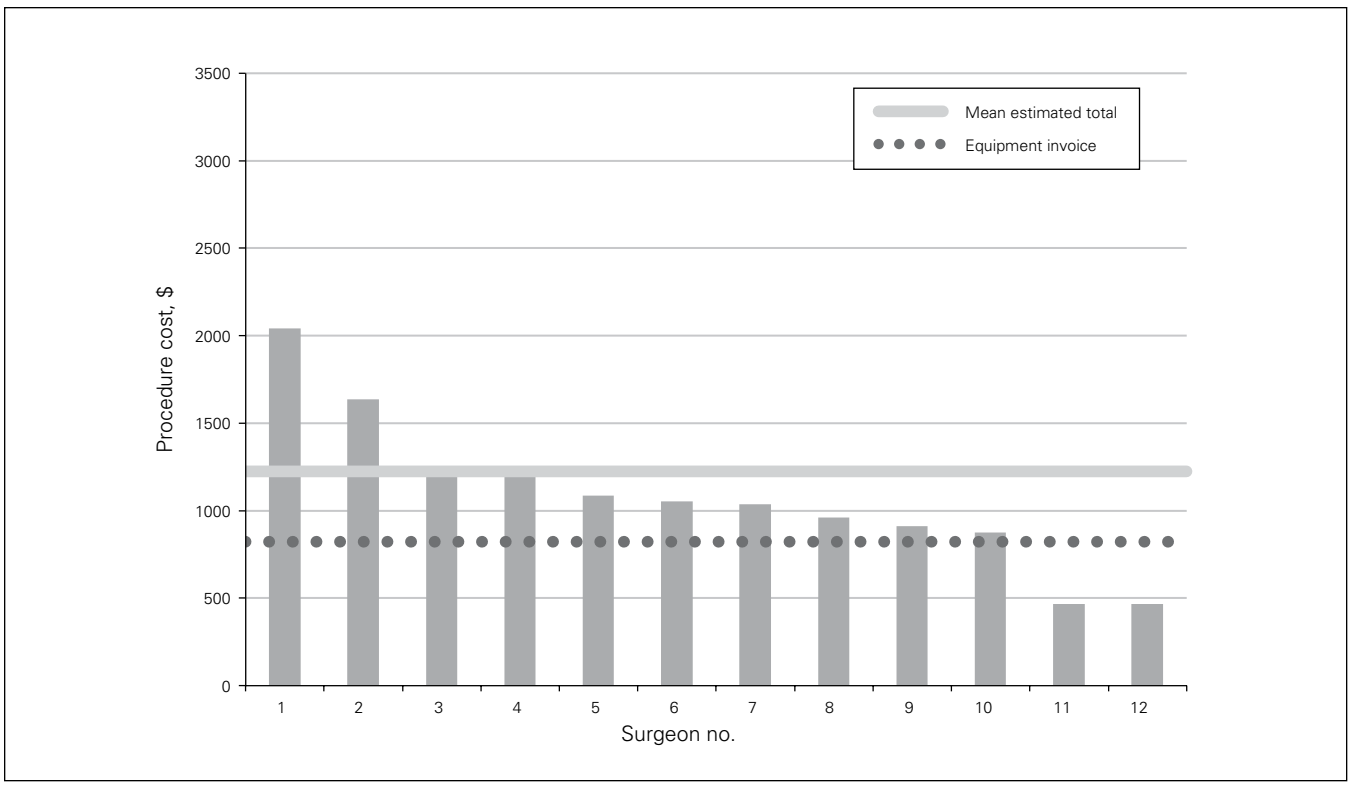

Fig. 1. Surgeons' estimated cost of open digital gastrostomy, 2015 Canadian dollars.

