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Costs of surgical procedures in Indian hospitals

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ABSTRACT

Objective: Despite a growing volume of surgical procedures in low-income and middle-income countries, the costs of these procedures are not well understood. We estimated the costs of 12 surgical procedures commonly conducted in five different types of hospitals in India from the provider perspective, using a microcosting method.

Design: Cost and utilisation data were collected retrospectively from April 2010 to March 2011 to avoid seasonal variability.

Setting: For this study, we chose five hospitals of different types: a 57-bed charitable hospital, a 200-bed private hospital, a 400-bed district hospital, a 655-bed private teaching hospital and a 778-bed tertiary care teaching hospital based on their willingness to cooperate and data accessibility. The hospitals were from four states in India. The private, charitable and tertiary care hospitals serve urban populations, the district hospital serves a semiurban area and the private teaching hospital serves a rural population.

Results: Costs of conducting lower section caesarean section ranged from rupees 2469 to 41 087; hysterectomy rupees 4124 to 57 622 and appendectomy rupees 2421 to 3616 (US$1=rupees 52). We computed the costs of conducting lap and open cholecystectomy (rupees 27 732 and 44 142, respectively); hernia repair (rupees 13 204); external fixation (rupees 8406); intestinal obstruction (rupees 6406); amputation (rupees 5158); coronary artery bypass graft (rupees 177 141); craniotomy (rupees 75 982) and functional endoscopic sinus surgery (rupees 53 398).

Conclusions: Estimated costs are roughly comparable with rates of reimbursement provided by the Rashtriya Swasthya Bima Yojana (RSBY)—India's government-financed health insurance scheme that covers 32.4 million poor families. Results from this type of study can be used to set and revise the reimbursement rates.

ARTICLE SUMMARY

Article focus

- The present study estimated the costs of 12 surgical procedures commonly conducted in five types of hospitals in India from April 2010 to March 2011.
- Given the budget and time constraints, we selected the most frequently performed procedures from different types of operating theatres of each study hospital and calculated the procedural cost from the provider perspective, using the micro-costing method.

Key messages

- Procedure-specific cost information is necessary for developing suitable reimbursement to healthcare providers and for resource allocation decisions within the healthcare system. However, planners have inadequate knowledge of the costs of surgeries. This study provides the cost of conducting 12 different surgical procedures in Indian hospitals from April 2010 to March 2011.
- Costs of conducting lower section caesarean section ranged from rupees 2469 to 41 087; hysterectomy rupees 4124 to 57 622; and appendectomy rupees 2421 to 3616 (US$1=rupees 52). We computed the costs of conducting lap and open cholecystectomy (rupees 27 732 and 44 142, respectively); hernia repair (rupees 13 204); external fixation (rupees 8406); intestinal obstruction (rupees 6406); amputation (rupees 5158); coronary artery bypass graft (rupees 177 141); craniotomy (rupees 75 982) and functional endoscopic sinus surgery (rupees 53 398).
- The estimated costs are roughly comparable with the rates of reimbursement provided by the Rashtriya Swasthya Bima Yojana (RSBY)—India's government-financed health insurance scheme that covers 32.4 million poor families. Results from this type of study can be used to set and revise the reimbursement rates.

INTRODUCTION

Developing countries have not considered surgical care a public health priority,[1] even though conditions that need to be surgically treated—cataracts, obstructed labour, symptomatic hernias—add a significant burden of ill health to their populations.[2–4] In these countries, surgery lies at one end of the spectrum of the curative medical model because of its perceived high cost and the limited human and material capacity available for its performance.[5] The global volume of surgery has recently been estimated at 234 million surgical procedures annually, and a very conservative estimate shows that 11% of the world's disability-adjusted life-years are

ARTICLE SUMMARY

Strengths and limitations of the study

- We used a previously validated micro-costing method to calculate the cost of conducting different types of surgeries in Indian hospitals.
- The cost calculation was based on the average time per procedure. Average time can differ from the actual time, especially in critical cases, but serves as a good proxy.
- We focused only on procedural cost, not on presurgery and postsurgery costs. Patient follow-up was beyond the scope of our study and that of the hospitals' recordkeeping systems.

