Cost-effectiveness of ambulatory surgery in Cali, Colombia

DONALD S SHEPARD,1 JULIA WALSH,2 WOLFANG MUNAR,3 LAURA ROSE,2 RODRIGO GUERRERO,4 LUIS F CRUZ,5 GUILLERMO REYES,5 GAIL PRICE6 AND CARLOS SOLARTE7

1Brandeis University, Waltham USA, 2Harvard School of Public Health, Boston USA, 3Health Secretariat, Atlantida Province, Colombia, 4City of Cali, Colombia, 5Fundacion Carvajal, Cali, Colombia, 6Department of Health and Hospitals, Boston, USA and 7Unidad Regional de Salud, Cali, Colombia

To compare the cost and effectiveness of a system of simplified ambulatory surgery against traditional inpatient surgery, we studied a surgical procedure commonly performed in both settings – non-recurrent elective inguinal herniorrhaphy. We compared the 17 operations performed in an 'intermediate health unit' (IHU) or outpatient hospital in Cali, against the 15 performed in a traditional secondary hospital from mid-January through mid-April, 1989. Pre-surgical characteristics of the patients were similar. After the operation, the IHU patients had few complications, were more satisfied, and resumed their usual activities sooner than the hospital patients (34 versus 52 days, respectively). The average cost per procedure was US$39.12 in the IHU as compared to US$148.76 in the hospital – a four-fold difference. Intermediate health units seem to offer important advantages for uncomplicated surgery in both cost and outcome.

Introduction

Among 29 developing countries for which consistent data were available, an average of 57% of public recurrent health expenditures was spent on hospital care. Colombia, according to a 1984 study, used 67% of these funds on hospital care.1 All curative services typically consume 80% of health resources in developing countries.2,3 Faced with shrinking public sector budgets and mandates to expand preventive and promotive health services, policy makers are always searching for ways to deliver curative services more efficiently.

To enhance efficiency, the types and sophistication of curative services have to be carefully matched to patient need. In Cali, Colombia's third largest city with 1.5 million inhabitants, previous studies of surgical services have shown that reorganizations offered substantial opportunities for greater efficiency.4-6 Cali's operating rooms, one of the most expensive hospital resources, had a mean utilization of only 42% in 1974; other expensive resources were also used inappropriately. In the university hospital, the tertiary hospital for the city and surrounding region, 69% of the surgical operations were in the two least complex levels, whereas only 2% were in the most complex category.5

In response to these data, university and government officials in Cali developed a new type of health facility in 1983, an intermediate health unit (IHU) or 'health centre-hospital', and instituted an innovative surgical technology called 'simplified ambulatory surgery', which is practised primarily in IHUs.7-13 Primary care facilities (health posts and centres) refer most surgical, and obstetric and selected medical cases to IHUs, which in turn refer cases they cannot treat to secondary and tertiary hospitals.7

Simplified ambulatory surgery was designed to diminish the costs of low to intermediate-risk surgical procedures without decreasing the quality of care. This surgery provides preoperative patient education, early ambulation and discharge (generally on the day of surgery), and family home care. The operating rooms are furnished only with equipment needed for a carefully-defined set of uncomplicated surgical procedures. Few medical personnel are assigned to each operation. Furthermore, operating
rooms are equipped with two operating tables, which could permit two surgical procedures to be performed simultaneously in the same operating room, under the supervision of a single anaesthetist. A 1975 study predicted that the system would lower costs by 75%, compared to traditional care in the university hospital with a 3-day hospitalization. It would also be more efficient than standard ambulatory surgery, in which the surgery uses the same facilities and personnel as traditional inpatient surgery. A leading public health journal praised the system’s potential to use existing resources more efficiently. This study is a controlled evaluation of the costs and effectiveness of simplified ambulatory surgery as it is routinely practiced in Cali, a decade after its implementation.

Methods

Study setting

When this study began in 1989, Cali’s public health system had three secondary hospitals and four IHUs. The study sites were Hospital San Juan de Dios (SJD), a 127-bed secondary-level hospital, and Centro Hospital Joaquin Paz Borrero (JPB), an IHU with 20 beds. Both facilities were representative examples of their type of institution. In 1988, the IHU performed approximately 1100 operations of all types, while the hospital performed 3500. Both facilities covered their operating costs through a combination of patient fees and government subsidy.

