Robotic Telepresence: Profit Analysis in Reducing Length of Stay after Laparoscopic Gastric Bypass

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BACKGROUND: With the continuing rise of health-care costs, lowering inpatient length of stay can help managers and hospital administrators cope with the financial pressures and challenges of anticipated unfavorable operating margins. The goal of this study was to assess the financial impact of postoperative robotic telerounding on length of stay of all patients undergoing noncomplicated laparoscopic gastric bypass operations.

STUDY DESIGN: We retrospectively reviewed 376 patients who underwent laparoscopic gastric bypass for morbid obesity from January 2004 to July 2006. The first 284 patients (group A) were assessed by bedside visits alone during the postoperative period. The second group (group B) consisted of 92 patients assessed by robotic telepresence combined with regular bedside visits before their discharge. Eleven patients were excluded from the study because they suffered from postoperative complications during the same admission.

RESULTS: After robotic rounds, 71 patients (77%) were discharged on postoperative day 1 (group B) and 218 patients (77%) assessed exclusively by bedside rounds were discharged on day 2 (group A). Mean length of stay was reduced from 2.33 days for group A to 1.26 days for group B. Early discharge created capacity for an additional 71 patient/days, although only 54 beds (76%) were reoccupied by new patients, representing a total financial gain of $219,578. Additionally, total room and board savings of $14,378 were realized as early discharge. Readmission rates within 7 days after discharge were 2% for group A and 1% for group B.

CONCLUSIONS: Robotic telerounding substantially reduces length of stay of patients undergoing noncomplicated laparoscopic gastric bypass operation. Telepresence technology applied in these settings had a substantial financial impact by reducing variable cost and creating capacity for growth and income. (J Am Coll Surg 2007;205:72–77. © 2007 by the American College of Surgeons)

It is well known that the current health-care system in the US is in crisis. Cost-containment policies are constantly being implemented by different sectors as survival strategies in a highly competitive market. With total health-care spending of $1.9 trillion in 2004, representing 16% of the gross domestic product, it is agreed that the current system is unsustainable unless new strategies are developed to control costs.[1] The cost of health care is expected to reach $4 trillion in 2015, or 20% of gross domestic product.[2] In addition, hospitals, which account for almost 40% of the total cost of health care, continue to cope with financial pressures and the challenge of decreasing operating margins.[3] In an environment where federal and state budget deficits result in low reimbursement, while health-care costs continue to escalate, lowering inpatient length of stay (LOS) continues to be one of the most appealing solutions for hospital managers and administrators to reduce expenses and create capacity for growth.[4]

The goal of this study was to assess the financial impact of robotic telepresence as an adjunct to standard postoperative rounds with regard to LOS in patients undergoing a noncomplicated postoperative course after laparoscopic gastric bypass.

METHODS

We retrospectively performed a chart review of all patients undergoing laparoscopic gastric bypass from Jan-

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uary 2004 to July 2006 at Sinai Hospital of Baltimore by a single surgeon. Patients who suffered postoperative complications during the same admission were excluded from this study, as LOS can be influenced by recovery from such complications.

Because we noticed considerable variance in LOS because of deployment of the robotic system, patients were grouped into those assessed and discharged by means of standard bedside physician rounds (group A) and those submitted to combined bedside and robotic rounds before discharge (group B).

The purpose of this study was to perform a profit analysis comparing the two groups' lengths of stay and identify change in profits/loss in those patients whose postoperative management was influenced by the robotic telepresence.

The financial department of the hospital calculated the average net contribution margin for every new admission by averaging all margins generated by the hospital for all patients admitted to the medical-surgical ward. All patients, regardless of their health plan or diagnosis, were included in the analysis. Readmission rates were defined as any return to the hospital ward within the first week after discharge as a result of postoperative complications.

Financial data

All financial information was obtained from the institution's financial database. Because all patients in both groups underwent the same surgical procedure, surgical cost was not analyzed. Instead, the average net contribution margin and room and board costs were the only parameters considered, as they were directly influenced by LOS. Also, no attempt was made to analyze any cost related to medication. The average net contribution margin are the results of averaging all profit margins generated from every new hospital admission, regardless of type of insurance or reimbursement.

Patient rounds

Group A was subject to bedside rounds only and group B was assessed by combining bedside with robotic rounds. Table 1 shows the type and frequencies of each assessment during the immediate postoperative period. During the preoperative meetings, patients were informed about the implementation of robotic rounding as an adjuvant to standard bedside visits. No refusal to participate in this study was recorded.