from conditions that require surgical interventions. But surgical services are unequally distributed, with only 26% of operations occurring in developing countries, which account for 70% of the world's population.[1 6]

Surgical procedures are expected to assume an increasingly important role in public health in both developed and developing countries.[7] In 2011, pregnancy-related complications caused an estimated 273 500 maternal deaths globally, of which 99% occurred in developing countries and 65% occurred in just 11 of these countries, including India. In the developing world, the most common aetiology of maternal death is obstructed labour. In the majority of cases, the risks posed by obstructed labour can be averted only by operative delivery of the fetus, most often by caesarean delivery.[8] Policies that would ensure free universal access to caesarean section require information on the cost of performing caesarean sections in a country's hospitals, but no such information is available for India. Cost information is unavailable for conditions such as hernia repair and appendectomy, conditions that, if neglected, pose a serious threat to life and for injuries from road traffic accidents, a significant proportion of which are best treated surgically.

Information on costs of surgical services can be used for monitoring the efficiency of service delivery, making resource allocation decisions involving surgery, and setting reimbursement rates to providers.[9] In India, hospital services are increasingly used both by those paying out of pocket as well as by beneficiaries of the government-supported insurance scheme Rashtriya Swasthya Bima Yojona (RSBY), which covers the cost of both inpatient and surgical services. RSBY, the country's largest government-backed hospital-based health insurance scheme, covers 32.4 million poor families, provides rupees 500 per day for inpatient stay, and covers more than 725 surgical procedures.[10] However, for many procedures, reimbursements to hospitals are insufficient to cover costs, and hence there are revisions in the payment rates.[11]

Costing studies could inform payment rates but are rarely conducted. For example, the costing studies on surgical procedures in India deal only with cataract surgery.[12 13] In this study, we estimated the costs of different surgical procedures in Indian hospitals. To the best of our knowledge, this study is the first attempt to estimate the costs of different types of surgical procedures for Indian hospitals.

METHODS

Study design

We conducted a unit cost analysis of medical services using a micro-costing approach from the provider perspective.[14] *Unit cost* refers to the cost of providing a single good or service, be it the cost per outpatient visit or cost of a particular surgical procedure. Microcosting is a valuation method where the unit of analysis is an individual patient or service. The method attempts to measure costs of services as accurately as possible by including all fixed and variable costs of care given the institutional structure within which the care has been given.

Study hospitals

In India, the government healthcare services are organised into several levels such as subcentres, primary health centres (PHCs), community health centres (CHCs), district hospitals and tertiary care hospitals.[15] Subcentres are the first contact point between the community and the primary healthcare system while PHCs are the first contact point between the community and a medical officer. CHCs generally have 30 inpatient beds with one operating theatre, a laboratory, x-ray facilities and a labour room. At the district level, the government maintains a 150-bed or a higher bed-sized district hospital and the tertiary care hospitals generally provide care to the inpatients referred from the primary or secondary healthcare facilities. Apart from that, private hospitals provide a significant part of medical care in India; currently, this sector delivers about 80% of all outpatient care and 60% of all inpatient care.[15]

For this study, we chose five hospitals of different types: a 57-bed charitable hospital, a 200-bed private hospital, a 400-bed district hospital, a 655-bed private teaching hospital and a 778-bed tertiary care teaching hospital based on their willingness to cooperate and data accessibility. The district and tertiary care teaching hospitals are government hospitals, and the charitable hospital is funded by a charitable trust. The hospitals were from four states in India. The private, charitable and tertiary care hospitals serve urban populations, the district hospital serves a semiurban area and the private teaching hospital serves a rural population.

