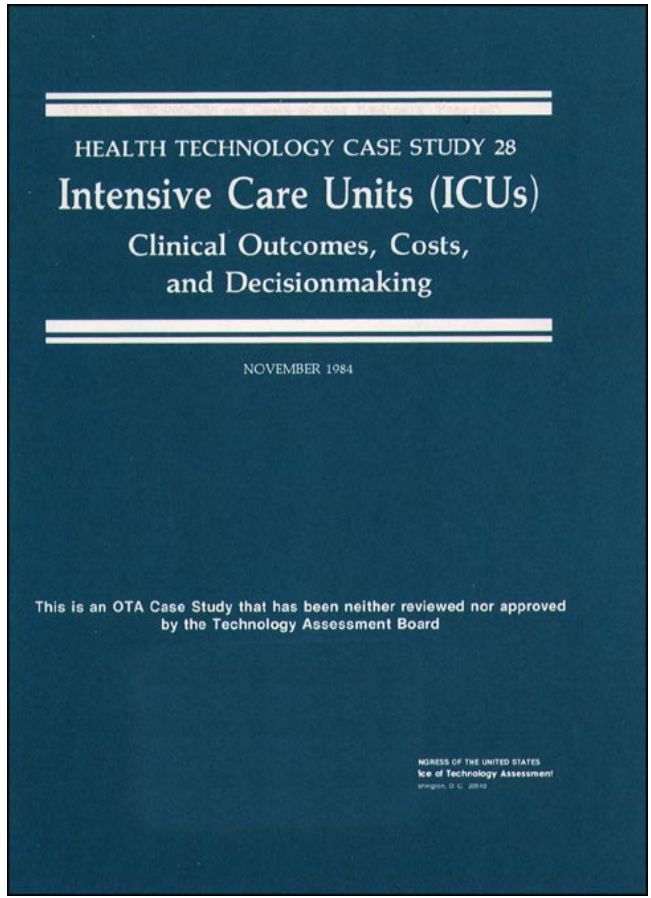
Intensive Care Units (ICUs): Clinical Outcomes, Costs, and Decisionmaking

November 1984

NTIS order #PB85-145928



HEALTH TECHNOLOGY CASE STUDY 28

Intensive Care Units (ICUs)

Clinical Outcomes, Costs, and Decisionmaking

NOVEMBER 1984

This case study was performed as a part of OTA'S Assessment of

Medical Technology and Costs of the Medicare Program

Prepared under contract to OTA by:
Robert A. Berenson, M.D.

OTA Case Studies are documents containing information on a specific medical technology or area of application that supplements formal OTA assessments. The material is not normally of as immediate policy interest as that in an OTA Report, nor does it present options for Congress to consider.

CONGRESS OF THE UNITED STATES
Otlke of Technology Assessment
Washington, D C 20510

Recommended Citation:

Berenson, R. A., ***Intensive Care Units (ICUs): Clinical Outcomes, Costs, and Decisionmaking*** (Health Technology Case Study **28),** prepared for the Office of Technology Assessment, U.S. Congress, OTA-HCS-28, Washington, DC, November 1984.

Library of Congress Catalog Card Number 84-601138

For sale by the Superintendent of Documents
U.S. Government Printing Office, Washington, D.C. 20402

Preface

Intensive Care Units (ICUs): Clinical Outcomes, Costs, and Decisionmaking, is Case Study 28 in OTA'S Health Technology Case Study Series. This case study has been prepared in connection with OTA'S project on *Medical Technology and Costs of the Medicare Program,* requested by the House Committee on Energy and Commerce and its Subcommittee on Health and the Environment and the Senate Committee on Finance, Subcommittee on Health. A listing of other case studies in the series is included at the end of this preface.

OTA case studies are designed to fulfill two functions. The primary purpose is to provide OTA with specific information that can be used in forming general conclusions regarding broader policy issues. The first 19 cases in the Health Technology Case Study Series, for example, were conducted in conjunction with OTA'S overall project on *The Implications of Cost-Effectiveness Analysis of Medical Technology.* By examining the 19 cases as a group and looking for common problems or strengths in the techniques of cost-effectiveness or cost-benefit analysis, OTA was able to better analyze the potential contribution that those techniques might make to the management of medical technology and health care costs and quality.

