Cost of neonatal care

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SUMMARY A six month evaluation of the costs of a regional neonatal medical and surgical unit was carried out. The total cost for six months was £970 000 and this covered 4349 inpatient days and 282 admissions. For medical cases the cost ranged from £132 to £27 600 and the mean daily cost for different weight groups ranged from £159 to £274. The average daily cost for regional patients at £258 was greater than for district patients who cost £199. Altogether 23 medical patients weighing less than 1000 g at birth were admitted. The total cost for nine of these infants who died was £30 991—about 3% of the unit's total budget.

It is widely accepted that improvements in neonatal care and in particular the provision of intensive care facilities has reduced mortality in preterm infants.¹ Surprisingly little, however, is known about the financial costs of such treatment. In the United Kingdom there have been only two comprehensive studies that have assessed the economics of neonatal intensive care.^{2,3} When in 1984 a new mixed medical and surgical neonatal unit was opened in this hospital an evaluation officer (AS) was specifically appointed to study the cost of running the unit. We believe that there is a need for more information concerning the economics of neonatal care if known deficiencies in the allocation of resources are to be corrected.

Methods

This evaluation was carried out on the neonatal unit of the General Infirmary at Leeds; this is a regional referral centre for both medical and surgical admissions. There are roughly 48 000 deliveries per year in the Yorkshire region with about 4500 births per year in this hospital. Within the neonatal unit there is a surgical area (10 cots), an intensive care area (six cots designated for ventilation), and a special care baby unit (20 cots). Although there are many occasions when more than six babies receive intensive care, the nursing establishment is based on these figures. In addition to admissions from our own delivery suite (including in utero referrals) there is also a 'flying squad' that transfers outborn referrals requiring intensive care.

In 1985 an evaluation officer (AS) was appointed for six months (February to July inclusive) with the

aim of providing an accurate prospective assessment of the costs of running this unit. Infants have been divided into regional referrals (outborn and in utero transfers) or district admissions and also into medical or surgical admissions. Surgical patients included both patients born in this hospital and those transferred from regional hospitals with primary surgical problems. Their medical and surgical care was provided by the surgical team, but not all infants required surgery. Unlike the district cases the cost for regional referrals does not represent their true total hospital cost because of the continuing need for special care once they are discharged back to their referring hospital. The three main areas of cost identified were:

(1) DIRECT TREATMENT COSTS

Direct treatment costs comprised the salaries (at 1984 pay award levels) for the medical nursing, and other professional staff (for example, medical physicists and pharmacists), and also the cost of supplies and equipment including replacement, repair, depreciation, and maintenance. For each patient costs were calculated on a day to day basis. Each patient day was allocated to one of three categories: intensive care, where patients generally required respiratory support (ventilation or continuous positive airways pressure) and were subject to intensive care staffing levels; special care, which included babies discharged from intensive care and preterm babies awaiting discharge home; and surgical care. For each of these three categories nursing costs were allocated in proportion to rostered staffing levels for each category. Medical staffing costs were apportioned according to indi-

vidual doctors' clinical responsibilities for daytime and on call periods.

(2) PATIENT TREATMENT COSTS

Patient treatment costs included the costs of drugs, intravenous feeding solutions, investigations by the pathology laboratories (chemical pathology, haematology, and microbiology), blood transfusions, radiology, and operating theatre time. Maternal care for regional referrals where appropriate was included in this category. A simple average daily cost was chosen for maternal care as a more accurate figure could only be obtained by a similarly detailed study of obstetric costing. The cost of the mothers' care was met from the obstetric budget. Care given to the infant by the mother did not result in any reduction in nursing costs for that infant because of the continued nursing supervision usually required.

(3) GENERAL SERVICE COSTS

The general service costs reflected the general running costs of the hospital such as payment to ancillary staff (for example, porters, cleaning staff, etc), services, power, heat, and lighting. Altogether 32% of the hospital's budget was in this category and that of the neonatal unit was calculated as an additional 32% of its budget. Figures for the costs (at 1985 prices) were supplied by the district finance officer and a record of all consumables used was available during the time of the evaluation. Each department within the hospital was, where necessary, asked to provide costs for each item of service.

