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Cost of a cardiac surgical and a general thoracic surgical patient to the National Health Service in a London teaching hospital

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ABSTRACT The cost of the inpatient stay for a typical aortic valve replacement and for an oesophagectomy were determined by recording and costing every aspect of the patients' care from admission until discharge. This method of cost calculation was found to be satisfactory and could be used by other centres to allow comparisons between hospitals or countries. At St Thomas's Hospital in 1977 the cost of a cardiac operation was £2755, an oesophagectomy £1870, and a general surgical operation £564.

In 1977 the St Thomas's Health District (Teaching) was faced with the need to economise in running costs. Attention was focused on the more expensive specialties, such as renal dialysis and open heart surgery, with a view to keeping the overall cost at the current level.

It became clear that the facts were not available for deciding whether this would be an effective economy measure. There was no information on exactly how much an open heart surgical patient cost the NHS in 1977 nor was it known how this cost compared with that of a non-cardiac thoracic patient. There was no question of limiting operations for the latter group. There was also no information on how this cost should be assessed in the NHS in Britain. The cardiac surgical costs in 45 American hospitals have been surveyed but the methods of breakdown of costs were not detailed (Marty *et al*, 1977).

A study was therefore set up by the district finance officer (KDM). It was decided to cost only the inpatient stay. An aortic valve replacement was chosen as a typical example of an open heart operation. The thoracic surgical operation chosen was an oesophagectomy carried out by a general surgeon at the hospital. Every aspect of each patient's care was then carefully recorded and costed from the moment of admission until discharge. A member of the finance department team was present at each operation and covered the stay in the intensive care unit and in the wards.

Assessment of costs

The assessment of the cost for each patient was split into three main sections: fixed patient costs, specific operation costs, and non-specific operation costs.

FIXED PATIENT COSTS

Fixed patient costs (table 1) were those necessarily incurred by any patient on that service occupying a bed for a given time. "Hotel service" included catering, domestic cleaning, portering, and laundry and linen services; "estate management"—engineering works, fuel, light and power, building work, and general estate expenses—for instance,

Table 1 *Fixed patient costs for aortic valve replacement and oesophagectomy. (For explanation see text)*

	Cardiac £	*Oesophagectomy* £
Nursing staff	537	365
Hotel services	261	314
Medical staff	203	190
Estate management	173	207
Administration	112	134
Professional and technical staff	93	79
Radiology	88	91
Pathology	47	58
Physiotherapy	43	40
Other service departments	35	42
Miscellaneous	4	5
Radiotherapy	—	89
Totals	£1596	£1614

rates; "administration services"—medical records, hospital administration, and general training; "other service departments"—social work and occupational therapy; and "miscellaneous"—staff accommodation and meals.

The cost of nursing the cardiac patient (£537) was greater than that for the oesophageal patient because of the cardiac patient's three-day stay in the intensive care unit. The cost of the medical staff, professional and technical staff, and physiotherapy were all higher than for the oesophageal patient for the same reason. The hotel services, estate management, administration, other service departments and miscellaneous costs were higher for the oesophageal patient purely because he was in hospital four days longer. Radiology (£91) and pathology (£58) were higher for the oesophageal patient because of the greater use of these service departments compared with the cardiac patient's costs of £88 and £47 respectively. The patient having the oesophagectomy underwent a course of radiotherapy (£89) which the cardiac patient did not. These fixed patient costs therefore depended primarily on the length of stay.

SPECIFIC OPERATION COSTS

Specific operation costs (table 2) were medical supplies and equipment. In this particular study they consisted of a prosthetic valve, extracorporeal circuitry and pacemaker wires, and special equipment, of which a proportion was charged to each case. These costs would vary depending on whether an artificial valve was used, type of extra-corporeal circuit chosen, and whether or not pacemaker wires were used, the variation depending on the surgeon and the specific operation. In this instance they totalled £780 for the cardiac patient. The cost of a general thoracic surgical operation varies little from case to case in terms of medical supplies and equipment because these are negligible.

NON-SPECIFIC OPERATION COSTS

Non-specific operation costs did not vary significantly between one open heart case and another, nor between different thoracic surgical cases (table 3). They refer to all general medical supplies and equipment (except the prosthetic valve pacemaker wires and extra-corporeal circuitry), pharmacy staff, and drugs, and a proportion of the salaries of the heart-lung machine technicians. The costs were higher for the cardiac (£286) than for the oesophageal patient (£193), and this amount would be expected to remain constant no matter who carried out the operation in each of these fields. The difference however was small (£93).