Surgical procedures

We selected two or three of the most frequently performed procedures from different types of operating theatres of each study hospital and calculated the procedural cost from the provider perspective, using the micro-costing method.[14] The cost of each surgical procedure comprises three main categories: preoperative,

operative and postoperative. It should be noted that we focused only on the operative cost, not on the preoperative and postoperative costs, because following up on patients was not possible, given our time and budget constraints and the hospitals' record-keeping systems. For the same reason, we chose only the most frequently performed procedures from the operating theatres of the study hospitals; we did not seek to calculate the cost of all procedures.

Data collection

All data were collected retrospectively for the financial year 2010–2011 (April 2010 to March 2011) in order to avoid seasonal variations. The main sources of data were the accounts and activity reports of the study hospitals. Annual recurrent expenditure data, which included salaries, drugs and medical supplies, office supplies, fuel and lubricants, laboratory and radiology materials, communications, water, electricity and telephone charges, were collected from the annual expenditure report of the study hospitals. Lists of equipment, furniture, etc were collected from the individual department stock register. Operating theatre statistics were taken from the theatre register. The details regarding individual procedure was obtained by interviewing surgeons, operating theatre nurses and anaesthetists.

Costing method

Costing started with the estimation of the operational cost of the operating theatres of our study hospitals. Operational costs include both direct and overhead costs. Direct cost was calculated as the sum of the labour, capital and materials cost. Labour cost comprises the salaries and fringe benefits of all staff involved in the operating theatres (regular and contract). Comprehensive information about the surgeons, anaesthetists, nurses and the ground level support staff involved in each operating theatre of the study hospitals was taken from the hospital payroll and confirmed by the hospital administrators. For operating theatre staff who also served other divisions, such as the outpatient or inpatient departments, labour costs were apportioned based on the working time in each division as reported by the operating theatre in-charge.[16] Capital costs of the operating theatre include the annualised discounted depreciation cost of the building (area under the operating theatre), furniture, vehicle, equipment and instruments used in the operating theatres and the opportunity cost of the land. Recent government contracts for purchasing equipment, instruments and furniture were used to get the price information of capital items. Based on the government of India income tax depreciation rule, we calculated the useful life of the building, equipment and furniture.[17] The useful life of buildings and structures was considered to be 10 years (this is under the category of buildings other than those used mainly for residential purposes); the useful life of furniture and fittings was assumed to be 10 years and that of machinery and plant, 7 years. However, for some lifesaving medical equipment such as the heart lung machine, colour Doppler, ventilator, etc, the useful life was considered to be 2.5 years.[17] A 3% discount rate was used to calculate the cost of depreciable assets and the interest rate on the 1-year government bank fixed deposit rate was used to calculate the opportunity cost of land.[18 19] The materials cost covers drugs, medical supplies, office supplies and utilities (water, telephone, electricity and Internet charges). It includes the actual usage of materials by the operating theatres during the study period. Utilities costs were distributed based on the allocation criteria.[19 20] For example, the electricity cost of the operating theatre was calculated based on the floor area of the operating theatre, and the telephone cost was distributed based on the number of personnel in the operating theatre. To assign the other overhead costs, such as administration, nursing administration, laundry, kitchen, maintenance, transport, blood bank and store, we devised allocation criteria that would be appropriate for our study hospitals based on either the literature or our knowledge about the particular hospital. For example, laundry charges, meal charges, maintenance, transport and sterilisation costs were the actual spending of the operating theatres, administration/nursing service; office expenses were distributed based on the full-time equivalent; water, cleaning services and sanitation charges were distributed based on the floor area. The simultaneous equation method was used for overhead cost distribution.[14] In this method, we made full adjustment for the interaction of overhead departments and solved a set of simultaneous linear equations to make the allocations to the operating theatres. Hence, the operational cost of the operating theatres includes not only direct costs but also the distributed overhead costs, known as indirect costs.

