

PAPERS AND ORIGINALS

Disease cost in a surgical ward

D R HARPER

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Data relating to the cost of caring for individual patients were collected for all patients in a general surgical ward over a six-month period. From this the cost per patient was calculated for various diseases and was found to be related to duration of stay. Postoperative morbidity was important in determining cost.

A system that calculates cost by means of units based on the use of resources rather than by cash cost accounting is probably the most suitable for a clinician who has to monitor resources.

Introduction

Increased expectations in health care have been met at least in part by increased resources. This is unlikely to continue, particularly in hospital care, without assurance that resources are being used to good advantage. A clinician should be responsible for using resources to the best possible degree, since he must maintain clinical standards in the face of financial restraint. A review of resource allocation depends on a detailed knowledge of the current distribution. In hospitals attention should centre on the consultant, who initiates most if not all health-care expenditure. Consultant cost must be related to the patients treated, so that initially the care of individual patients must be costed. I have carried out a study to estimate the cost of care in a busy general surgical ward.

Patients and methods

I studied all patients passing through the professorial surgical unit of the Aberdeen Royal Infirmary in a six-month period in 1971. The unit caters for 25% of the elective and emergency surgical load of the

Aberdeen hospitals and, for the purposes of the study, was staffed at the level of the other three surgical units. A day-by-day tally of nursing dependency category,¹ drugs, and surgical and other treatment procedures and investigations was carefully recorded and collated by a nursing sister and myself.

COSTING ASSUMPTIONS

To design a disease costing system the distribution of expenditure on staff, equipment, and other resources among patients must be known. These costs fall into three categories.

(1) *Individual patient costs*—These are costs of items clearly identified with the patient ("consumables"), such as drugs and infusions.

(2) *Resource-area costs*—These derive from the patients' use of medical, paramedical, and nursing care in the investigative and treatment departments. Each resource-area cost included the appropriate proportion of overheads. Thus the ward, theatre, and each laboratory had ascribed to them the costs of rates, power, light, administration, teaching, cleaning, portering, etc, which maximised resource-area expenditure and reduced common "hotel" costs to a minimum. Differences between patients were thus highlighted.

(3) *General overheads*—These were overheads that could not be allocated and were distributed by the day to all patients. Capital costs and depreciation, though acknowledged to be important, were omitted from the study for reasons of time and simplicity.

THE UNIT OF WORK

A patient's use of resources was defined in terms of a unit of work, this being a compound of the time, skills, materials, and facilities required to perform a clinically identifiable task for a patient. Units of work based on time, grades of staff, and sometimes materials were created for all services offered by the following resource areas: ward care, dressings, theatre, radiodiagnosis, chemical pathology, haematology, bacteriology, pathology, blood transfusion service, radiotherapy, physiotherapy, electrocardiography, and pharmacy. Units of work for ward care included the work of medical and nursing staff, based on nursing dependency; dressings were averaged for all who had surgery; and theatre units were based on the time spent under anaesthesia. Blood transfusion units were based on the units of blood required, whether used or not, and no account was taken of fractionated blood products derived from whole used blood. Radiology had two unit systems, one for staff costs and the other for films and materials. These were independent variables, and the films and materials represented an appreciable proportion of the radiology costs. Pharmacy costs were partly individual costs (drugs) and partly resource-area costs

(dressings), while the balance was distributed as a day charge. In the laboratories special regard was taken of emergency and out of hours work.

All services offered by each resource area were described in terms of these work units, thus permitting the total output of the resource area over a given accounting period to be described in specific units. A unit cost could then be readily identified in clinical terms, and debiting each patient who used the resource was straightforward. Details of the method have been described elsewhere.^{2,3}

Results

Comparative costs—I found that treating acute appendicitis, renal colic, and pilonidal sinus cost about £100; generally, treatments entailing major surgery cost more and minor surgery less (table I). There was a significant correlation between cost and the duration of stay in all patients apart from those who had a cholecystectomy and choledochotomy. The correlation of age with duration of stay was less widespread, reaching significance only in cases of acute appendicitis, unilateral varicose veins, peptic ulcer, and cholecystectomy.