For each admission a careful record was kept of the number of days spent on the unit. All investigations, including *x* radiography and blood transfusions, were tabulated as well as the days of intravenous feeding and drug treatment. (A fuller account of the costing method is available from the authors.)

All prices quoted are at 1985 levels.

Results

Over the six month period there were 282 admissions with a total of 4349 inpatient days on the neonatal unit (table 1). Medical patients were

Table 1 Admissions and (inpatient days) during the six month evaluation

Admissions	Medical	Surgical	Total
District	119 (1594)	22 (283)	141 (1877)
Regional	71 (1373)	70 (1099)	141 (2472)
Total	190 (2967)	92 (1382)	282 (4349)

largely preterm infants suffering from respiratory and other complications. Surgical patients consisted largely of those with malformations and those with surgical complications of prematurity (for example, necrotising enterocolitis). Included in these figures were seven admissions to the unit who despite being older than 4 weeks required the specialised care available on this unit. They were included for complete accuracy. They spent a total of 23 inpatient days at a total cost of £6000.

During the evaluation period direct treatment costs amounted to £556 000 (table 2). When this was allocated to each area of care and then divided by total inpatient days for that area the daily direct treatment cost could be calculated: intensive care £294 per day, special care £89 per day, and surgical care £125 per day. The estimated cost for each facility used in the category of patient treatment costs and the total cost to the newborns' unit of these facilities is shown in table 3. Patient treatment costs were £104 000 in total. The general service cost for the unit for the six month evaluation was estimated at £312 000. When these two additional elements of cost were included the average charge for intensive care was £467 per day while for special care it was £166.

The analysis of cost for district and regional

Table 2 The breakdown of direct treatment cost

Category of cost	Cost in £000's per six months (%)
Medical staff	72 (13)
Nursing staff	330 (59)
Other staff	19 (3)
Supplies/equipment	110 (20)
Repair/maintenance	25 (5)
Total	556 (100)

Table 3 Breakdown of the patient treatment costs and approximate cost for each category

Facility	Total cost for six months (£)	Cost per unit (£)
Intravenous feeding	5 900	10 per day
Intravenous drugs	1 300	1 per day
Chemical pathology	7 100	5 per day
Microbiology	2 600	4 per request
Haematology	6 600	5 per request
Group/save	2 100	9 per request
Blood/plasma	5 000	20 per unit
Ultrasound	4 400	39 per scan
<i>x</i> Radiography	7 300	27 per film
Maternal inpatient care	22 000	123 per day
Operating theatre	1 600	144 per hour

Table 4 Patient numbers, duration of stay, and costs (£) for neonatal medical patients

	Birth weight			
	≤1000 g	1001–1500 g	1501–2500 g	>2501 g
<i>District patients</i>				
No of patients	6	18	42	49
Average stay (days)	48	36	11	3
Average cost/case	10 300	8 100	1 800	600
Average cost/day	213	224	159	187
Average range of costs/case	621–27 600	490–18 300	132–10 900	139–3 500
<i>Regional patients</i>				
No of patients	17	22	23	6
Average stay (days)	26	20	19	8
Average cost/case	6 700	5 300	4 600	2 700
Average cost/day	258	270	246	274
Average range of costs/case	444–21 900	564–22 750	445–15 300	851–5 700

Table 5 Patient numbers, duration of stay, and costs (£) for surgical patients

	Origin	
	District	Regional
<i>Birth weight ≤2500 g</i>		
No of patients	6	31
Average stay (days)	16	16
Average cost/case	3 350	3 650
Average cost/day	214	227
<i>Birth weight >2500 g</i>		
No of patients	16	39
Average stay (days)	12	16
Average cost/case	2 400	3 250
Average cost/day	202	209

medical admissions and for surgical admissions are shown in tables 4 and 5. Over a six month period the total running costs of a combined medical and surgical unit amounted to £972 000: this is the equivalent of £1.94 million per year. This cost was divided roughly into equal thirds for district medical, regional medical, and surgical groups. Although our analysis dealt with a six month period, there was a total of 560 admissions over the whole of 1985 so the assumption that a six month period would be representative of the unit's workload was correct.