Costing of surgical procedures

The staff time required for each procedure started with the time it takes the ground-level staff to clean the theatre and accessories, as well as preparing the theatre for the procedure. Ground-level staff bring the patient to the operating theatre; nurses and anaesthetists then prepare the patient for the surgery and perform related activities during the procedure. Doctors perform the procedure. Finally, the ground-level staff take the patient out of the theatre. Several common pieces of equipment, such as Boyle's trolley and suction apparatus, are used in all procedures; hence, to determine the equipment cost, we first listed the equipment required for each procedure and then noted the time of usage of each piece. It should be mentioned in this context that for the staff time and equipment usage time in each procedure, average time was considered. For example, external fixation time depends on the type of fixation: finger fixation took 30 min of the surgeon's time in the study hospital, whereas pelvis fixation could take up to 2 h. For cost calculation, we took the average time, and we used average costs for fixators and equipment use as

well. Similarly, finger amputation took a minimum 20 min of the surgeon's time in the study hospital, but below-knee amputation took up to 2 h. Again, we took the average as reported by the surgeons and anaesthetists to calculate the cost of amputation. The time spent by each member of the surgery team and the usage time of all equipment for each procedure were determined from interviews with the doctors and theatre nurses. The drugs and materials used was based on the actual usage for a particular procedure. Every such item used by the operating team was identified, including drugs for anaesthesia and all medical supplies, such as gloves, masks, caps, syringes, catgut, vicryl and cotton rolls. The corresponding unit prices of all drugs and materials were also collected. Some hospitals have a specific list of drugs and medical supplies for each procedure; we used those lists in calculating the materials cost of each procedure. For hospitals that did not maintain such lists, we asked the anaesthetists and theatre nurses about the drugs and medical supplies they used. For some shared materials such as cleaning solutions, which are used for all procedures, the nurses reported the approximate fraction they used for individual procedure and the cost was calculated accordingly. Each procedure consumed a fraction of the total overhead cost of the operating theatre; thus, we calculated the overhead cost for each procedure by using the proportion of time taken by that procedure.

RESULTS

Basic information about the study hospitals during our study period are presented in table 1. The occupancy rate of the study hospitals ranged from 42% (in the charitable hospital) to 80% (in the private teaching hospital). The staffing of the study hospitals covered both the salaried and contract staff. For example, the district hospital had 24 doctors (including 3 in contract service), 98 nurses (including 22 in contract service), 36 paramedical staff (including 3 in contract service) and 90 nonclinical support staff (including 22 in contract service). The private hospital also hired nursing and ground-level support staff on a contract basis during this period.

The operating costs, outputs and average cost per procedure at the study hospitals' operating theatres during the 1-year study period are presented in table 2. Data for the charitable hospital indicate that the total number of surgical cases was 319, of which lower segment caesarean section accounted for 93%. The average cost per procedure at the charitable hospital operating theatre was rupees 41 607. The total number of surgeries performed in the general operating theatre of the district hospital was 3623, of which LSCS accounted for the most, followed by hysterectomy, appendectomy and hernia repair. In the emergency operating theatre of the district hospital, a total number of 7718 dressings were performed. The average cost of dressing at the emergency theatre was rupees 147. Among 3219 surgeries performed in the general operating theatre of the tertiary care hospital, 2270 were categorised as major surgeries of which lap cholecystectomy accounted for the most, followed by open cholecystectomy. Other surgeries performed included mastectomy, cleft lip and palate, skin grafting, hernia repair and prostatectomy. At the emergency operating theatre, total surgical cases were 4446, of which 2569 were general surgical emergencies and 1877 orthopaedic emergencies. Among the general surgical emergencies, the common procedures were intestinal obstruction and appendectomy; in orthopaedic emergency, the commonly performed procedures were external fixation of compound fracture and traumatic amputation. The average costs of surgery at the emergency and ophthalmic operating theatres at the tertiary care hospital were rupees 3585 and 3490, respectively, while the same at the orthopaedic operating theatre was rupees 11 642 and at the general surgery operating theatre, rupees 8551 (table 2). Among 2508 surgeries performed in the general operating theatre of the private hospital, craniotomy and functional endoscopic sinus surgery (FESS) were most frequently performed; other surgeries included spine fixation, lap cholecystectomy and hernia repair. In the cardiothoracic operating theatre, the majority of cases were coronary artery bypass graft (CABG). Of the 2055 major surgeries performed in the gynaecology and obstetrics operating theatre of the private teaching hospital, 59 per cent were LSCS. The average cost per procedure at the gynaecology operating theatre was rupees 5958.