Postoperative morbidity—Postoperative morbidity played a major part in raising the cost of care within each group. Caring for seven patients with complications after appendicitis (mean (\pm SD) disease cost £106.0 \pm 44.5) cost on average £171.00, and in two of those cases over £250.00, although a significant difference between patients with and without a complicated course was not established. The average cost of eight cases of emergency herniorrhaphy was double the mean for the whole group. In patients with colorectal carcinoma resection and anastomosis of either right or left colon claimed far fewer resources than abdominoperineal excision of the rectum, largely due to problems that included non-healing of the perineal wound and bladder dysfunction.

Disease costs by the non-costed unit—The disease costs specified above are aggregates of costed units of work (for ward care, physiotherapy, theatre, etc) and suffer the constraint of historical costing. The computation may be stopped at the stage at which a patient's stay in hospital is described in work units, rather like a hotel bill before it is added up. Since beds are often a scarce resource, table II compares the disease cost of five groups of patients standardised to 100 bed-days. This form of disease cost appears more cumbersome initially but may well be more flexible in the long term.

Discussion

Disease costs provide the clinician with a further index with which to measure care, or perhaps they simply express differently what he already knows. The clinician can identify his use and need of resources for patients in his care. Against known facts he can control expenditure and justify investment. Such an exercise may well prove a firm ground for clinical budgeting, so that the clinician and others responsible for using resources can scrutinise their distribution and influence development more

TABLE II—No of units of each resource used in 100 bed-days by patients in five diagnostic groups

	Acute appendicitis	Peptic ulcer	Varicose veins	Inguinal hernia	Carcinoma of breast
Theatre	697	960	1717	1012	410
Drugs	3843	6231	2159	3747	2271
Ward care	467	537	311	327	413
Radiodiagnosis:					
Staff time	170	110	30	92	100
Films and materials	15	29	12	20	56
Chemical pathology	136	238	41	80	82
Haematology	102	130	98	84	166
Bacteriology	183	168	30	119	56
Pathology	136	84		25	118
Blood transfusion service	136	973		100	649
Physiotherapy	48	53		56	40
Electrocardiography		2	6	8	3
Emergency surcharge	17	12		4	4
No of patients	13.6	8.9	31.9	21.1	5.7

directly.⁴ Disease costing may also be related to the daily cost of various clinical groups such as emergency admissions, and this is useful in planning a new emergency unit. By identifying high-cost patients a clinician can examine the reasons for such expenditure retrospectively and consider how the morbidity might have been avoided or the scheduling improved. In this way disease costing relates to medical audit.

Avoiding inpatient morbidity may be a crucial factor in reducing disease costs, and this concept has important implications in training and supervising junior staff. Undiagnosed abdominal pain is common among emergency admissions, and many patients admitted for observation are never really under threat of early surgery. An important group of borderline cases exists, however, in which the patients require close observation and repeated clinical examination before a decision may be reached. Acute appendicitis is the most common provisional diagnosis, and an understandable respect for atypical presentations often leads to early surgery. If a normal appendix is found at laparotomy and no other disease isolated then an unnecessary exploration has been undertaken.⁵ A substantial increase in cost to £81.3 \pm 19.9 from £31.6 \pm 27.8 results. Apart from the unfortunate misdirection of resources, the increased disease cost indicates unwarranted upset to the patient. Emergency herniorrhaphy consumed twice the resources needed for elective repair. Acute cholecystitis was normally treated conservatively initially, with a second admission for elective surgery. When acute cholecystectomy was undertaken at the initial admission the cost was the same as the sum of the costs of the more usual policy of double admission.