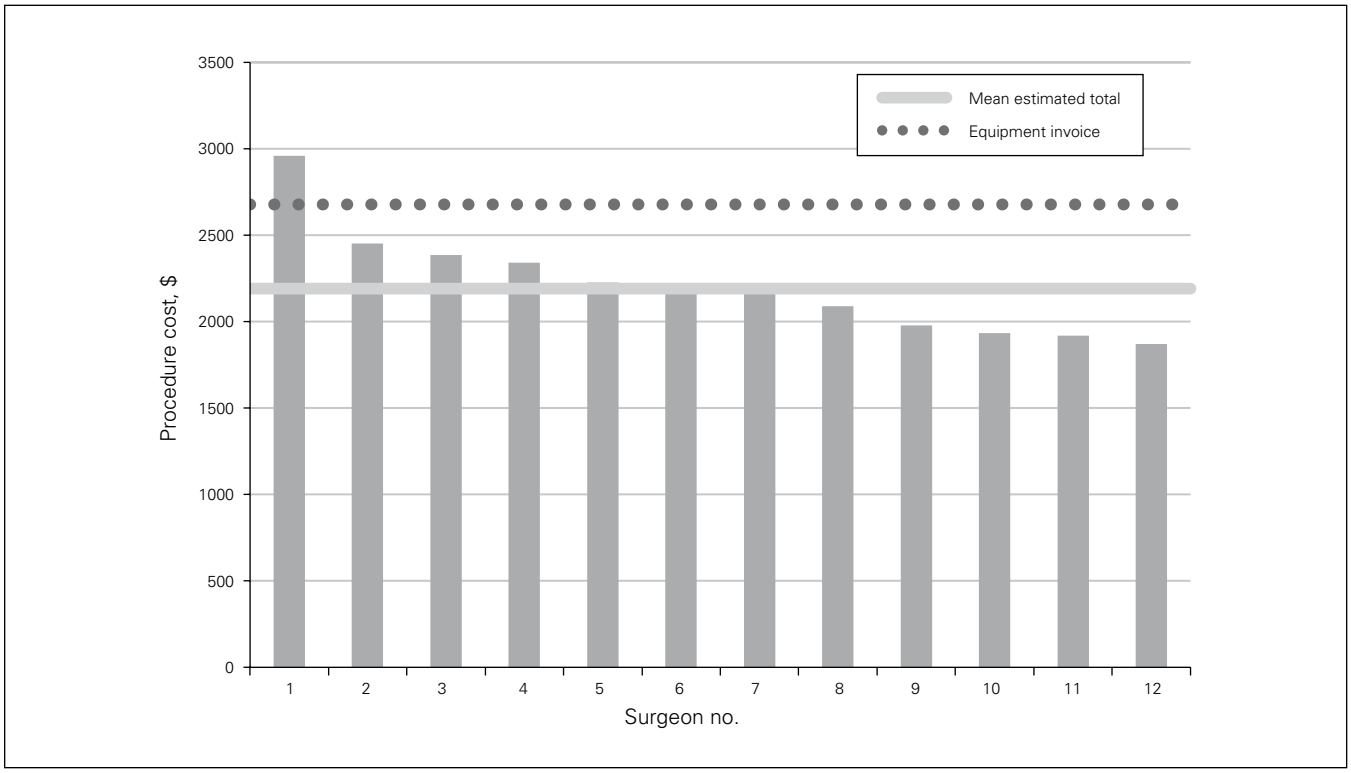

Fig. 2. Surgeons' estimated cost of laparoscopic digital gastrostomy, 2015 Canadian dollars.

Table 1. Total costs of supplies for distal gastrectomy for gastric adenocarcinoma estimated by surgeons and actual costs, 2015 Canadian dollars

Variable	Approach	
	Open	Laparoscopic
Estimated costs, $, mean ± SD (range)	1223 ± 692 (500–3000)	2191 ± 1039 (1500–5000)
Requested supply costs, $, mean ± SD (range)	1088 ± 439 (464–2055)	2209 ± 304 (1870–2960)
Invoiced procedure costs, $ (CI)	821 (690–960)	2678 (2344–3031)
Surgeon estimated supply costs within 25% of equipment invoice, no. (%) of responses	5 (42)	8 (67)
Surgeon estimated procedure costs within 25% of equipment invoice, no. (%) of responses	1 (9)	3 (27)

CI = confidence interval; SD = standard deviation.

diagnostic and therapeutic interventions.[6,7,11,27] Previous research has suggested that surgeons tend to overestimate less expensive, more common surgical equipment and to underestimate the cost of more expensive, less common equipment.[11,28,29] Similarly, we found that surgeons tended to overestimate the total cost of the less expensive open procedure and underestimated the cost of the more expensive laparoscopic procedure. These findings suggest that, although surgeons are aware of the higher cost of laparoscopic equipment, they do not know the specific additional cost of this equipment. One possible explanation is that equipment costs may be unavailable to surgeons owing to purchasing agreements between hospitals and equipment suppliers that preclude the sharing of this information. Also, determining the specific additional costs of laparoscopic gastrectomy is difficult given variations in product use among surgeons and differences in negotiated purchasing arrangements between hospitals and suppliers.