In table 3, we present the costs of 12 different procedures. The labour, capital and drugs and materials cost are presented separately for each procedure. Labour cost was the single largest component of total direct cost for all procedures except for hernia repair, external fixation and CABG. For these three procedures, drugs and materials costs dominated. For hernia repair, hernia mesh was the highest-cost item, and for external fixation, fixators cost the most. In the charitable hospital, the indirect cost (ie, the overhead support from other departments) was higher than the direct cost.

We also compare the different cost components for the same procedures across hospitals (table 3). The cost of conducting LSCS was lowest (rupees 2469) in the district hospital and highest in the charitable hospital (rupees 41 087) (US$ 1=rupees 52). The hysterectomy cost was lower at the district hospital than in the charitable and the private teaching hospitals, and the cost of appendectomy was lower in the district hospital than in the tertiary care hospital (rupees 2421 vs 3616).

Even though the RSBY rates are not strictly comparable with our cost estimates, we use these rates as reference and found that in some cases the RSBY rates are lower than our estimates and in others, vice versa (table 3). For example, the RSBY rate is rupees 12 000 for lap cholecystectomy, rupees 9000 for FESS and rupees 28 000 for CABG.[10] In all these cases, the RSBY rates are much

Table 1 Basic information about the study hospitals (April 2010–March 2011)

	Charitable hospital	Private hospital	District hospital	Private teaching hospital	Tertiary care hospital
Number of beds	57	200	400	655	778
Occupancy rate (%)	42	59	65	80	72
Total staff	108	671	248	620	1067
Doctors	12	103	24	139	237
Of whom surgeons	3	31	8	46	77
Nurses	22	135	98	107	212

lower than our estimates. On the other hand, the RSBY rate for appendectomy (rupees 6000) and average rates for amputation (rupees 9658) and external fixation (rupees 13 000) are higher than our estimates.

DISCUSSION

The study presents the procedural cost of surgeries in Indian hospitals from the provider perspective. In India, some cost estimates are available for cataract surgery,[12 13] but no information has been available about the cost of several other surgeries—LSCS, appendectomy, hernia repair and traumatic amputation—which, if performed at the right time, can save many lives. This study provides such cost estimates. Except for hernia repair, external fixation and CABG, the major direct cost component is labour cost, which varies from 7% (for LSCS at the charitable hospital) to as high as 81% (for lap cholecystectomy at the tertiary care hospital). In several other studies, labour cost dominated, for example, in Pakistan, 40% of the total cost of conducting LSCS was spent on staff salaries.[21] The labour cost is lower at the charitable hospital than in other hospitals because the salary structure at this hospital is lower than the prevailing market rate.

Calculated from a representative sample, surgery-specific costs can be a basis for developing a fee structure or provider payment rate for both private and public hospitals in India. The cost information from this study can help hospital administrators understand the efficiency of their system and set charges (especially at private hospitals, which charge specific amounts for different medical services). The study also helps policymakers in setting or revising provider payment rates. When we compare our cost estimates with the RSBY rates, we find that the latter are roughly comparable with our estimates. However, it should be mentioned in this context that the RSBY rates include the cost of hospital stay, drugs and medical supplies, and diagnostic tests, whereas our estimates consider only the procedural cost; thus, the rates are not strictly comparable. Nevertheless, policymakers can use the results to set and revise the provider payment rate. Assuming that the payment rate might not include the capital cost, we did

Table 2 Operating theatres, by hospital (April 2010–March 2011)