The second function of the case studies is to provide useful information on the specific technologies covered. The design and the funding levels of most of the case studies are such that they should be read primarily in the context of the associated overall OTA projects. Nevertheless, in many instances, the case studies do represent extensive reviews of the literature on the efficacy, safety, and costs of the specific technologies and as such can stand on their own as a useful contribution to the field.

Case studies are prepared in some instances because they have been specifically requested by congressional committees and in others because they have been selected through an extensive review process involving OTA staff and consultations with the congressional staffs, advisory panel to the associated overall project, the Health Program Advisory Committee, and other experts in various fields. Selection criteria were developed to ensure that case studies provide the following:

- examples of types of technologies by function (preventive, diagnostic, therapeutic, and rehabilitative);
- examples of types of technologies by physical nature (drugs, devices, and procedures);
- examples of technologies in different stages of development and diffusion (new, emerging, and established);
- examples from different areas of medicine (e.g., general medical practice, pediatrics, radiology, and surgery);
- examples addressing medical problems that are important because of their high frequency or significant impacts (e.g., cost);
- examples of technologies with associated high costs either because of high volume (for low-cost technologies) or high individual costs;
- examples that could provide information material relating to the broader policy and methodological issues being examined in the particular overall project; and
- examples with sufficient scientific literature.

Case studies are either prepared by OTA staff, commissioned by OTA and performed under contract by experts (generally in academia), or written by OTA staff on the basis of contractors' papers.

OTA subjects each case study to an extensive review process. Initial drafts of cases are reviewed by OTA staff and by members of the advisory panel to the associated project. For commissioned cases, comments ***are*** provided to authors, along with OTA'S suggestions for revisions. Subsequent drafts are sent by OTA to numerous experts for review and comment. Each case is seen by at least ***30*** reviewers, and sometimes by ***80 or*** more outside reviewers. These individuals may be from relevant Government agencies, professional societies, consumer and public interest groups, medical practice, and academic medicine. Academicians such as economists, sociologists, decision analysts, biologists, and so forth, as appropriate, also review the cases.

Although cases are not statements of official OTA position, the review process is designed to satisfy OTA'S concern with each case study's scientific quality and objectivity. During the various stages of the review and revision process, therefore, OTA encourages, and to the extent possible requires, authors to present balanced information and recognize divergent points of view.

Health Technology Case Study Series[a]

