Appendix B.—Cost Estimates

As emphasized in chapter 3, there are significant technical problems in estimating the actual or even the relative costliness of intensive care unit (ICU) care, It is essential to recognize some of the most important data problems that have had to be confronted. First, only charge data is generally available. Assumptions about the relation of charge to cost have been made separately for room and board and for ancillary services. Second, national data on the amount of inpatient ICU care provided is available for Medicare, but not for the general population. In addition, there are concerns about the reliability of the MEDPAR data base (254). The national estimates have necessarily had to build up from this Medicare data base.

Third, standardized national data exists for ICU beds but not for ICU days. Usually, bed occupancy rates in ICUs are comparable to hospital bed occupancy rates in general. We assume, then, that the proportion of ICU days to total hospital days is nearly the same as ICU beds to total hospital beds.

Fourth, the relevant data bases combine ICU and coronary care unit (CCU) care. No attempt, therefore, is made to distinguish ICU and CCU costs. Furthermore, the assumptions underlying cost estimating for ICU and CCU care may not hold for other types of special units, such as pediatric, neonatal, and burn ICUs. A data base for intermediate care units is simply not available at all. Therefore, the estimates presented here are for adult ICU/CCU costs which understate the costs of more broadly defined special care units. As was noted in chapter 2, adult ICU/CCU beds in 1982 made up 5.9 percent of hospital beds, while separate pediatric, neonatal, and burn ICUs together made up another 1 percent of beds.

Definition 1—8 to 10 percent: **The percentage of hospital costs represented by the direct and indirect cost of running the ICU, as reflected in charges for ICU room and board.** The Health Care Financing Administration (HCFA) has analyzed the use of and charges for accommodation and ancillary services in short-stay hospitals for Medicare beneficiaries based on a 20-percent sample of Medicare beneficiaries—the MEDPAR data base (112). In 1980, HCFA'S sample showed that charges for ICU/CCU care constituted 7 percent of total hospital charges. Since Medicare patients' utilization of ICUs is roughly in the same proportion as non-Medicare patients (see ch, 4), we assume then that about 7 percent of all hospital charges were for ICU/CCU room and board charges. As discussed in chapter 3, charges generally underestimate actual costs of operating ICUs. In one careful study from a single hospital, the hospital charge for special care room and board was found to be only 65 percent of the marginal cost of maintaining the bed. In contrast, the marginal cost for general floor beds was less than the established charge by approximately one-third **(110).** Thus, based on this and other anecdotal reports, one can conservatively estimate that ICU/CCU costs represented 8 to 10 percent of hospital costs in 1980. The proportion of hospital beds devoted to intensive care has, however, increased since 1980. It is likely that the proportion of ICU bed days has increased as well. Therefore, today, the estimate would be at the high end of the 8- to 10-percent range or even slightly higher.

Definition 2—14 to 17 percent: **The percentage of total hospital costs consumed by patients when in the ICU.** This includes room and board and ancillary services.

Method A: The simple approach to this estimate is to double the room and board charges—room and board makes up about 50 percent of total hospital charges—and then make a charge-to-cost adjustment. As noted in chapter 3, in general, hospitals mark up costs for ancillary services by almost a third to determine charges. Thus, it would not be appropriate to simply double the cost estimate derived from the calculations in Definition 1 above. We simply do not know precisely the appropriate charge-to-cost adjustments to make for ICU room and board charges and for ancillary service charges. In addition, data suggest that ICU patients use more ancillary services per day than non-ICU patients (see ch. 3). The extent of this additional utilization is not precisely known.

If one assumes that the markup for the ancillary services and the markdown for ICU room and board were roughly the same and that ICU patients use the same amount of ancillary services as non-ICU patients—conservative assumptions—the estimate for percentage of hospital costs consumed by patients when in the ICU would be 14 percent, relying on the MEDPAR data for 1980 presented above. If it is assumed that ICU patients used 20 percent more ancillary services than non-ICU patients, the estimate rises to 15 percent. The recent expansion in ICU beds since 1980 might add another 1 to 2 percent. The estimated range, then, is 14 to 17 percent.

Method B: Louise Russell provided a method for estimating the total costs of ICU care by relating the percentage of the total hospital beds that were ICU/CCU beds to the relative costs per day in an ICU and in a general hospital ward (205). This method assumed that days of care are proportional to the number of beds. Russell also used a 3:1 ratio for relative costliness of an ICU day compared to a regular bed day. Her method, when applied to 1976 American Hospital Association (AHA) bed data, provides a conservative

estimate that adult ICU/CCU costs represented about 13 percent of total hospital costs at that time. Updating for 1982 AHA data that 5.9 percent of beds in non-Federal, short-term hospitals are ICU or CCU beds would give an estimate of about 15 percent, assuming the same 3:1 cost ratio.