Historical costs are particularly vulnerable to progress, and standard costing may be more workable if an expression of total disease cost, with a currency denominator implied, is desired. A

TABLE I—Cost per patient for each of 16 diagnostic groups in a general surgical ward in 1971. Results expressed as means \pm SD

Diagnostic group	No in group	Cost (£)	Age (years)	Men		Women	
				No	Duration of stay (days)	No	Duration of stay (days)
Acute appendicitis	54	106.9 \pm 44.5	27.4 \pm 13.5	31	7.3 \pm 3.0	23	6.9 \pm 2.8
Inguinal hernia	107	73.5 \pm 48.7	54.3 \pm 15.1	93	4.4 \pm 3.1	14	6.3 \pm 3.6
Varicose veins:							
Bilateral	49	64.0 \pm 12.0	44.7 \pm 3.6	12	3.7 \pm 1.9	37	3.3 \pm 0.7
Unilateral	51	46.8 \pm 10.0	39.2 \pm 12.2	15	2.8 \pm 1.1	36	2.7 \pm 1.5
Peptic ulcer	64	203.1 \pm 126.7	49.1 \pm 15.6	44	10.9 \pm 4.8	20	13.1 \pm 10.0
Carcinoma of breast	15	226.7 \pm 57.3	59.4 \pm 11.7			15	16.2 \pm 6.6
Cholecystitis:							
Conservative treatment	13	64.3 \pm 45.3	53.1 \pm 14.7	3	4.7 \pm 2.9	10	6.2 \pm 3.6
Cholecystectomy	37	170.1 \pm 44.2	51.6 \pm 17.5	6	10.3 \pm 2.5	31	10.0 \pm 3.6
Exploration of common bile duct	8	294.2 \pm 8.1	53.4 \pm 19.8	2	22.0 \pm 1.0	6	15.2 \pm 3.0
Prostatectomy	12	255.4 \pm 50.2	70.8 \pm 5.6	12	16.6 \pm 5.4		
Renal colic	17	103.1 \pm 92.6	47.7 \pm 15.4	14	6.7 \pm 6.8	3	10.3
Haemorrhoids	36	67.7 \pm 30.0	47.0 \pm 15.5	25	6.8 \pm 2.8	11	6.3 \pm 1.9
Abdominal pain	39	40.9 \pm 20.2	50.9 \pm 15.4	11	4.8 \pm 1.9	28	4.4 \pm 2.8
Pilonidal sinus	15	11.3 \pm 34.3	24.1 \pm 6.3	8	11.9 \pm 5.0	7	10.7 \pm 3.8
Peripheral vascular disease	24	183.3 \pm 123.7	65.1 \pm 10.8	16	17.9 \pm 11.4	8	11.63
Carcinoma of colon and rectum	11	412.2 \pm 148.1	69.3 \pm 8.1	5	31.4 \pm 17.1	6	22.8 \pm 8.2

"green pound" for health care may be required. Total disease costing in standard or historical terms, however, is still an aggregate of largely independent variables. Reducing all such variables to a single disease cost may well obscure their contribution to the care of the patient.

DISEASE COSTING WITHOUT MONEY

The question arises of whether cash cost is necessary for all applications of disease costing. If costing is to be used to monitor the distribution and use of resources, for instance, then the final stage of costing the unit of work becomes optional. A method using units of work alone simplifies costing considerably; in particular, it is much cheaper to run and avoids contentious comparisons of expenditure between departments, hospitals, and areas, since the content of work units may be nationally agreed. A hernia operation may be more expensive in Falkirk than in Birmingham either because available facilities are used inefficiently or because such facilities vary in cost. The clinician is concerned only with using efficiently what is available to him and so requires only the non-costed approach. By using units of work alone, for example, potentially scarce resources may be identified.