Case Study Series number	Case study title; author(s); OTA publication number[b]
1	Formal Analysis, Policy Formulation, and End-Stage Renal Disease; Richard A. Rettig (OTA-BP-H-9(1))[c]
2	The Feasibility of Economic Evaluation of Diagnostic Procedures: The Case of CT Scanning; Judith L. Wagner (OTA-BP-H-9(2))
3	Screening for Colon Cancer: A Technology Assessment; David M. Eddy (OTA-BP-H-9(3))
4	Cost Effectiveness of Automated Multichannel Chemistry Analyzers; Milton C. Weinstein and Laurie A. Pearlman (OTA-BP-H-9(4))
5	Periodontal Disease: Assessing the Effectiveness and Costs of the Keyes Technique; Richard M Scheffler and Sheldon Rovin (OTA-BP-H-9(5))
6	The Cost Effectiveness of Bone Marrow Transplant Therapy and Its Policy Implications; Stuart O. Schweitzer and C. C. Scalzi (OTA-Bp-H-9(6))
7	Allocating Costs and Benefits in Disease Prevention Programs: An Application to Cervical Cancer Screening; Bryan R. Luce (Office of Technology Assessment) OTA-BP-H-9(7))
8	The Cost Effectiveness of Upper Gastrointestinal Endoscopy; Jonathan A. Showstack and Steven A. Schroeder (OTA-Bp-H-9(8))
9	The Artificial Heart: Cost, Risks, and Benefits; Deborah P. Lubeck and John P. Bunker (OTA-BP-H-9(9))
10	The Costs and Effectiveness of Neonatal Intensive Care; Peter Budetti, Peggy McManus, Nancy Barrand, and Lu Ann Heinen (OTA-BP-H-9(1O))
11	Benefit and Cost Analysis of Medical Interventions: The Case of Cimetidine and Peptic Ulcer Disease; Harvey V. Fineberg and Laurie A. Pearlman (OTA-BP-H-9(11))
12	Assessing Selected Respiratory Therapy Modalities: Trends and Relative Costs in the Washington, D.C. Area; Richard M. Scheffler and Morgan Delaney (OTA-BP-H-9(12))
13	Cardiac Radionuclide Imaging and Cost Effectiveness; William B. Stason and Eric Fortess (OTA-BP-H-9(13))
14	Cost Benefit/Cost Effectiveness of Medical Technologies: A Case Study of Orthopedic Joint Implants; Judith D. Bentkover and Philip G. Drew (OTA-BP-H-9(14))
15	Elective Hysterectomy: Costs, Risks, and Benefits; Carol Korenbrot, Ann B. Flood, Michael Higgins, Noralou Roos, and John P. Bunker (OTA-BP-H-9(15))
16	The Costs and Effectiveness of Nurse Practitioners; Lauren LeRoy and Sharon Solkowitz (OTA-BP-H-9(16))
17	Surgery for Breast Cancer; Karen Schachter Weingrod and Duncan Neuhauser (OTA-BP-H-9(17))
18	The Efficacy and Cost Effectiveness of Psychotherapy; Leonard Saxe (Office of Technology Assessment) (OTA-BP-H-9(18))[d]
19	Assessment of Four Common X-Ray Procedures; Judith L. Wagner (OTA-BP-H-9(19))[e]
20	Mandatory Passive Restraint Systems in Automobiles: Issues and Evidence; Kenneth E. Warner (OTA-BP-H-15(20))[f]
21	Selected Telecommunications Devices for Hearing-Impaired Persons; Virginia W. Stern and Martha Ross Redden (OTA-BP-H-16(21))[g]
22	The Effectiveness and Costs of Alcoholism Treatment; Leonard Saxe, Denise Dougherty, Katharine Esty, and Michelle Fine (OTA-HCS-22)
23	The Safety, Efficacy, and Cost Effectiveness of Therapeutic Apheresis; John C. Langenbrunner (Office of Technology Assessment) (OTA-HCS-23)
24	Variation in Length of Hospital Stay: Their Relationship to Health Outcomes; Mark R, Chassin (OTA-HCS-24)
25	Technology and Learning Disabilities; Candis Cousins and Leonard Duhl (OTA-HCS-25)
26	Assistive Devices for Severe Speech Impairments; Judith Randal (Office of Technology Assessment) (OTA-HCS-26)
27	Nuclear Magnetic Resonance Imaging Technology: A Clinical, Industrial, and Policy Analysis; Earl P. Steinberg and Alan Cohen (OTA-HCS-27)
28	Intensive Care Units (ICUs): Clinical Outcomes, Costs, and Decisionmaking; Robert A. Berenson (OTA-HCS-28)

available for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C., 20402, and by the National Technical Information Service, 5285 Port Royal Road, Springfield, Va., 22161. Call OTA's Publishing Office (224-8996) for availability and ordering information.

[b] Original publication numbers appear in parentheses.

[c] **The first 17 cases in the series were 17 separately issued cases in** *Background Paper #2: Case Studies of Medical Technologies,* **prepared in conjunction with OTA's August 1980 report** *The Implications of Cost-Effectiveness Analysis of* **Medical** *Technology.*

[d] Background Paper **#3 to The** *Implications of Cost-Effectiveness* ***Analysis*** *of Medical Technology.*

[e] **Background Paper #5 to** *The implications of Cost-Effectiveness Analysis of* **Medical** *Technology.*

[f] Background *paper #1* to OTA's **May 1982 report** ***Technology and*** *Handicapped People.*

[g] Background Paper *#2 to Technology and Handicapped People.*

OTA Project Staff for Case Study #28

H. David Banta[1] and Roger C. Herdman,[2] ***Assistant Director, 0TA***
Health and Life Sciences Division

Clyde J. Behney, *Health Program Manager*

Anne Kesselman Burns, *Project Director*
Pamela Simerly, *Research Assistant*

Virginia Cwalina, *Administrative Assistant*
Beckie I. Erickson,[3] *Secretary/Word Processing Specialist*
Brenda Miller, PC *Specialist*
Jennifer Nelson,[3] *Secretary*
Mary Walls,' *Secretary*