Operating theatre	Total operating cost (rupees)	Output	Unit cost (rupees)
Charitable hospital			
Gynaecology and obstetrics	13 272 532	319	41 607
Private hospital			
General	68 306 946	2508	27 236
Cardiothoracic	65 793 051	533	123 439
District hospital			
General	10 051 495	3623	2774
Ophthalmic	3 265 834	1239	2636
Emergency	1 137 671	7718	147
Private teaching hospital			
General	46 806 271	2768	16 910
Gynaecology and obstetrics	12 243 615	2055	5958
Tertiary care hospital			
General	27 526 490	3219	8551
Orthopaedic	20 781 051	1785	11 642
Ophthalmic	10 673 179	3058	3490
Cardiothoracic	15 757 241	471	33 447
Emergency	15 941 060	4446	3585

Table 3 Cost components of surgical procedures in the study hospitals (rupees 2011) (US$1=rupees 52)

Procedure	Operations (n)	Person-time (minutes)	Labour cost (rupees)	Capital cost (rupees)	Drugs, materials cost (rupees)	Direct cost (rupees)	Indirect cost (rupees)	Unit cost (rupees)	Reference (RSBY rate)	Difference (%)
Lower section caesarean section (LSCS)									6000	
Charitable hospital	282	101	3044	720	1516	5280	35 807	41 087		585
Cost component (%)			7	2	4	13	87	100		
District hospital	2028	68	1266	87	376	1729	740	2469		–59
Cost component (%)			51	4	15	70	30	100		
Private teaching hospital	1220	70	3520	254	2660	6434	1551	7985		33
Cost component (%)			42	4	32	78	22	100		
Hysterectomy									10 000	
Charitable hospital	12	159	4792	899	1714	7405	50 217	57 622		476
Cost component (%)			8	2	3%	13	87	100		
District hospital	416	93	1732	122	1035	2888	1235	4124		–59
Cost component (%)			42	3	25	70	30	100		
Private teaching hospital	138	96	4828	351	2944	8123	1958	10 081		0.81
Cost component			48	3	29	80	20	100		
Appendectomy									6000*	
District hospital	196	69	1285	193	218	1695	725	2421		–60
Cost component (%)			53	8	9	70	30	100		
Tertiary care hospital	771	66	2312	240	799	3351	265	3616		–40
Cost component (%)			64	7	22	93	7	100		
LSCS+tubal ligation									Not available	
Charitable hospital	15	105	3164	720	1516	5401	36 624	42 025		
Cost component (%)			7	2	4	13	87	100		
Hernia repair									10 000	
District hospital	154	98	1825	227	7196	9248	3956	13 204		32
Cost component (%)			14	2	54	70	30	100		
Intestinal obstruction									9000	
Tertiary care hospital	899	126	4414	303	1219	5936	470	6406		–29
Cost component (%)			69	5	19	93	7	100		
External fixation									13 000†	
Tertiary care hospital	547	96	3363	309	4117	7789	617	8406		–35
Cost component (%)			40	4	49	93	7	100		
Lap cholecystectomy									12 000	
Tertiary care hospital	472	64	22 464	1473	1713	25 649	2083	27 732		131
Cost component (%)			81	5	6	92	8	100		
Amputation									9658†	
Tertiary care hospital	390	80	2803	276	1701	4780	378	5158		–46
Cost component (%)			54	5	33	92	7	100		
Open cholecystectomy									10 000	

Continued

Table 3 Continued

Procedure	Operations (n)	Person-time (minutes)	Labour cost (rupees)	Capital cost (rupees)	Drugs, materials cost (rupees)	Direct cost (rupees)	Indirect cost (rupees)	Unit cost (rupees)	Reference (RSBY rate)	Difference (%)
Tertiary care hospital	186	96	33 695	2031	5100	40 827	3315	44 142		341
Cost component (%)			76	5	11	92	8	100		
Coronary artery bypass graft									28 000‡	
Private hospital	255	190	25 989	15 662	61 311	102 961	74 180	177 141		533
Cost component(%)			15	9	35	59	41	100		
Craniotomy									23 000§	
Private hospital	162	173	41 468	2776	6253	50 497	25 486	75 982		230
Cost component (%)			54	4	8	66	34	100		
Functional endoscopic sinus surgery									9000	
Private hospital	112	98	23 490	4937	7060	35 487	17 910	53 398		493
Cost component (%)			44	9	13	66	34	100		

