ple aerosol generator is increasing. For purposes of illustration, assume that half of the 70-percent decrease over the 1976-79 period in utilization of IPPB treatments per 100 hospital admissions that we found in these hospitals were replaced by utilization of simple aerosols or incentive spirometry. For hospitals in the Washington, D. C., SMSA, this change would produce an estimated cost savings of about $408,000 per year .35 To estimate other potential savings would require more detailed data on the substitution between different treatment modalities. Research on the substitutability of different respiratory treatment modalities should receive a high priority.

[35] In making this calculation, we assumed that there was one initial setup cost per nine followup treatments.

CONCLUSIONS AND IMPLICATIONS

Over the past two decades, there has been phenomenal growth in the United States in respiratory therapy departments offering a variety of treatment modalities aimed at improving lung dysfunction. These departments offer four major types of therapy: 1) oxygen therapy, 2) humidity and other aerosol therapy, 3) chest physiotherapy, and 4) mechanical aids to lung inflation (including IPPB). In many instances, the increased use of these services has occurred without much scientific evidence demonstrating that they bring about a measurable improvement in the patient's physical condition.

We have reviewed research findings on what is known about the efficacy and effectiveness of respiratory therapy modalities, emphasizing in our review IPPB treatments delivered for several accepted therapeutic indications. Oxygen therapy is the least controversial respiratory therapy, because easily definable indications and outcomes can be measured during the administration of supplemental oxygen. The values of aerosol therapy and chest physiotherapy have not yet been scientifically demonstrated, although specific uses have been shown to be beneficial. The lack of scientifically demonstrated effectiveness is not proof that these therapies are not effective; it only indicates that we currently do not know that they are effective.

IPPB treatments have enjoyed widespread acceptance for several therapeutic indications. For all of these indications, the rationale underlying the use of IPPB is the assumption that an IPPB machine can deliver a larger breath to the patient with less work required of the patient. We have found that there exists very little scientific evidence to support the overall efficacy of IPPB. Many studies that have compared IPPB to technologically less sophisticated devices (e. g., simple aerosols or incentive spirometers) have concluded IPPB is not more effective than the simpler alternative. To deliver an aerosol medication to a patient, for example, IPPB and a simple aerosol generator are comparable. In the prevention of postoperative lung collapse, IPPB treatments are at best comparable to the use of an incentive spirometer.

Our analysis of data we collected on the hospitals in the Washington, D. C., SMSA showed that the utilization of different respiratory therapy treatment modalities varied substantially by type and size of hospital. Private for-profit hospitals delivered more IPPB treatments and fewer incentive spirometry treatments per 100 patient admissions than other hospitals; private for-profit and nonprofit hospitals delivered over twice the number of chest physical therapy treatments per 100 patient admissions that Federal and non-Federal Government hospitals did. As hospital size (number of beds) increased, the number of respiratory therapy patients and IPPB patients per 100 admissions declined. However, before normative judgments on these utilization differences can be made, the differences need to be related to the each hospital's case mix and the severity of illness of the patient population treated in each hospital.

Our subsample of five teaching hospitals showed dramatic changes in the use of certain

respiratory therapy treatments during the 1976-79 period. The utilization of IPPB and ultrasonic treatment declined over 70 percent, while utilization of incentive spirometry and simple aerosol doubled. Although we did not explore all the reasons for this change, it does seem plausible that the 1974 Sugarloaf Conference on the Scientific Basis of Respiratory Therapy and editorials in medical journals had an impact on IPPB use in teaching hospitals. What is surprising is the vast amount of flexibility that respiratory therapy departments appear to have and the speed at which changes in treatment modalities can be accomplished.

According to our relative cost estimates, changes away from the use of IPPB machines and ultrasonic nebulizers toward the use of incentive spirometers and simple aerosol generators appear to be a move in the direction of selecting the least costly treatment modalities. Our relative cost estimates also suggest that for a followup treatment, an incentive spirometer and a simple aerosol generator are substantially less costly than an IPPB machine or an ultrasonic nebulizer. The move toward utilization of less costly respiratory treatment modalities by the hospitals in our subsample appears to have occurred without Government regulation and without any planning. As an illustration of a possible cost savings, we estimated that the substitution of simple aerosols or incentive spirometry for half the decrease in IPPB could produce yearly cost savings of about $400,000 for the hospitals in the Washington, D. C., SMSA. The validity of this assumption and the possibility of other cost-effective substitutions between treatment modalities warrant further study.

Performing a rigorous cost-effectiveness analysis of respiratory therapy would involve the use of a prospective random sample of patients using different respiratory therapy treatment modalities. Data on measurable health outcome parameters and costs of the different therapies would be required. The cost comparisons should include all hospital costs related to the treatment of the patient.