Table 1. Type of Rounds and Frequency Between Patient Groups

Patient visits	Group A (n = 284)	Group B (n = 92)
Postoperative	Bedside	Bedside
Night rounds (10 PM)	NA	Robot
Morning rounds	Bedside	Bedside
Noon rounds	NA	Robot
Early afternoon (2 PM)	NA	Robot
Late afternoon (5 PM)	Bedside	Bedside
Early night (7 PM)	NA	Robot (DC)
Early morning	Bedside	Bedside

DC, discharged; NA, not available.

Patient rounds were conducted in standard bedside fashion during the immediate postoperative period by the attending surgeon. A complete physical examination, including evaluations of all wounds, vital signs, urine output, and respiratory function, was performed to obtain a full assessment of a patient's status. In addition, robotic telerounding took place the night of operation in group B, to identify any circumstances that might result in delay of discharge, such as dehydration, inadequate pain control, or poor ventilation status. This assessment included real-time audio and visual communication with the patient, electronic chart review through the control station, and final discussion with nursing staff about patient treatment. Patients were encouraged to demonstrate adequate lung function by reaching a target goal of 1,000 mL using the portable spirometer.

The morning after operation, standard rounds were once again conducted in all patients, as explained previously, followed by two robotic telerounding sessions during afternoon hours in group B. Patients were discharged from the hospital once discharge criteria were met (Table 2).

Remote presence

The system consists of a robotic mobile unit, known as RP7 (Intouch Health), which is accessed remotely by client software running on a Windows-based control station computer. The 6-foot-tall robot, equipped with a 15-inch flat screen, two high-resolution cameras, and a directional microphone, uses an advanced proprietary video conference system to conduct a two-way communication session with the remote console. Access to the public Internet or the hospital Ethernet is achieved over

Table 2. Discharge Criteria after Laparoscopic Gastric Bypass

Patient able to tolerate water
Nausea controlled
Pain no more than 3 out of 10
Incentive spirometer ≥ 1,000 mL
Ambulatory
Afebrile
Urine output ≥ 50 mL/h
Pulse no more than 95 bits/sec

an 802.11-G wireless network. The videostream broadcast by the robot is rendered by the client software in a 320 × 240 pixels window, with an encoding rate that ranges from 300 to 700 kb/s displaying video images up to 30 frames/s. Similar algorithms are used to render real-time video images generated from the control station computer to the robot flat screen. The remote control station computer was also capable of transmitting radiographs to the robot screen and conveyed this information to the patient. During each session, the physician at the control station is able to drive the robot to the patient's room, emulating an on-site experience (Fig. 1). Robot mobility is enabled by three spheres (not wheels) located at the base of the unit, allowing the device to move forward, backward, and sideways.

Connectivity from outside the hospital campus was secured through virtual private network protocols (Cisco Systems, Inc). Patient information was protected at all times by ensuring data encryption through authentication, authorization, and accounting servers.

RESULTS

From October 1, 2004, to June 30, 2006, a total of 387 patients underwent Roux-en-Y gastric bypass for morbid obesity. The first 284 patients (group A) were assessed in a traditional format, which involved bedside visits alone during the postoperative period. The second group (group B) consisted of 92 patients who were assessed by robotic rounds in addition to traditional bedside visits.

A total of 11 patients were excluded, 5 from group A and 6 patients from group B, because of complications during the same hospital admission. These complications included postoperative bleeding (n = 7), ileus (n = 2), hepatitis (n = 1), and death (n = 1).

The hospital accounting department calculated the average contribution margin for any new admission at $3,800. This figure represents the average profit of all new hospital admissions, with the exception of those admitted to the ICU, regardless of their health plan or diagnosis. Total savings for early discharge resulted from avoiding room and board cost of an extra day. Room and board cost at Sinai Hospital was calculated at $203 per day.

Figure 1. RP7 making rounds at Sinai Hospital.

Robotic rounds resulted in 71 patients (77%) being discharged on postoperative day 1 (group B), and 218 patients (77%) assessed exclusively by bedside rounds were discharged on day 2 (group A). No patients in group A were discharged on the first postoperative day. Use of robotic rounds through telepresence reduced the mean LOS from 2.33 days to 1.26 days (Table 3).