[1] Until August **1983.**
[2] Since December ***1983.***
[3] Since January ***1984.***
[4] Until January **1984.**

Medical Technology and Costs of the Medicare Program Advisory Panel

Stuart Altman, Panel Chair
Dean, Florence Heller School, Brandeis University

Frank Baker
Vice President
Washington State Hospital Association

Robert Blendon
Senior Vice President
The Robert Wood Johnson Foundation

Jerry Cromwell
President
Health Economics Research
Chestnut Hill, MA

Karen Davis
Chair, Department of Health Policy and Management
School of Hygiene and Public Health
Johns Hopkins University

Robert Derzon
Vice President
Lewin & Associates
San Francisco, CA

Howard Frazier
Director
Center for the Analysis of Health Practices
Harvard School of Public Health

Clifton Gaus
President, Foundation for Health Services Research
Washington, DC

Jack Hadley
Director
Center for Health Policy Studies
Georgetown University

Kate Ireland
Chair, Board of Governors
Frontier Nursing Service
Wendover, KY

Judith Lave
Professor
Department of Health Economics
University of Pittsburgh

Mary Marshall
Delegate
Virginia House of Delegates

Walter McNerney
Professor of Health Policy
J. L. Kellogg Graduate School of Management
Northwestern University

Morton Miller
Immediate Past President
National Health Council
New York, NY

James Morgan
Executive Director
Truman Medical Center
Kansas City, MO

Seymour Perry
Deputy Director
Institute for Health Policy Analysis
Georgetown University Medical Center

Robert Sigmond
Director, Community Programs for Affordable Health Care
Advisor on Hospital Affairs Blue Cross/Blue Shield Association

Anne Somers
Professor
Department of Environmental and Community and Family Medicine
UMDNJ—Rutgers Medical School

Paul Torrens
School of Public Health
University of California, Los Angeles

Keith Weikel
Group Vice President
AMI
McLean, VA

Contents

Chapter	Page
CHAPTER 1: INTRODUCTION AND EXECUTIVE SUMMARY	3
Introduction	3
Executive Summary	4
Utilization oflCUs	5
Outcomes of lntensive Care	5
Payment for ICU Services	6
Decision making in the ICU	6
Foregoing Life-Sustaining Treatment	7
Possible Future Steps,	7
CHAPTER 2: EVOLUTION, DISTRIBUTION, AND REGULATION OF INTENSIVE CARE UNITS	11
The Development of the ICU	11
Advantages and Disadvantages of ICU Care..	12
Definitions.	13
Requirements of an ICU	14
Specialty. Multispecialty ICUs.	14
Distribution of ICU Beds	15
Expansion of ICU Beds	16
Regulation of ICUs	17
CHAPTER 3: COST OF ICU CARE	21
Components of ICU Costs	21
Costs of an ICU Day	21
Total National Costs of Intensive Care..	22
CHAPTER 4: UTILIZATION OF ICES.	25
Introduction	25
Utilization by Type of ICU	25
ICU Admission Rates	25
Sex and Age Distribution of ICU Use	27
ICU Case Mix.	28
Diagnoses	28
Other Case Mix Parameters	28
Readmission	29
Length of Stay	29
CHAPTER 5: OUTCOMES OF INTENSIVE CARE: MEDICAL BENEFITS AND COST EFFECTIVENESS	33
Difficulties in Assessing Effectiveness.	33
Clinical Outcomes of ICU Care	34
Functional Outcome	35
Characteristics of ICU Nonsurvivors	35
Age	35
Severity of Illness	36
Resource Use	36
Distribution of ICU Costs Among Patients	37
Monitored Patients	38
Adverse Outcomes of ICU Care..	39
Iatrogenic Illness	39