Table 2 *Specific operation costs for aortic valve replacement and oesophagectomy. (For explanation see text)*

Medical supplies and equipment	*Cardiac* £	*Oesophagectomy* £
Xenograft valve	438	
Extracorporeal circuitry	200	
Pacemaker wires	96	
Proportion of special equipment	46	
Total	£780	Nil

Table 3 *Non-specific operation costs of aortic valve replacement and oesophagectomy*

	Cardiac £	*Oesophagectomy* £
General medical supplies and equipment	195	86
Pharmacy—staff and drugs	68	107
Heart-lung machine technicians	23	—
Totals	£286	£193

Comparison of costs of the two operations shows that the main difference between the two (£885) was in the specific operation costs (£780 for the cardiac case, none for the oesophagectomy) (table 4).

Table 4 *Total costs of aortic valve replacement and oesophagectomy*

	Cardiac £	*Oesophagectomy* £
Fixed costs	1596	1614
Specific operation costs	780	—
Non-specific operation costs	286	193
On cost for district headquarters at 3·5%	93	63
Total	£2755	£1870

Comparison of costs of cardiac and oesophageal patients with the cost of an average St Thomas's inpatient

The information obtained was converted into cost per patient and compared with the cost of the average inpatient at St Thomas's Hospital for the financial year ending March 1977, 15% being added for inflation. Table 5 analyses the cost per day of the cardiac patient, the oesophageal patient, and an average inpatient. The cardiac patient was in hospital for 20 days and the oesophageal patient for 24 days. The average inpatient stay, both surgical and medical, was 10·3 days in 1977. The cost per day of the cardiac patient was

Table 5 *Comparison of cardiac and oesophagectomy inpatient day costs with average of St Thomas's Hospital inpatient day costs for the financial year 1976–7+15% inflation*

	Cardiac £	*Oesophagectomy* £	*General* £
Medical and nursing staff salaries, equipment, and drugs	94.75	36.33	23.91
Pathology and radiology	8.20	7.79	4.24
Physiotherapy etc	2.45	3.67	0.71
Catering, laundry, cleaning	28.50	28.29	24.68
Meals	0.80	0.79	0.63
District HQ costs	4.65	2.63	1.85
Total cost per day	£137.75	£77.92	£54.76

£137.75, the oesophageal patient £77.92, and the average inpatient £54.76.

The greatest cost variation among the three cases is in the first item because it includes the specific and non-specific operation costs in tables 2 and 3 and the fixed patient cost relating to nursing and medical salaries. All these were significantly greater in the cardiac patient (£94.75). than for the general thoracic patient (£36.33) and of course were very different from those of the average inpatient (£23.91). Pathology, radiology, and physiotherapy costs were similar in both the cardiac (£10.65) and thoracic patients (£11.46) but were almost double that of the average patient (£4.95). The other items in table 5 were related directly to the length of stay, except for the extra charges due to the higher standards of cleanliness in the operating theatre and the intensive care unit.

The total cost of the cardiac patient staying 20 days was £2755, the oesophageal patient staying 24 days £1870, and the average patient staying 10·3 days £564 (table 6).

Table 6 *Comparison of cost of cardiac and oesophagectomy cases with average cost of St Thomas's Hospital inpatients for the financial year 1976–7+15% inflation*

	Cardiac £	*Oesophagectomy* £	*General* £
Direct treatment services/ supplies	1895.00	872.00	246.18
Diagnostic services	164.00	187.00	43.67
Other medical and paramedical services	49.00	88.00	7.34
General services	570.00	679.00	254.27
Meals	16.00	19.00	6.53
District HQ at 3·5%	93.00	63.00	19.07
Total cost per case	£2755.00	£1870.00	£564.00

Discussion

Districts seeking economies in their hospital services because of financial stringency in the NHS have inevitably looked at the most expensive areas. They may be tempted to propose reductions in the work of cardiac surgical units, on the basis of the correct impression that an open heart operation costs more than any other. This may not take into account the amount by which the cost of the operation differs from a major general surgical or thoracic procedure that would not be under consideration for cuts. Nor may it take into account the value in teaching and innovation of a cardiac surgical unit to a hospital and its attractiveness to doctors, nurses, and auxiliary staff.

This study has attempted to cost a typical open heart surgical operation, the method having been developed arbitrarily because there was no publication on the technique of costing. The results were analysed in two ways. The fixed patient costs, which were incurred by any patient undergoing this type of surgery, depended primarily on the length of stay of the patient in the hospital and did not differ significantly between the cardiac and oesophageal patient. The oesophageal patient stayed four days longer in hospital (24 days compared with 20 days) than the cardiac patient, but the fixed costs were higher per day for the cardiac patient because of the increased cost of nursing, medical, professional, and technical staff in the intensive care unit where the cardiac patient stayed for three days. The oesophageal patient underwent a course of radiotherapy.

The specific operation costs were those that depended on the individual type of operation carried out within the type of surgery specified. They varied depending on the surgeon and the operation. For instance, the valve replacement used in this case was a mounted xenograft valve, the most expensive type. Pacemaker wires were used, and also one of the more expensive oxygenators. These costs did not apply to the oesophageal patient. The specific operation costs were therefore £780 greater for the cardiac patient than for the general thoracic patient. If the operation chosen had been coronary artery bypass grafting, the difference would have been only £342 as no valve would have been used.