Although early discharge created capacity for an additional 71 beds, only 54 (76%) were reoccupied by a new patient, contributing $205,200 incremental income and $14,378 in room and board savings (Table 4). There were a total of seven patients readmitted because of postoperative complications within the first postoperative week. Readmissions for group A were related to

Table 3. Timing of Patient Discharge

	Nonrobotic (standard)		Robotic rounds	
Discharged on POD	**n**	**%**	**n**	**%**
1	0	0	71	77
2	218	77	18	20
3	48	17	3	3
4	12	4	0	0
5	3	2	0	0
6	1	0	0	0
7	2	1	0	0
Totals	284	100	92	100

POD, postoperative day.

dehydration (n = 5) and pneumonia (n = 1), although 1 patient was readmitted from group B because of postoperative bleeding.

DISCUSSION

Although hospital administrators have often seen the length of hospitalization as an important factor in health-care economics, there is still much controversy about whether reducing LOS actually results in a decrease in hospital costs.[5]

The goal of this study was to assess the financial impact of using robotic technology on LOS of patients undergoing uncomplicated laparoscopic gastric bypass operation.

Several studies have demonstrated the importance of using clinical pathways to reduce LOS.[6,7] By following standardized protocols, variances in treatment are minimized, cost is reduced, and patient outcomes are improved.[8] In our study, robotic telepresence ensured that all medical recommendations and outlined pathways were carried out in a timely manner that resulted in early patient discharge. These include early ambulation and an improved response from the floor staff to administer antiemetics and analgesia medication. Although the interaction between the robot and the patient was not the focus of this article, we have noticed a similar response, such as that in the study conducted by Ellison and colleagues,[9] in which robotic telerounding was associated with increased patient satisfaction. This is particularly true when a physician is not physically present in campus and patients need to be assessed, treated, or eventually discharged home.[10]

A 5-day readmission rate was chosen arbitrarily to assess outcomes directly influenced by early discharge. Any postoperative complication beyond that time period, which prompted a readmission, would have probably occurred regardless of early patient discharge.

Table 4. Profit Analysis after Early Patient Discharge

Total patients	92
Patients DC on day 1	71 (77)
New adm after early bariatric DC on day 2	54 (74)
Contribution margin ($3,800/case), $	205,200
Room and board savings/d ($203), $	14,378
Total contribution, $	219,578

Values in parentheses are percentages.
adm, admission; DC, discharged.

Table 5 represents the annual financial forecast based on patient throughput from 1 surgeon practice (AG). The author's total experience with laparoscopic gastric bypass includes more than 500 patients. To avoid the variability produced by the learning curve, the first 100 of the author's patients were not considered in this analysis.[11]

Assuming that the average number of gastric bypass patients per day for a solo practitioner remains constant (1 patient per day) and LOS is reduced to 1.07 days, robotic telepresence can contribute with 167.86 new beds available for admissions that can accommodate 133 new potential inpatient admissions:

Additional days/new length of stay = new admissions: 167.86/1.26 = 133 new admissions

Annual savings associated with room and board could be projected by multiplying all new available beds by the cost per day, as shown:

Additional days × $203 = annual room and board savings: 167.86 × $203 = $34,076

Annual contribution margin generated, by additional 133 new admissions, is projected as:

Additional new admission × contribution margin new admission: 133 × $3,800 = $505,400

Knowing that only 76% of the all new beds are filled before a new billing cycle commences, the annualized total profit margin is adjusted as:

$504,400 × 0.76 = $384,104

In order for an early discharge to make a financial impact, the new admission has to take place before a new billing cycle commences. At Sinai Hospital this takes place at midnight.

Cost and maintenance of the robot have been calculated as $5,000 per month. This figure is applied to the final calculation to compute the net return on investment:

Table 5. Annual Financial Forecast (Solo Practitioner) Using Robotic Telepresence for Early Patient Discharge

LOS assumptions	
Analysis period (d)	365
Mean no. of patients/d	1.0
Historical	
Average LOS	2.33
Patient days (current)	365
Patient cases	156
New	
Average LOS	1.26
Patient days (current)	197
Change	
Average LOS	1.07
Patient days (current)	167.86
Patient cases	133
Financial return	
For current patients, savings	
Daily savings ($)	203
Days saved	167.86
Annual total ($)	34,076
New patients, contribution	
Case contribution ($)	3,800
New cases	133
Annual total ($)	505,400
Beds filled before new cycle (%)	76
Annual total ($)	384,104
ITH and related system costs ($)	
Monthly total cost	5,000
Annual total	60,000
Annualized benefit	358,180

ITH, Intouch Health (robot); LOS, length of stay.