Contents—continued

	Page
Nosocomial Infections	40
Psychological Reactions	40
Cost-Effectiveness Analysis of Adult Intensive Care	41
CHAPTER 6: PAYMENT FOR ICU SERVICES	45
Traditional Hospital Reimbursement	45
Patient Copayments	45
Utilization Review	45
Prospective Payment Programs	46
Medicare's Current Inpatient Hospital Payment System	46
Description	46
Medicare Utilization of ICUs by DRGs	48
Applicability of DRGs to Ices	48
Physician Payment	51
CHAPTER 7: THE ICU TREATMENT IMPERATIVE	55
Introduction	55
The Highly Technological Nature of ICU Care	55
The Nature of ICU Illnesses	56
Traditional Moral Distinctions in Medicine	57
The Diffusion of Decision making Responsibility	58
Problems of Informed Consent in the ICU	59
Legal Pressures: Defensive Medicine	60
Payment and the Treatment Imperative	62
The Absence of Clinical Predictors	63
CHAPTER 8: FOREGOING LIFE-SUSTAINING TREATMENT	67
Introduction	67
The Natural Process of Death	67
Fundamental Ethical, Moral, and Legal Considerations	68
Procedures for Review of Decisionmaking	70
Rationing ICU Care	71
Explicit or Implicit Rationing of ICU Care?	72
Explicit Rationing	72
Implicit Rationing	73
CHAPTER 9: CONCLUSIONS AND POSSIBLE FUTURE STEPS	77
APPENDIX A: ACKNOWLEDGMENTS AND HEALTH PROGRAM ADVISORY COMMITTEE	81
APPENDIX B: COST ESTIMATES	84
REFERENCES	89

Tables

Table No.	Page
1. Distribution of ICU Beds in Short-Term, Non-Federal Hospitals, by Size of Hospital 1982	16
2. ICU/CCU Beds as Percent of Total Beds by Hospital Size for Short-Term Non-Federal Hospitals, 1982	16
3. Distribution of ICU and CCU Beds, by Region, 1981	16
4. Percentage of ICU/CCU Beds in Short-Term Hospitals, by Hospital Sponsorship, 1976 and 1982	16
5. Summary of Selected ICU Studies	26

Contents—continued

Page

6. Use and Percentage of Hospital Charges Incurred in ICUs and CCUs for Medicare Beneficiaries Discharged From Short-Stay Hospitals, 1979 26
7. Use and Percentage of Hospital Charges Incurred in ICUs and CCUs for Medicare Beneficiaries Discharged From Short-Stay Hospitals, by Geographic Region, 1979.. 27
8. Use and Percentage of Hospital Charges Incurred in ICUs and CCUs for Medicare Beneficiaries Discharged From Short-Stay Hospitals, by Age, 1980 27
9. Retrospective Outcome Studies of ICU Care 35
10, Estimated Number of Special Care Days by Primary Diagnosis Based on HCFA 20-Percent Sample of Medicare Discharges, 1980. 49

Glossary of Acronyms

AHA	– American Hospital Association
APACHE	– Acute Physiology and Chronic Health Evaluation Scale
CBA	– cost-benefit analysis
CCC	– coronary care unit
CEA	– cost-effectiveness analysis
CON	– certificate-of-need
D H H S	– U.S. Department of Health and Human Services
DRG	– Diagnosis Related Group
HCFA	– Health Care Financing Administration (U.S. Department of Health and Human Services)
HMO	– health maintenance organization
ICU	– intensive care unit
IRB	– institutional review board
Iv	— intravenous
LOS	– length of stay
NIH	– National Institutes of Health (U.S. Department of Health and Human Services)
OR	— operating room
PSRO	— Professional Standards Review Organization
SCU	— special care unit
TISS	— Therapeutic Intervention Scoring System
UCR	— usual, customary and reasonable physician charges for payment purposes
UR	— utilization review

OTA Note

These case studies are authored works commissioned by OTA. Each author is responsible for the conclusions of specific case studies. These cases are not statements of official OTA position. OTA does not make recommendations or endorse particular technologies. During the various stages of review and revision, therefore, OTA encouraged the authors to present balanced information and to recognize divergent points of view.

1 .

Introduction and Executive Summary

"The patient's recovery will be watched not only by nurses but by electric eyes too. Sensing devices will constantly monitor his heart rate, his temperature, his respiration rate, his electrocardiogram, and the blood pressure both in his veins and in his arteries. The nurses will not rouse the patient early in the morning to poke a glass thermometer between his gums and then spend much of the day checking up on his and the other patients' conditions. They will simply push a button at the console of their station to get as many readouts as they want. The patient will not have to hope that if he enters a crisis somebody *may* spot it.