Selection of procedure and patients

Inguinal herniorrhaphy was selected because of the frequency with which it is performed at both facilities, its moderate degree of technical complexity, and the existence of standardized indices of surgical risk at both facilities. Eight percent of each facility’s operations were herniorrhaphies. This study included all patients aged 16 years or older with a low surgical risk, who received an elective inguinal herniorrhaphy (which was not for a recurrent or incarcerated hernia) in the three months from January to mid-April, 1989. Thirty-two patients met these criteria: 17 at the hospital and 15 at the IHU. In theory, all uncomplicated cases should be treated as the IHU, and only complicated cases referred to the secondary hospital. In practice, uncomplicated cases were also treated at the hospital, due to previously established patterns of referral or utilization.

We compared the two groups of patients on demographic and medical characteristics (sex, age, per capita income, education, underlying pathologies, previous hospitalization, household size, and preoperative pain expectation). The auxiliary nurse who admitted the patients interviewed all available patients on the day of admission (the day before surgery at the hospital, and the day of surgery at the IHU) about these characteristics.

Measures of effectiveness

Using indicators similar to those in previous evaluations of surgery, we compared effectiveness of the two settings based on complication rates, patient satisfaction, and duration of postoperative disability. Trained Colombian health professionals assessed complication rates until the eighth post-operative day through systematic abstraction of patients’ medical records. We assessed several components of patient satisfaction through a second and third survey. The second survey was generally conducted at the facility in which the surgery had taken place, one week after surgery, when the patient returned for his surgical follow-up visit. If the patient did not report for his follow-up visit, however, we tried to interview the patient at home. At this stage, we also asked patients about their out-of-pocket costs.

The third interview took place at the patient’s home in August, 1989, four to seven months after the surgery. The second and third interviews were conducted by Colombian medical students who were not employed by either study facility. We assessed the period of convalescence at the second and third survey - the patient’s expectation at one week after surgery, and the actual experience four to seven months later.

Average cost per herniorrhaphy

To fully capture health system costs related to the site of care, we measured each patient’s health care costs, from the patient’s admission to the facility for surgery until the eighth post-operative day. We excluded costs of diagnostic tests and examinations, which were done prior to admission in both settings. We assessed direct service costs in each department of each facility.
that provided care and the associated overhead costs (such as administration, cleaning, and building maintenance). We determined direct service costs in the operating and recovery rooms for both facilities, and also in the surgical ward for the hospital.

Direct service costs consisted of medical supplies (sutures), general supplies (disinfectant, gauze), which could not be readily assigned to an individual procedure, personnel, and the finance for medical equipment. Costs of medical supplies were obtained by multiplying the utilization of each item for the surgeries in the study (obtained from abstraction forms completed by nurses and technicians in each facility, and direct observation) multiplied by their unit costs. Costs of general supplies, personnel, and depreciation were allocated to a single hernia repair, based on the ratio of the average time for a single herniorrhaphy (estimated as the mean for study patients in each facility), compared to the total time that the operating room was in use for all procedures during the year (derived from each facility's operating room log-books). Financial records of each institution provided financial data. All monetary amounts were valued in July 1988 prices converted to US dollars at the then exchange rate of 307 Columbian pesos (COP) per dollar.

Results

Patient characteristics and clinical outcomes

Although patients at the hospital tended to be older, there were no statistically significant differences between the means of the two groups on any of the preoperative patient characteristics examined (that is, the chance probability was at least 10%) (Table 1).

The study provided no evidence of inferior quality at the IHU. The inpatient group actually had higher rates of both surgical and anaesthetic complications. Among the 17 hospital patients, three had surgical complications (two wound infections and one haematoma) and four had anaesthesia complications (two failed anaesthesia, one intraoperative hypotension, one perforation of duramater). No complications were reported among the fifteen IHU patients.

