On the estimation of hospital cost: the approach

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18 May 2010

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Recent discussions on mobilisation of resources for the health sector have suggested various possibilities. These may be broadly classified as cost recovery and cost containment methods. Cost recovery methods include user financing and health insurance. Cost containment measures refer to decentralisation and private public mix. Among the direct measures of cost recovery, user financing is widely conceived as unpopular. Health insurance as a method of financing health care services has received the attention of the academicians and policy makers for it allows for customer choice. Out of pocket payments are the main source of financing for discretionary care in low-income countries. Since, out of pocket financing cannot cover expensive care or deal with catastrophic illness, widespread financing of discretionary care is possible only through insurance (World Development Report 1993). However, operationalizing health insurance programme is a tough task. In addition to the institutional requirements, the success of an insurance package depends on a clear understanding of the health care environment of the region under consideration, the cost of provision of different health care services through the various systems and providers of heath care etc..

The following discussion attempts to bring to light the issues and methodology related to cost estimation in health care provision. A study on insurance needs to examine the cost involved in the provision of different health care services. In order to ensure that scarce resources are used to best effect and to develop a financing strategy which will help to cover all or some of the costs involved in operating such institutions, it is necessary to know how hospital costs are influenced by output levels and other variables. Such attempts would often examine the determinants of hospital costs and ascertain whether an improved policy insight can be obtained in the process, particularly with respect to the development of a financing strategy. In this context, the principal questions to be addressed are: What causes costs to vary among hospitals? Do they vary simply because activity levels differ from hospital to hospital or is there something more fundamental involved? How does hospital size enter the picture? Are larger hospitals really more efficient than smaller hospitals in terms of lower costs per day or per unit of service? What is the influence of the occupancy rate on hospital costs? What is the

effect, if any, of the composition of services, that is, the product-mix? Finally, are costs at the departmental level determined by the same factors as costs at the aggregate level, and are there any economies of scale and scope present in the provision of health?

Costs are related to the scale of outputs. While considering the relationship between cost and output it is necessary to distinguish between marginal cost (the cost of producing an additional unit of output) and the average cost (the total cost of all units divided by the total units produced). Since fixed costs cannot be avoided, it is more relevant to look at marginal costs than average costs. The marginal cost will be lower than average cost so long as the capacity created by the fixed cost is not fully utilised. In the long run the impact of output on marginal and average costs will depend on whether economies of scale existed for the production technology or not. If economies of scale existed up to a certain level in the production of hospital services the average and marginal costs will fall up to this level succeeded by diseconomies. Estimating the link between scale of production and average and marginal costs help in planning to take advantage of scale up to the point at which they begin to rise.

There are two methods of cost analysis - the accounting method and the statistical method (Barnum and Kutzin 1993). The accounting method can be applied usefully to a single hospital and can involve a labour-intensive, detailed examination of hospital accounts, staffing patterns, and admissions. Less detailed data are needed in the statistical method, but it requires observations of costs and service use for many hospitals. Statistical studies provide insights into cost issues - the relation between marginal and average cost, and the degree to which hospitals exhibit economies of scale and scope - that accounting method do not reveal as readily. Ideally, the information used for the statistical analysis would be derived from a large number of detailed and well-documented observations. In actuality this is not often possible, and inferring a general pattern of costs from a reasonably large number of observations must compensate for the lesser quality of data in a statistical analysis. Thus, the accounting method and the statistical method yield different but complementary views of costs. Whichever method is used, estimation of a cost function in the health sector confronts a number of problems. These include problems related to output measurement, definition of input prices and definition of cost and its components.

Measurement of output: Unlike the cases of industrial and agricultural output, it is difficult to measure the output of health sector, as the concept of output is ambiguous. Provision of health services aims at improving

the patient's health, the outcome of which is difficult to measure accurately. However, output, being a crucial variable for the estimation of cost, needs to be measured. Breyer (1987) argues that given the ambiguous nature of the concept of output in health sector, it is essential to identify the level of easily observable intermediate products and use them as proxies for output. These proxies for output may be in terms of either total number of patients admitted or the total number of bed days respectively.