If any single bodily function or combination of functions deviates beyond the fixed limits the patient's Physician has programmed into a computer, lights will flash and a buzzer will sound the-alarm Within seconds, nurses, technicians, doctors, and-plete array of equipment will be in action at his bedside."

–Life Magazine, December 2, 1966unun

"Physicians tend to be unimpressed with the published descriptions of units and their working. It often seems to them that the assessment of the results is naive, survival being taken as equivalent of a life saved. They suspect that, however expert the handling of the apparatus, there is often a shallow understanding of the disease and an over-readiness to employ the most dramatic treatment;. . . One is tempted to say that treatment is often more intense than careful . . .

I believe, therefore, with many of my colleagues, that the attempt to segregate all medical emergencies on a basis of apparatus need will prove to have been an aberration."

—Professor A. C. Dornhorst, April 1, 1966

Introduction and Executive Summary

INTRODUCTION

Intensive care units (ICUs) exemplify the best that American medicine has to offer—teams of dedicated professionals using the latest technology to save lives that in the past would have almost surely been lost. Formally developed only in the late 1950s, ICUs are present in almost 80 percent of hospitals in the United States. They are estimated to consume between 15 and 20 percent of the Nation's hospital budget, or almost 1 percent of the gross national product. Yet, despite such large expenditures of public and private resources, there has been remarkably little critical evaluation of the effectiveness of ICU care by either the public or the medical profession.

In recent years, however, there has been growing public and professional awareness of the emotional torment suffered by the patients and their families related to the use of "lifesaving" medical care which does not really benefit the patient. Correspondingly, there has been increasing support for the notion that patients have the right to reject measures that will prolong their lives without improving their condition.

Along with the increasing public recognition that there are times when extraordinary medical care should not be employed, three key developments have made this an opportune time to analyze the costs and benefits of ICU care. First, the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research issued a comprehensive report in March 1983 on the medical, ethical, and legal issues underlying decisions on whether to forego life-sustaining treatment for seriously ill patients (191), The recommendations of the expert commission have direct bearing on decisionmaking for many ICU patients.

Also in March 1983, a Consensus Development Conference sponsored by the National Institutes of Health (NIH) formally evaluated the efficacy and appropriateness of critical care medicine[1] for the first time (176). The Conference Report examines the evidence for efficacy of critical care medicine for various clinical problems and provides recommendations for organization and administration of ICUs.

Finally, in April 1983, Congress enacted a prospective payment system for Medicare in the Social Security Act Amendments of 1983 (Public Law 98-21). This new payment system, which began to be phased in over a 3-year period beginning in October 1983, will dramatically alter payment for services provided in ICUs by placing a limit on the amount of reimbursement available for different categories of illnesses. These limits may have a significant impact on the services available for critically ill patients.

This case study has two purposes. The first is to present what is currently known about ICUs in terms of the distribution of ICU beds, the costs of maintaining ICUs, the utilization of ICUs, the characteristics of ICU patients, and the outcome of ICU care. There are still important gaps in the data, but a substantial body of knowledge exists about the technical aspects of ICU care. The ICU is examined as a discrete medical technology.

The second purpose of the study is to establish a framework for considering some of the clinical, moral, and legal issues that arise with respect to ICU care. The study explores, for example, the factors unique to the ICU that sometimes lead physicians to continue life-support for patients who have minimal hope of improving. It discusses ways in which patients can make known their wishes about foregoing or discontinuing life-support if their condition deteriorates and how physicians and family members can decide whether to terminate life-support when the patient is not capable of making such a decision. It also con-

[1] This case study defines both "'intensive care" and "critical care" as care provided in separate hospital units generally known as "intensive care units. " See ch. 2 for a discussion of definitions.

siders how ICU treatment might be rationed in the future if it becomes necessary to do so.

As is shown in the review of data on costs and benefits of ICU care, the ICU is often an effective, lifesaving technology. However, it is effective at a high cost. Indeed, partially because of its success in many clinical situations, it will not be easy to simply find and eliminate the "waste" in ICUs. Changing the economic incentives for provision of ICU care, as under Medicare's new hospital payment system, has not made it any easier for patients, families, and ICU staffs who frequently face difficult decisions about how aggressively to treat individual patients. Indeed, as the case study explores, the new prospective payment system may make ICU decisionmaking even more difficult and contentious than in the past.