<table>
<thead>
<tr>
<th>Variables*</th>
<th>Hospital (N = 13)*</th>
<th>IHU (N = 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>69%</td>
<td>66%</td>
</tr>
<tr>
<td>Female</td>
<td>31%</td>
<td>34%</td>
</tr>
<tr>
<td>Age (years)</td>
<td>57.4 ± 6.1</td>
<td>45.0 ± 4.8</td>
</tr>
<tr>
<td>Years of education</td>
<td>4.4 ± 0.7</td>
<td>4.6 ± 0.7</td>
</tr>
<tr>
<td>Household size</td>
<td>5.1 ± 0.7</td>
<td>4.7 ± 0.7</td>
</tr>
<tr>
<td>Total monthly household expenditures:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colombian pesos</td>
<td>72843 ± 14785</td>
<td>77056 ± 12634</td>
</tr>
<tr>
<td>US dollars</td>
<td>237 ± 48</td>
<td>251 ± 41</td>
</tr>
</tbody>
</table>

*Statistical significance of differences between the two groups revealed P > 0.10 for all variables shown. Means ± standard error of the mean.
* Data unavailable for four hospital patients who were not interviewed.

Patient satisfaction

Patients treated at the IHU tended to be more satisfied than those at the hospital at both assessments (Table 2). At the eighth post operative day, patients at the IHU expected to spend less time away from work than those treated in the hospital. The follow-up survey confirmed that IHU patients had, indeed, returned to work sooner. Because of the small sample size, none of the differences are statistically significant, although they consistently favour the IHU. No complications requiring rehospitalization were reported among the 26 patients followed post-operatively from both groups. Conservatively, these results indicate that the IHU outcomes were at least as good as those in the hospital.

Personnel involved

While the total number of personnel present during the hernia operations at the two types of facilities was comparable (5.5 in hospital and 6.1 in IHU), the mix differed. The hospital had almost twice as many physicians including residents for surgery and anaesthesia, as the IHU (3.5 versus 2.0), but only half as many nurses and technicians (2.1 versus 4.1). Thus the IHU relied more heavily on less costly personnel. The IHU had almost twice as many nurses and technicians as the hospital.
Table 2. Postoperative results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hospital (N = 17)</th>
<th>IHU (N = 15)</th>
<th>Difference (Hosp-IHU)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>At eighth postoperative day</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived stay was too long</td>
<td>15%</td>
<td>0%</td>
<td>15% + +</td>
</tr>
<tr>
<td>Satisfied with appearance of scar</td>
<td>46%</td>
<td>80%</td>
<td>-34% *</td>
</tr>
<tr>
<td>Would have preferred alternative type of facility</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Postoperative perception of severity of pain*,**</td>
<td>3.1 ± 0.8</td>
<td>2.8 ± 0.7</td>
<td>0.3 ± 1.1*</td>
</tr>
<tr>
<td>Expected number of days from operation to resume usual activity**</td>
<td>52 ± 14</td>
<td>35 ± 9</td>
<td>17 ± 17*</td>
</tr>
<tr>
<td><strong>At 4-7 months†</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days after surgery to return to regular activity**</td>
<td>56 ± 7</td>
<td>49 ± 6</td>
<td>7 ± 9†</td>
</tr>
<tr>
<td>Days after return until all limitations ended**</td>
<td>53 ± 19</td>
<td>23 ± 11</td>
<td>29 ± 23†</td>
</tr>
<tr>
<td>Total days with any limitation**</td>
<td>108 ± 23</td>
<td>72 ± 14</td>
<td>36 ± 27†</td>
</tr>
<tr>
<td>Patient satisfied with length of hospitalization**</td>
<td>64% ± 15%</td>
<td>77% ± 12%</td>
<td>-13% ± 19%°</td>
</tr>
</tbody>
</table>

*On a scale from 1-5 of increasing severity
**Mean ± Standard Error of Mean
†5 hospital and 1 IHU study patients had moved from Cali region or were otherwise not available for interview
°°Borderline statistical significance (P = 0.12 with Yates continuity correction)
•Difference not statistically significant.

Average cost per herniorrhaphy

The average cost of an inguinal herniorrhaphy was US$39.12 (12010 COP) at the IHU and US$148.76 (45 668 COP) at the hospital – almost a four-fold difference. When the cost of hospitalization was excluded, the cost of the procedure is three times greater at the hospital than at the IHU. The largest differences occur in three categories: overhead costs, personnel costs, and surgical ward costs (Table 3). The average length of the operations (from incision to closure) performed at the hospital was 37 minutes compared to 26 minutes at the IHU. Because computations of costs in both facilities involved allocating shares of total operating room and surgical ward costs to sample patients, standard statistical tests on cost differences would not be meaningful.