As noted in the discussion under Method A above, critical assumptions are used to generate the 3:1 relative costliness ratio, i.e., that the markup for ancillary services is roughly comparable to the markdown for ICU room and board, and that ICU patients use ancillary services in the same proportion as non-ICU patients. The 3:1 ratio may well be too conservative. A 3.5:1 ratio would give an overall estimate of about 17 percent, using Russell's method. Russell herself using 1979 AHA bed data estimated that almost 20 percent of all hospital costs are accounted for by intensive care (206). This estimate included costs of neonatal and, presumably, pediatric ICU and burn unit beds. Thus, our estimates of percentage cost, 15 to 17 percent, using Russell's method, is consistent with her own estimate. This estimate also agrees with the estimate calculated according to Method A above.

Definition 3—28 to 34 percent: The total hospital costs for patients who spend any time in the ICU. Some authors have utilized this concept to demonstrate the high proportion of total hospital costs accounted for by intensive care patients (175). This calculation is relatively easy to obtain from hospital accounting reports. Reports from two large hospital ICUs show that approximately 50 percent of the total hospital costs incurred by ICU patients occurs when patients are on regular medical floors (54,175). Similarly, HCFA's MEDPAR data demonstrates that the average room and board charge for routine bed stay and for an ICU/CCU bed stay were roughly the same (112). Therefore, a user of both an ICU/CCU bed and a regular bed would have charges two times the charge of the ICU/CCU stay. If by Definition 2, it was estimated that 14 to 17 percent of total hospital costs are incurred by patients while in the ICU, then about twice that percentage—between 28 to 34 percent of hospital costs—probably is expended on patients who spend any time during their hospitalization in the ICU or CCU. The estimate agrees with the findings in one large community hospital in which patients spending any time in the ICU represented 9.5 percent of total hospital admissions and, yet, incurred nearly 30 percent of total hospital charges (175). Unfortunately, while relatively easy to calculate, this cost definition is not very relevant to consideration of ICUs as a separate technology.

Definition 4—cannot be estimated: The incremental cost generated by ICUs above the cost that a hospital would have to absorb for treating ICU-type patients if the ICU did not exist. This definition tests whether the ICU is a cost generator independent of the patients it treats. Certainly, some amount of the fixed ICU costs would be saved if the ICU did not exist. However, some of these costs, e.g., depreciation of ICU equipment, would be generated in any case since the costs would be transferred to regular medical and surgical floors. To the extent that efficiencies are achievable by aggregating equipment and personnel in separate areas, an initial impetus to development of ICUs, ICUs conceivably could reduce hospital costs. In fact, the scant data available suggests that costs of running a conventional medical floor did not decrease with development of the ICU (97).

Experts in provision of ICU care maintain that some patients require ICU care to have a chance at survival (50). The sickest ICU patients simply would not survive without the coordinated and concentrated care provided in the ICU. For practical and ethical reasons that were discussed in chapter 5, this hypothesis cannot be directly tested. To the extent that these experts are correct, ICUs do generate a large incremental cost to the hospital, but with substantial benefits to survivors. These very sick patients may consume as much as 40 to 50 percent of ICU costs in some institutions (54,175).

ICUs, however, also generate increased incremental costs for patients who are likely to survive hospitalization whether they are cared for in the ICU or not. Griner followed the experience of patients admitted to a general hospital with the diagnosis of acute pulmonary edema for the year before and the year after the opening of an ICU (98). While the mortality rate of 8 percent did not change, the average hospital bill for patients admitted during the year after opening of the ICU was 46 percent greater than for those admitted the year before (99). His sample size, unfortunately, was quite small.

Griner's study is essentially the only one of its kind which gives an estimate of the incremental cost of an ICU for treating similar patients with similar medical outcomes. Difficulties from generalizing the results of this study for the purposes of this case study include: 1) the patient population studied represents a small subpopulation of ICU patients; 2) the study is a decade old; and 3) the observational period of ICU care was the first year of its operation, a period during which care may be the least efficiently provided.

In 1981, Cromwell's group (49) attempted to isolate the role of various factors which might explain variations in inpatient charges using a complex regression equation. One finding was that both hospital routine and ICU bed stays were significant explainers of ancillary use. They found that ICU bed days are associ-

ated with a greater use of ancillary services than routine bed days. Using the regression, they found that ICU days on average cost about 56 percent more in ancillary services than regular days, holding case mix, surgery, insurance status, and other variables constant. While the case mix measure used (diagnosis and urgency of admission) may not be a precise measure of severity of illness, the regression did confirm that the ICU days are associated with additional costs in ancillary services above those that can be explained by patient characteristics. Again, it is possible that very sick, "ICU-type" patients would have greater ancillary services used for their care regardless of their bed location. The 56-percent increment, however, is substantial and, at least, suggests that the ICU itself may have been partly responsible for the greater use of ancillary services.

Griner's and Cromwell's work together suggest that ICUS generate incremental hospital costs both in additional direct ICU costs and in greater use of ancillary services to achieve similar outcomes as care on regular medical and surgical floors. An estimate of the amount of this cost cannot be provided.