*Appendectomy rate is the rate under general surgery.
†External fixation and amputation rates are the average rates.
‡Coronary artery bypass graft rate is under procedures requiring bypass techniques.
§Craniotomy rate is the rate for Burr hole.

a recalculation excluding the capital cost from the operational cost of the operating theatre and from the procedural cost. We found that the costs of surgical procedures at the charitable hospital decline significantly excluding capital cost (LSCS from rupees 41 087 to 8838; hysterectomy from rupees 57 622 to 12 608). For other hospitals, the decline in procedural costs ranges from 9% to 46%. Therefore, this type of costing study helps policymakers to decide whether the reimbursement rate should include capital cost and/or indirect costs (overhead).

The study demonstrates that a detailed costing of hospital operations in India is feasible and this study helps hospital administrators to run their business more efficiently. The average costs of procedures at different operating theatres of the study hospitals can be used to monitor the efficiency of the hospitals and operational cost can help in better resource utilisation. For example, even though the operational costs of the surgical units of the charitable hospital and the private teaching hospital were not significantly different, there were huge differences in the average cost per procedure (rupees 41 607 at the charitable hospital vs rupees 5958 at the private teaching hospital). One of the reasons was the number of surgeries performed by these two hospitals during our study period. While there were only 319 procedures performed at the charitable hospital, the number was 2055 at the private teaching hospital. Therefore, the charitable hospital administrator should examine the reasons for the low caseloads at the operating theatre.

Even though it is feasible to conduct this detailed costing study in India, the biggest challenge lies in collecting data from the hospitals. Although accounts data can be accessed relatively easily, obtaining accurate activity statistics, stock-related data and price information is difficult. The operating theatres of the study hospitals (especially government hospitals) maintained statistics for the total number of surgeries performed every month but did not keep records of the types of surgeries performed; researchers had to go through the operating theatre registers and count the surgeries by type for the study period. Moreover, some hospitals did not have proper stock registers of equipment, furniture or instruments. Hence, improvements in the hospital record-keeping could help researchers conduct cost studies in Indian hospitals, which in turn will help hospitals to run their system more efficiently.

Although very time-consuming because of the level of detail required, we used the micro-costing method because it provides a valid, reliable estimate of final costs.[22 23] However, some limitations of the present study should be mentioned. First, the cost calculation was based on the average time taken for each procedure. Average time can differ from the actual time, especially in critical cases, but because it was not possible to track every case, average time was the best alternative. Second, we focused only on procedural cost, not on presurgery

and postsurgery costs, because following up on patients was not possible, given our time and budget constraints and the hospitals' recordkeeping systems. For the same reason, we chose only the most frequently performed procedures from the operating theatres of the study hospitals; we did not seek to calculate the cost of all procedures. Finally, donated items have not been considered in the cost calculation. Shepard *et al*[16] have argued for the inclusion of donated items in cost analyses, since hospitals or wards with more donated items may appear more efficient than their peers, even though their actual efficiency may be the same. Because the study hospitals did not keep any record of donated items, we excluded them from our calculation, but the cost estimates of the study hospitals would have been different had they been included.

CONCLUSIONS

The present study provides the cost of conducting 12 different surgeries in Indian hospitals from the provider perspective using the micro-costing approach. This type of cost estimate can be used for different types of policy decisions, such as setting fee schedules and planning for reimbursement. Constraints on conducting such a study in India include data unavailability, poor recordkeeping and hospitals' reluctance to share detailed data. Nevertheless, it is possible to conduct costing studies in India. Furthermore, our study results are roughly comparable with the RSBY rates; therefore, for revising the provider payment rate under programmes like RSBY, a larger scale study should be undertaken in a representative sample of hospitals in India. Also, this type of study can be extended to estimate the cost-effectiveness of different surgical procedures—something we did not address, given our time and budget constraints. An extension of this study to calculate the cost-effectiveness of different surgical interventions might help policymakers rethink the perception that surgery is not cost-effective and hence should not be given priority in public health, particularly in developing countries.

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