In the literature, the unit case approach has been used more frequently than the patient day approach because of two major reasons. First, it is more closely related to the true output, that is, health improvement than that of the patient days. And second, under the patient day approach, length of stay can be easily influenced by the hospital rendering the patient days an endogenous output variable. This violates an important property of cost functions. Adoption of the unit case approach overcomes this problem. However, the unit case approach assumes away the differences in case mix, length of stay and severity of the ailment, the factors which have an important bearing on the cost incurred for cure. The unit case approach overcomes the problem of the length of stay becoming endogenous variable. If the study does not cover a cross-section of hospitals, length of stay does not become an endogenous variable. Thus, days rather than the number of patients become important, and the patient day approach becomes the better alternative. However, this approach is not devoid of limitations. Following this approach would not help to account the out patient services. The only possibility to overcome this problem is to ascertain the number of outpatient visits. The cost of a day of inpatient also may vary substantially with respect to the severity and complexity of the ailment. For example, the cost of an inpatient day for Cardiac Surgery could be higher than that for many other ailments.

Cost classification for the health sector: The classification of cost into fixed and variable will not capture all the cost heads for the health services. It calls for analysing cost in a broader perspective. A widely accepted way of classification of cost in the health sector is to categorise cost into capital costs and operating costs (De Ferranti, 1985). Operating costs includes those costs directly attributable in the production process, connoting the variable cost. There are certain costs which change with the changes in output, but cannot be attached or identified to any single output, as they are spread in the different products (services) produced in a multi-product (service) system. These costs are called common costs. Panzar and Willig (1981) has classified them as

shared input costs. Hence, the total cost in the hospital is the sum of the costs directly attributable to each hospital department plus the common costs inclusive of fixed cost. In the case of multi-product firms, it is practically very difficult to arrive at a separate cost measurement for the different services provided.

In this context let us mention some basic steps in hospital costing

1. Define the intervention: It is required to specify the nature of intervention, the types of patients to be treated and the types of treatment to be administered.

2. Identify relevant costs: These include both direct and indirect costs, such as patient time, lost earnings or other social costs associated with the intervention.

3. Measure costs: This involves attaching a monetary value to every component of costs, discounting future costs to present values.

4. Account for uncertainties: This involves the testing of the robustness of the measurement using sensitivity analysis.

Methodological Formulations in Hospital Cost Studies

Earlier models of hospital cost estimated average cost as a function of various hospital determinants. This widely used set of "behavioural" cost function is often accused of being adhoc and lacking foundation in the usual assumptions of production technology.

A later group of models, following the work of Fuss and McFadden (1978), employs "flexible" functional forms. Because these forms regress total costs on output quantities and input prices, they are more consistent with economic theory of production than the earlier adhoc cost functions. Notable within this literature are the papers by Cowing and Holtmann (1983). They reject the concept of a single aggregate measure of output.

The trend in recent work is toward "hybrid" flexible forms that include explanatory variables in addition to output quantities and input prices. These efforts strike some balance between the previous two groups of models and retain a number of desirable features from each. Leading in this approach is the study by Grannemann et al. (1986), which separates inpatient discharges (by type) from patient days and emergency department visits from other outpatient visits. They found distinct measures of marginal cost for the two dimensions of inpatient care. They also showed strong emergency department scale economies, unlike other outpatient visits for which marginal and average incremental costs were roughly equivalent. Vita (1990)

continued with this line of inquiry using data on a sample of California hospitals for five outputs. The results indicated ray scale diseconomies. Breyer (1987) was critical of rudimentary classification of patients in most output measures. He proposed a specification in which the flexibility of the functional form is applied to the three global output categories of cases, patient days, and staffed beds. This approach offers potential for reducing the number of parameters to be estimated without sacrificing detailed measurement of case mix. Thus far a consensus has not been reached on the appropriate form of the hospital cost function.

The existing cross-sectional studies are not equipped to control for individual hospital differences that cause variation in costs. One exception is the study of hospital competition by Melnick and Zwanziger (1988), that draws on California data for the years of 1980-1985. These authors tested for the presence of hospital - specific effects in the residual. Finding a very high degree of intra-hospital correlation, they used a variance components model in their study. Gaynorand and Anderson (1995), in an analysis of the cost of hospital beds, also used panel data in a fixed-effects model, which they applied to American Hospital Association (AHA) data for 1983-87.