Discussion

While it is widely accepted that the provision of neonatal intensive care has been associated with an improved survival for very low birthweight babies,¹ only two studies have comprehensively investigated the costs of such care in the United Kingdom.^{2 3} The total cost for 119 district and 71 regional medical patients was similar: £320 000 and £350 000, respec-

tively, with the average cost for regional patients being £5000 compared with £2700 for district patients. This is due to the longer average stay (19 days against 13 days) for regional patients and their greater average daily cost. The above trends are reversed if we consider only the 63 very low birthweight babies admitted who constituted 57% of regional and 21% of district admissions. The district admission babies stayed longer on average (39 days compared with 22 days for the regional patients) and cost £8700 per admission while regional infants cost £5900. The shorter stay for regional babies was because they could be transferred back to their referring hospital to complete their care. The longer average length of stay for regional medical patients weighing >1500 g (17 days) compared with equivalent district patients (seven days) occurred for two reasons: (a) the district patients could complete their hospital care on our transitional care unit and, (b) regional admissions of this weight represented a selected group of very ill patients.

The average daily cost of care varied between £187 and £274 for medical patients. The regional admissions required more intensive care (26% of inpatient days) than district cases (17% of inpatient days). This was probably a reflection of the greater number of very low birthweight babies among the regional admissions. Maternal care for mothers transferred with their baby amounted to a total of £20 000 and contributed £14 on average to the daily cost of regional medical patients.

The ethical and economic aspects of the care of the most immature infants (less than 1001 g birth weight) merit, and have received, recent discussion.^{4 5} Our study showed that of 23 such babies nine died: five on day 1, three more by day 3, and one at 44 days. The average cost for their care was £3443, but actual costs ranged from £498 to £21 859 and for

Table 6 Comparison of estimated costs (£) for three recent British costing studies (and financial year)

	Birmingham 1984*	Liverpool 1984	Leeds 1985
Average cost/day			
Care level:			
High	281	297	467
Intermediate	146	138	} 166
Low	51	71	
Babies of very low birth weight			
Cost/patient	4850	4159	6979
Cost/survivor	6220	4490	8192
Cost/non-survivor	1081	3446	4169

*Birmingham study undertaken in 1981, figures converted to 1984 levels by Sandhu *et al.*³

these nine babies totalled £30 991; this is about 3% of the unit's total expenditure.

Direct treatment costs for medical patients were calculated for two levels of care only—intensive and special care. Intensive care in this study was broadly equivalent to that in other studies,^{2,3} but our special care also included high dependency or intermediate care as described in these studies. The special care area studied here formed a continuum of the levels mentioned above and staffing costs cannot be broken down further. A transitional care unit in this hospital provides special care facilities on postnatal wards for a large number of babies born between 30 and 35 weeks' gestation. Therefore our special care unit may not be directly comparable with others.^{2,3} It was also decided not to allocate specific equipment costs to various levels of care as it was felt that, as equipment is often not in use, its costs should be borne by those who used it and by those who had access to it if required. Table 6 shows the comparison between this study with those from Birmingham¹ and Liverpool.² These studies were broadly similar despite being conducted in different financial years

and using different methods. Our analysis clearly shows that the major cost incurred in treating very low birthweight babies is staff salaries. Additional patient treatment costs (table 3) are minor but hospital overheads make an important contribution to the total cost of care.

We believe that funding for neonatal care should be based on demonstrated costs. As the future direction of finance within the National Health Service is likely to be based on the concept of semiautonomous budgeting for individual units within hospitals it is important that such budgets should be based on accurate costing information. Furthermore if regional centres are to continue to develop and flourish then appropriate funding must be forthcoming. This should be related to numbers of patients treated rather than by funding intensive care costs that may not reflect the workload.

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