The non-specific operation costs—general medical supplies, pharmacy, and heart-lung machine technicians—were rather higher in the cardiac patient. They remain constant for each individual operation, irrespective of who performs the operation.

A second analysis assessed the cost per day of each operation and compared this with the daily cost of the average patient, either medical or surgical. The overall daily cost of the cardiac patient was almost twice that of the oesophageal patient and almost three times that of the average patient.

When the daily cost was multiplied by the number of days that the three groups were in hospital (20, 24, and 10·3 days respectively), the total cost for a cardiac surgical operation amounted to £2755, £885 more than for the major thoracic patient, and £2191 more than for the average inpatient. The main reason for the difference between the cardiac and the oesophageal patient was the specific operation costs. Many cardiac and thoracic operations can be performed with a hospital stay of a good deal less than 24 days. The total cost is then considerably smaller because of reduction of the cost elements that depend on length of stay.

Hospital charges for cardiac operations in America have been recently reported (Marty *et al*, 1977). In the first six months of 1976, 417 bills of patients undergoing aortic valve replacement or coronary artery surgery were collated from 45 American hospitals. The mean hospital stay was 16·4 days. The variation in charges was wide, the middle 50% ranging between $5914 (£3360 at 1976 rates of exchange) and $10 315 (£5861), with a mean of $8905 (£5060). The operation and immediate postoperative period accounted for 38% of the total charges. The hospital accounting systems, and therefore the assessment of the true cost as compared with what the patient was charged, however, were not known to us.

The charges for a cardiac surgical operation in four French hospitals averaged 19 419±5757 francs (£2300±£682 at 8·44 francs to the £) and in two Japanese hospitals 2 532 631±1 869 776 yen (£5073±£3745 at 495·25 yen to the £) (Marty *et al*, 1977). The cost of disposable American open heart surgery equipment and valves is higher outside America by as much as 10–300% according to two manufacturers quoted.

The methods of costing a cardiac surgical operation in the NHS in Britain are necessarily different from the American system of quoting charges. Two other hospitals in Britain have attempted to cost their cardiac surgical operations —the Southampton Western (Monro *et al*, 1978) and the London Hospital (Thick *et al*, 1978). The techniques chosen at the Southampton Western and St Thomas's were similar—a "typical" patient was carefully followed through his entire hospital stay and his use of disposable equipment, drugs, and hospital facilities was determined. The size of the units and their work loads were roughly comparable but the calculated cost of the Southampton patient to the NHS, after allowing for the length of stay which was three days shorter, was £490 less than at St Thomas's. At the London Hospital (Thick *et al*, 1978) the study was retrospective and reported the average cost of a group of patients, in contrast to the Southampton and St Thomas's studies which were prospective and specific to one patient. The average cost of a selected group of 148 valve replacements was determined by subtracting operating theatre and ITU costs from total hospital costs over a one-year period to arrive at the cost of a hospital bed-day. The mean stay of their group was 33·9 days. To this was added a calculated ITU cost on the basis of the average length of stay (£371.54) and theatre costs calculated from a percentage of total staff, disposable equipment, and drug costs (£632.25). The estimated cost of a valve replacement from this retrospective study was £1999.54.

In these three studies it is not possible to compare exactly one hospital with another as the techniques have been somewhat different, but it would appear that the cost of a major open heart operation to the NHS in Britain lies between £2000 and £2700. The cost, however, of an oesophagectomy on a general surgical firm at St Thomas's was £1800. Major surgery is expensive.

The cost of a major surgical operation to the NHS today compares well with the charges made abroad but it is nevertheless considerable and an open heart surgical operation is more expensive than any other. It is tempting therefore for districts to multiply the figure arrived at for the cost of an individual open heart operation by, say, 100 and to propose that diminishing the cardiothoracic service by 100 operations would save the district, in this case, £275 500. This arithmetic can be applied only when operating theatres are not used, some consultants, registrars, housemen, and technicians on the cardiothoracic unit withdrawn, beds left empty, and nursing staff transferred. The actual saving, as the information detailed here shows, is clearly otherwise much less because the costs of an occupied bed, theatre time, and medical, nursing, and technical salaries continue, general thoracic surgery replacing the number of cancelled open heart operations. By the same token the larger the number of cardiac surgical operations carried out, the smaller the cost per case, as overheads remain the same. In the American series, however, hospitals with 600 open heart operations a year charged no less than

those performing 200 procedures (Marty *et al*, 1977).

We have made no attempt to argue the cost effectiveness of cardiac surgery in returning cardiac patients to work from State and hospital dependence. Our main object is to propose a method of calculating costs of a surgical operation so that other centres performing the same operation or centres comparing the cost of different operations may arrange their data in an analogous pattern. In this way, true assessment of relative costs in different hospitals, cities, and countries may be made.

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