In table II all the resource-area units of work totals were adjusted in proportion for a hypothetical 100 bed-days for each of five diagnostic groups. Thus if a ward stopped admitting patients with acute appendicitis, then for every 13.6 patients with acute appendicitis normally admitted 100 bed-days would become available. Nearly nine patients with peptic ulcer, 32 with varicose veins, 21 with inguinal hernias, or six with carcinoma of breast could be admitted for surgery in their stead. These alternatives would fill the beds, but would other resources cope? A total of 100 bed-days of acute appendicitis uses 697 theatre units; patients with breast carcinoma would use fewer theatre units but other alternatives would require more—perhaps in the form of extra lists or staff—especially the patients with varicose veins, who would require twice as much theatre time. This might be more than the theatre could supply, so identifying a scarce resource. Ward costs would be greater for the nine patients with peptic ulcers but less for the other options. Radiology staff would have a lighter burden with all alternatives, but films and materials would be in greater demand, particularly if the six patients with breast carcinoma were substituted. Few laboratory tests would be needed by patients with hernias or varicose veins, but patients with peptic ulcers and breast carcinoma would need more haematological examinations and seven times more blood for the equivalent number of bed-days, which might well create a scarce resource. Lastly, the numerical waiting list would profit best by admitting patients

with varicose veins and least by admitting cases of carcinoma of the breast.

The example given is standardised for bed-days, but any resource could be used as a base. Analysing the use of resources by disease may point to desirable developments within existing resources. For example, if skeletal survey before mastectomy were abandoned, how many more postoperative chest radiographs could be handled? What are the implications of a shorter stay and a reduced turnover interval for resources other than beds? If ward care units of work were doubled, could we expect the same standard of care from the same staff? The ebb and flow of resource use in clinical management may be measured by this approach, even within a single consultant's practice.

In the event of the scarce resource being money—for example, when developing facilities or replacing plant is under consideration—the relative costs of units of work could be considered and updated as necessary, and the various resource areas compared. In the present study this was not done because in many departments—particularly the laboratories with research and teaching functions—the basis of accounting was more superficial and approximate than in clinical departments, although the laboratories represented on average only 7.6% of the cost of the 1205 patients studied.

A system for costing individual patients and thus each disease is workable. Its appeal lies in its ability to harmonise clinical concern with sound financial management. There are two separate stages, the first being to describe patient treatment in terms of resource work units and the second to apply cash values to these work units.

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ONE HUNDRED YEARS AGO The late trial of a parish medical officer for culpable neglect of duty, in the case of a child who died four days after the order for medical relief was delivered, and the severity of the sentence passed by the presiding judge, Lord Chief Justice Coleridge, must give rise to serious misgiving as to the justice administered. The surgeon charged with the manslaughter of the child was no doubt responsible for a neglect which, according to the medical evidence, may have contributed to the death, "caused by weakness resulting from diarrhoea"; but no attention could have saved the child's life, though it might have been prolonged for a short time. The jury gave a verdict of guilty, with a very strong recommendation to mercy. This recommendation does not seem to have influenced the judge, who sentenced the surgeon to four months' imprisonment with hard labour. The result to the medical officer must not only be total ruin as regards his position and practice, but he has been classed by the hard labour clause with the lowest class of felons, and made to bear the intolerable burden of four months' companionship with them. Surely an act of culpable negligence, without malice or criminal intention, has never before been so visited. If we compare this sentence with the judgment given almost daily in cases of the most brutal and savage attacks on defenceless women by their husbands,

beaten and kicked, often with permanent injury to life or limb, and with every intention of inflicting such injury, we cannot but feel the grievous inequality of the law as it has been administered in the case of this unfortunate medical officer. Nor is it easy to dismiss a feeling of doubt whether some share of the blame may not lie at the door of the parish authorities, who, as a rule, pay most inadequately the services of the medical officers under the Poor-law. If the number of visits to be paid annually to the sick at their own homes, often scattered over a wide area, in addition to dispensary attendance, be counted, and a computation made of the remuneration afforded to a qualified medical man for his time and skill, it will be found that it affords a more miserable pittance than would be required for the remuneration of the lowest kind of skilled labour. The parish surgeon in this case, we believe it was stated, received £63 *per annum*. One would like to see the computation made on the labour performed in one year, and see how many pence were the reward of each visit to the sick poor of his district. We earnestly hope this case will be brought under the notice of the Home Secretary, and that he may see just reason for mitigating the rigour of the judgement as to the hard labour, and even the term of imprisonment. (*British Medical Journal*, 1879.)