With the growing movement toward hospital cost containment, considerable concern has arisen over the relationship between cost and quality of care. While there is some evidence that quality improvement is consistent with lower costs (Fleming (1991), Binns (1991)), the underlying relationship between the quality and the cost factor is unclear. Despite the interest in the quality variable, very few cost studies include measures of quality as an explanatory variable. Inclusion of a quality variable has been attempted by Fleming (1991), who found mortality and re-admission indexes to be significant determinants of cost. Gertler and Waldman (1992) developed an empirical model in which costs are adjusted for unobserved endogenous quality and applied it to a sample of long term care facilities. The parameter estimates differed significantly from those in which quality was treated as an unobserved factor subsumed in the error term. If quality is an important determinant of hospital costs, routinely ignoring it in cost function estimation can be a serious problem. Yet reliable measures of quality may be generally unavailable. Incorporating an individual hospital effect through estimation of a panel data model is an alternative approach that may capture variation in cost due to quality or other unobservable differences among hospitals.

Bitran and Dunlop (1993) used a translog like cost function specification similar to the one employed by Grannemann et al. (1986). This specification enables an explicit determination of the marginal expenditure of care, given the structure of output and other factors, such as input prices, that might affect the structure of expenditures. Thus the specification provides a more theoretically appropriate framework of analysis than that of the overworked 'unit cost' approach. The analytical approach followed in this paper recognize that hospitals in all countries are multi-product institutions as they provide a number of different types of both inpatient and outpatient curative services.

Most of the studies mentioned above focus on estimating hospital cost functions. Accounting based studies are rather rare. This is basically because of the difficulty in isolating hospital specific components and come with meaningful values. However, whatever may be the methodology of hospital cost measurement, collection of the following details over a sufficient number of years will be handy.

The required data format ideally suited for carrying out an empirical examination of hospital cost

I Information on Cost
A) Fixed Costs

A detailed break up, if available, as given below, would be of use for a detailed analysis.

1. Land
2. Buildings
3. Tools
4. Instruments
5. Glasswares
6. Construction Materials
7. Others (Specify)

B) Variable Costs: Expenditure on broad categories such as

1. Compensation to employees (wages and salaries, allowances etc.)
2. Medicines (including chemicals, medical gases etc.)
3. Hospital Accessories
4. Stationaries
5. Others

A detailed break up, if available, as given below, would be of use for an examination of the disaggregated pattern of expenditure.

1. Medicines
2. Chemicals
3. Medical Gases
4. Films & Chemicals for X-ray unit
5. Uniforms & Hospital Linen
6. Consumable stores - Hospital items
7. Other Consumables
8. Hospital Expenses
9. Inpatient Diet
10. Laboratory Expenses
11. Salaries & Allowances
12. Honorarium to Visiting doctors
13. Leave salary & Pension Contribution
14. Medical benefit to staff
15. Contribution to provident fund
16. Travelling expenses
17. Expenses for visiting Faculties
18. Home travel and Leave travel concession
19. Group Gratuity Insurance
20. Postage, telephone & Telegram
21. Printing & Stationary
22. Advertisement
23. Recruitment expenses
24. Electricity & Water charges
25. Freight, Insurance and Handling charges
26. Vehicle maintenance expenses
27. Bank charges & commission
28. Taxes & License
29. Repairs & Maintenance of Equipments
30.   "   Buildings
31.   "   Others
32. Staff training expenses
33. Animal research lab.expenses
34. Other expenses
35. Bonus & Festival allowances
36. Tools, Glasswares and Instruments-consumed
37. Contribution to pension fund
38. Contribution to sinking fund
39. Customs duty paid
40. Expenses for symposium
41. Others (specify)

II Information on Revenue Receipts

1. Inpatient charges
2. Investigation charges
3. Registration charges
4. Excess of Income over Expenditure (subsidy)
5. Others (specify)

III Information on Service Indicators   (Department-wise)
1. Facilities in the hospital - Departments
                        Ortho Gen. Medicine Obstetrics etc.
2. Number of beds
3. Bed occupancy (%)
4. No. of Major operations
5. No. of Minor operations
6. No. of New cases
7. No. of Repeat cases
8. No. of Admissions - Inpatients
9. No. of Outpatients
10 No. of Discharges
11. No. of Deaths
12. No. of Doctors, Nurses and Support staff
13. No. of Non paying patients
14. No. of Paying patients
15. Length of stay (days)
16. Bed turnover rate
17. Mortality rate
18. Operative mortality rate
19. Autopsy rate
20. Sophisticated Investigations (number)
21. Lab investigations (Number)
22. X-Ray (Number)
23. Physiotherapy (number)
25. ECG (Number)
26. ECHO (number)
28. EMG (number)
30. Pace maker (Number)
31. Perfusion (number)
32. Scan (number)
33. Others (specify)