Interestingly, there was far less variation in the cost of surgeons' requested supply lists for laparoscopic procedures than for open procedures, which, instead, had a fourfold variation in supply costs. This finding may reflect the fact that surgeons have more equipment options for open procedures, while being limited to using certain equipment for laparoscopic cases. Given the substantial variation in equipment used and supply costs for open procedures, there may be opportunities to significantly reduce procedural costs of open gastrectomy through more cost-conscious equipment selection.

This study adds to the growing body of literature suggesting insufficient knowledge of medical costs on the part of care providers.[6,7,30,31] Although this trend likely exists within many industries, the limited cost awareness among medical providers is concerning given that health care in Canada is publicly funded. The shared responsibility of judicious spending and distribution of services falls to and has been accepted by physicians.[32–34] Despite this, levels of cost literacy among physicians appear to have remained stagnant. This may be explained by the

lack of education aimed at cost and value of care historically provided to medical trainees, as well as a cultural belief that more care is equal to better care.[35] Another possible explanation is the lack of accurate and timely case-costing information available to surgeons. Investments in systems that provide real-time information about equipment costs to surgeons while in the operating room may encourage more cost-effective and discretionary equipment use. However, confidential purchasing agreements may impede such interventions, as institutions may not be able to easily provide pricing details to physicians, who, nonetheless, act as their purchasing agents. Furthermore, although governments have attempted to move toward value-based procurement systems, there has been limited evidence of differences in outcomes with the use of different surgical equipment.[36] As a result, choice of equipment has fallen largely to surgeons.

Recently, several new curricula and interventions aimed at teaching medical residents and physicians to provide "high-value, cost-conscious care" have been developed; however, these have yet to show a widespread impact on physicians' knowledge of care costs.[37,38] Future research should focus on improving the development and evaluation of educational interventions for surgical trainees and practising surgeons. In addition, future research should explore the impact of providing actual case costs to providers and the development of surgeon-led programs for new equipment acquisition. Furthermore, value-based purchasing of surgical instruments warrants further investigation, as this may reduce variations in equipment use and costs between institutions.

Limitations

A principal limitation of this study was the low survey response rate (23%). In addition, the invoices included in this study were collected from 2 hospitals, whereas survey responses represented surgeons from 8 different hospitals. The surgical practices of respondents may have been different from those reflected in the invoices obtained, which would have had an ambiguous effect on the accuracy of surgeon estimates. These invoices are, however, a relatively accurate reflection of actual equipment costs at all sites given that there is a centralized purchasing agreement for most Toronto-area hospitals. Another limitation is that the ideal equipment lists would not account for equipment malfunction, need for additional staplers or sutures, or contaminated equipment, all of which would be reflected in the actual costs. Moreover, the invoices used to calculate the actual procedure costs were restricted to simple distal gastrectomy for adenocarcinoma, and, as such, the reported average cost of supplies used in laparoscopic and open procedures may not have accounted for more clinically complex and expensive cases. In addition, this study did not capture the costs of extending operating room time (e.g., nursing hours, pharmacy costs or hospital overhead), which would likely be higher with a laparoscopic approach, nor the impact on length of stay and associated costs, which would likely be higher with the open approach.[19] Finally, owing to privacy regarding hospital purchasing contracts, we could not explore physician knowledge of costs of single items.

Conclusion

Surgeons were unaware of the costs of disposable supplies for open and laparoscopic gastrectomy procedures. Surgeons tended to overestimate the costs of disposable equipment for open cases but underestimated the additional equipment costs for laparoscopic procedures. Surgeons also more accurately estimated the total costs of laparoscopic procedures than of open gastrectomy operations, although the overall accuracy of estimates was low. Given the growing concerns about rising health care costs, efforts for cost containment should include programs that focus on surgeon education, provide timely case-costing feedback and encourage cost-conscious equipment selection.

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Competing interests: J. Hallet has received speaking honoraria and unrestricted grants from Novartis Oncology and Ipsen Biopharmaceuticals Canada. No other competing interests declared.

Contributors: L. Abraham, D. Kagedan, A. MacNeil, M. Cleghorn, J. Hallet, F. Quereshy and N. Coburn designed the study. L. Abraham, N. Goyert, M. Cleghorn and N. Coburn acquired the data, which L. Abraham, N. Goyert, D. Kagedan, M. Cleghorn, F. Quereshy and N. Coburn analyzed. L. Abraham, N. Goyert and N. Coburn wrote the article, which all authors reviewed and approved for publication.

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