Patients’ costs

The facility’s charge to the patient for the operation and follow-up care was US$38.96 (12 000 COP) in the hospital and US$16.23 (5000 COP) in the IHU. In addition, patients had to pay for some of the drugs and supplies, raising their total medical charges to US$44.07 and US$18.77, respectively. Thus, patient charges represented 30 and 48% of costs, respectively. Patients’ transportation expenses were also greater in the hospital (US$5.06) than the IHU (US$1.38), so out-of-pocket costs were 2.5 times higher in the hospital (US$49.13) than for the IHU (US$20.15). For the average patient in each setting, these out-of-pocket costs represented 21% of monthly household expenditures for hospital patients, but only 8% for IHU patients.

Table 3. Medical care cost per inguinal herniorrhaphy by type of facility

<table>
<thead>
<tr>
<th>Cost category</th>
<th>Hospital</th>
<th>IHU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating and recovery rooms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct service costs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personnel</td>
<td>57.96</td>
<td>39.0</td>
</tr>
<tr>
<td>General supplies</td>
<td>1.04</td>
<td>0.7</td>
</tr>
<tr>
<td>Medical supplies</td>
<td>2.79</td>
<td>1.9</td>
</tr>
<tr>
<td>Equipment depreciation</td>
<td>1.72</td>
<td>1.2</td>
</tr>
<tr>
<td>Overhead costs</td>
<td>51.58</td>
<td>34.7</td>
</tr>
<tr>
<td>Subtotal</td>
<td>115.08</td>
<td>77.4</td>
</tr>
<tr>
<td><strong>Surgical ward</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>148.76</td>
<td>100.0</td>
</tr>
</tbody>
</table>
A worker earning the minimum wage of US$3 per day would have to work 16 days to pay for the heavily subsidized hospital operation, compared to only 7 days for the less subsidized IHU procedure.

Discussion

This study has found that an elective inguinal herniorrhaphy costs 74% less at an IHU than at a secondary level hospital. The IHU’s lower cost is due to both its shorter time for the surgery (probably due to its standardized protocols), and its lower cost-per-minute. The average direct service cost-per-minute of operating room time is US$1.99 (610 COP) at the IHU compared to US$3.14 (965 COP) at the hospital. Both the savings in operating room costs and the overall proportional savings from simplified ambulatory surgery are consistent with the previously mentioned predictions from 1975.8 Shorter hospitalization and devaluation have also lowered the cost of inpatient surgery compared to 1975.

The generalizability of the clinical outcomes is somewhat limited by the modest sample size in each facility, the absence of randomization, and the inclusion of only one facility of each type. These design characteristics could not, however, change the direction of our findings. Although eligibility criteria for the study produced generally comparable samples of patients in the two settings, hospital patients tended to be older (though not significantly so) and might have had more undocumented risk factors for complications. Even if adjustment for such characteristics could have explained all, or most, of the complications in the hospitalized patients, it would only equalize the risk-adjusted complication rates between the two settings. As no complications were observed in the IHU, its estimated complication rate would always remain the lowest possible value, zero.

Sensitivity analyses showed that neither sample variation nor the absence of randomization could explain the lower cost of the IHU. To examine the impact of sample variation, we obtained independent estimates of the duration of a hernia repair from separate samples of 19 consecutive herniorrhaphies taken from operating room log-books during three to four randomly chosen weeks at each institution. The mean time was 43 minutes for hospital surgeries versus 34 minutes taken for IHU operations. As complicated hernias were not excluded from these samples, the times were longer than those of study patients. Recalculating costs using these times, the hernia repair still cost 70% less in the IHU than in the hospital.

To estimate the largest possible bias that the absence of randomization would have introduced, we assumed that in a randomized study, hospital patients would have spent as little time as IHU patients in the operating room (26 minutes) and in postoperative ward care (0 days). Even under these implausible assumptions, an operation in the IHU would remain 52% less costly than in the hospital. The IHU retains its cost advantage largely because its cost-per-minute for the operating room (both direct service and overhead) is considerably lower.