Annual room and board savings for early discharge = $34,076

Annual contribution margin of new admissions = $384,104

Annual robotic cost and maintenance = $60,000

Annualized benefit $358,180

Although an earlier study conducted by Taheri and colleagues[12] concluded that "cutting off" the last day of an inpatient stay has little impact on overall cost of care, our study does show substantial revenue when there is an opportunity to treat highly reimbursed new admissions. In economic terms, the possibility of accepting a new patient as a result of reduced LOS and creating additional hospital capacity is known as "opportunity cost."

From a payor's standpoint, reducing LOS using a DRG reimbursement or capitation approach might not have any financial benefit. Using any mechanism, such as robotic telerounding, to reduce LOS will be welcome in a fee-for-service system, as is usually seen in nonsurgical specialties.[13] From provider and hospital's perspective, any strategy that will result in decreased LOS is directly related to profits.[14]

Like most corporations, our institution uses the weighted average cost of capital to represent the return on investments. The hospital administrators normally use this information for capital budgeting purposes.[13] The financial data here indicate a total annual projected net benefit of approximately 597% (358,180/60,000 × 100), which is considerable, compared with the hospital weighted average cost of capital of 11%, making robotic telepresence an interesting and profitable investment.

In summary, our study showed that robotic telepresence had a substantial positive financial impact by reducing variable cost (room and board) and by creating opportunity cost. Close patient monitoring through remote telepresence can help anticipate events that can otherwise prolong hospitalization. By increasing frequency of rounding, patients were prompted and "coached" on several tasks, including incentive spirometer, pain control, nausea management, and ambulation. Robotic telepresence, combined with clinical pathways, shows a potential benefit in improving hospital operating margin by lowering LOS, increasing capacity, and improving quality by reducing practice variability.

Author Contributions

Study conception and design: Gandsas
Acquisition of data: Gandsas, Parekh
Analysis and interpretation of data: Gandsas, Tong
Drafting of manuscript: Gandsas, Parekh, Bleech
Clinical revision: Gandsas, Parekh

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REFERENCES

1. Hadley J, Holahan J. Covering the uninsured: how much would it cost? Health Aff (Millwood) 2003;Suppl Web Exclusives:W3-250−265.
2. Thorpe KE, Knickman JR. Financing for health care. In: Kovener AR, Jonas S, eds. Jonas and Kovner's health care delivery in the United States. 6th ed. New York: Springer Publishing; 1999;46–89.
3. Borger C, Smith S, Truffer C, et al. Health spending projections through 2015: changes on the horizon. Health Aff (Millwood) 2006;25:w61–73. Epub February 22, 2006.

4. Herrle G. Reducing inpatient length of stay: the time has come to revisit this discarded strategy. Available at: http://www.milliman.com/pubs/Healthcare/content/consultants_corner/Reducing-InPatient-Length-Stay-CC.pdf. Accessed July 28, 2006.
5. Carey K. Hospital cost containment and length of stay: an econometric analysis. South Econ J 2000;67:363–380.
6. Huerta S, Heber D, Sawicki MP, et al. Reduced length of stay by implementation of a clinical pathway for bariatric surgery in an academic health care center. Am Surg 2001;67:1128–1135.
7. Stellato TA, Hallowell PT, Crouse C, et al. Two-day length of stay following open Roux-En-Y gastric bypass: is it feasible, safe and reasonable? Obes Surg 2004;14:27–34.
8. Ferri LE, Feldman LS, Stanbridge D, et al. Patient perception of a clinical pathway for laparoscopic foregut surgery. J Gastrointest Surg 2006;10:878–882.
9. Ellison LM, Pinto PA, Kim F, et al. Telerounding and patient satisfaction after surgery. J Am Coll Surg 2004;199:523–530.
10. Petelin JB, Nelson ME, Goodman J. Deployment and early experience with remote-presence patient care in a community hospital. Surg Endosc 2007;21:53–56.
11. Schauer P, Ikramuddin S, Hamad G, et al. The learning curve for laparoscopic Roux-en-Y gastric bypass is 100 cases. Surg Endosc 2003;17:212–215.
12. Taheri PA, Butz DA, Greenfield LJ. Length of stay has minimal impact on the cost of hospital admission. J Am Coll Surg 2000; 191:123–130.
13. Reinhardt UE. Spending more through 'cost control:' our obsessive quest to gut the hospital. Health Aff (Millwood) 1996; 15:145–154.
14. Carey K. Hospital cost containment and length of stay: an econometric analysis. South Econ J 2000;67:363–380.