Previous studies have reached conflicting conclusions regarding the relative costs of ambulatory and traditional surgery. A randomized clinical trial found ambulatory surgery to be cost-effective for certain types of surgery.24 Most studies found that when surgery is performed at a hospital and the patient is hospitalized, the costs exceed similar procedures performed on an outpatient basis, because in the latter case, the cost of hospitalization is saved.32-31 Studies which compare the cost of performing ambulatory surgery at a hospital with the cost at a free-standing clinic, however, have not always found savings.32-33

With increased utilization, surgery in both an IHU and a secondary hospital could become more efficient. Because virtually all operating and recovery room expenses except those for supplies are fixed, a higher volume of services will lower the average cost per procedure. In 1988, the occupancy rates of Cali’s surgical services were 56% in IHUs and 60% in secondary hospitals.34 If both occupancy rates were raised to 90%, the average cost of an elective herniorrhaphy would drop to US$25.40 in the IHU and US$111.67 in the secondary hospital.

While an IHU might have been expected to exhibit lower quality than a more sophisticated hospital, the complication rates demonstrate the
opposite, probably a result of the systematic protocols for simplified ambulatory surgery. The results from the IHU are consistent with the complication rate in a larger series in a comparable IHU in Cali (the only other such data we are aware of). Carlos Carmona IHU had a 2.3% complication rate in 1431 consecutive ambulatory surgeries through 1988 (Wooley, unpublished data). Assuming this same rate applied to hernia repair in JPB, 0.3 complications would have been expected among the 15 herniorrhaphies studied: in fact, zero were observed. The IHU's advantage in patient satisfaction adds to findings in other populations showing one-day surgery to be comparable to traditional surgery in quality, and acceptable to consumers.13-19

From a social viewpoint, ambulatory surgery at the IHU entailed considerable advantages over inpatient hospital surgery. An average IHU patient saved US$3.68 in transport costs, gained 7 days of his time (through earlier resumption of his usual activities), and reduced the time and expenditure his family and friends spent visiting the hospital and assisting in the patient's care. These are slightly offset by the one extra day a family member was estimated to spend caring for an ambulatory surgery patient at home (approximately by the length of stay of the hospitalized patients). On balance, the patient and his family gain at least 6 days from ambulatory surgery. Most importantly, the easier access to, and lower charges at IHU's, may encourage patients to have hernias and other health problems diagnosed and treated more promptly.

Simplified ambulatory surgery and other IHU functions can be adapted to various organizational and physical settings. Although surgeons in Joaquin Paz Borrero receive salaries from the local government, in another IHU, the surgeon is paid fee-for-service directly by patients. While the newer IHUs were specially built, older ones were upgraded from health centres.

**Conclusion**

Reflecting its commitment to IHUs, Cali officials opened a fifth IHU after this study began, and plan to open a sixth one this year. Building on Cali's experience, Mexico has started to establish similar units. A WHO consultation which reviewed this experience recommended that cities carry out a situation analysis to help establish reference health centres (its term for IHUs) in appropriate locations.

In conclusion, uncomplicated hernia operations in intermediate health units cost only a quarter of what they would in a traditional hospital. Outcomes, complication rates, patient satisfaction, and return to work were comparable, if not superior, in IHUs. Cali's IHUs provide services organized around similar principles for other surgical services and obstetrics with, presumably comparable results.

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Biographies

Donald S Shepard PhD, completed doctoral studies in public policy at the Kennedy School of Government, Harvard University. Dr Shepard was formerly Associate Professor and is now Adjunct Professor at the Harvard School of Public Health. His current research includes studies on health financing and cost-effectiveness in both the US and developing countries, including an evaluation of the health and population activities of the Carvajal Foundation in Cali.

Julia Walsh, MD, DTPH, is a Lecturer in international health at the Harvard School of Public Health.

Wolfgang Munar, MD, MS, is Vice-Minister of Health at Atlantic Province, Colombia, and an adjunct faculty member of Universidad del Norte, Barranquilla, Colombia.

Laura Rose, MS, is a doctoral candidate at the Harvard School of Public Health.

Rodrigo Guerrero, MD, Dr PH, is Mayor of the City of Cali.

Luis F Cruz, MD, MSP, is Executive Director of the Carvajal Foundation.

Guillermo Reyes is a medical student at Universidad del Valle, Cali, Colombia.

Gail Price, MS, is Assistant to the Commissioner of Health, City of Boston, Massachusetts.

Carlos Solarte, MD, MAS, is Director of Planning of the City of Cali, Colombia.

Correspondence: Dr Donald S Shepard, Research Professor, Institute for Health Policy, Brandeis University, Heller School, Waltham, MA 02254-9110, USA.