The case study focuses on adult ICUS and not neonatal, burn, or cardiac units. While some of the issues raised here are applicable to these other specialized care units, these other units generally present different clinical, ethical, and public policy issues. Certainly, all units treat seriously ill patients. However, the moral, ethical, and legal problems raised by withholding care for seriously handicapped newborns, for example, differ from the problems raised by withholding care for an elderly person with a terminal condition. The issues related to treatment of such infants, which has been the center of the recent "Baby Doe" controversy, deserve separate attention. Likewise, as the study emphasizes, coronary care patients are clinically different from general intensive care patients.

EXECUTIVE SUMMARY

The ICU has been called the hallmark of the modern hospital but has come into existence only over the last 25 years. Initially, the ICU was an expansion of the surgical recovery room and was subsequently an outgrowth of the respiratory care units made possible by the development of the mechanical ventilator.

Today, almost 80 percent of short-term general hospitals have at least one ICU. **Overall, 5.9 percent of total hospital beds in non-Federal, short-term community hospitals in** 1982 **were beds in** ICU **and coronary care units (CCUS).** Beds in other types of special care units, including pediatric, neonatal, and burn units, add another 1 percent to the total complement of special care beds.

ICU beds are reasonably evenly distributed among all sizes of hospitals, regions of the country, and types of hospital sponsorship. Over the last 6 years, the number of ICU beds has risen abouts percent a year, compared to a rise of general hospital beds of only 1 percent a year. A major rise of ICU beds occurred between 1979 and 1981, particularly in hospitals of greater than 500 beds. Federal and State policy, particularly certificate-of-need laws and Medicare reimbursement policy until 1982, probably contributed to the continued expansion of ICU beds and ICU utilization.

For a number of technical and conceptual reasons, an accurate estimate of the cost of ICU care is difficult to make. For example, there is disagreement on whether consideration of ICU costs should include the room and board costs of ICU care only, the room and board and ancillary care costs of patients while in the ICU, or the incremental costs of ICUs above that which the hospital would have to bear in any case for seriously ill patients. The national average per diem charge in 1982 of an ICU bed was $408 compared to a regular bed per diem charge of $167, a ratio of about 2.5:1. However, it is likely that the true cost ratio is closer to 3-3.s:1. In addition, ICU patients consume a greater proportion of ancillary services, particularly laboratory and pharmacy services, than regular floor patients.

Based on these and other considerations, **it is estimated that the costs of adult ICU and CCU care—the cost to the hospital patients while they are in the special care unit—represents about 14 to 17 percent of total inpatient, community hospital costs, or *$13* billion to** $15 **billion in 1982.**

Inclusion of the other types of specialized and Federal hospital ICUs would bring the percentage up to about 20 percent.

Utilization of ICUs

According to 1979 Medicare data, 18 percent of Medicare discharges included a stay in intensive care (including coronary care) in that year. Unfortunately, similar data are not available for the entire population. From reports from individual hospitals, however, certain general utilization patterns do emerge (these reports are weighted towards large and teaching hospitals). The representation of the elderly in ICUs seems to be the same or slightly more than in the hospital as a whole. Poor chronic health status, rather than age, appears to be a predominant factor limiting use of ICUs in individual cases in the United States. In comparison to the United States, ICU patients in other countries have a significantly lower mean age.

There is no accepted classification scheme that describes the clinical characteristics of ICU patients, largely because ICU patients are a heterogeneous population who have multiple underlying medical problems and who exhibit varying physiologic disturbances. **ICU patients range from those who are in the ICU primarily for monitoring for potential disturbances to those who are critically ill and receive life-supporting treatment and continuous intensive nursing and physician care.**

Outcomes of Intensive Care

Unfortunately, it is difficult to separate the intensity of care from the setting in which it is provided, and therefore, to know whether intensive care would be as effective if provided on the general hospital floor as in the physically and administratively separate ICU. Many believe that randomized clinical trials of ICUs, at least for unstable patients, are currently unethical, because ICU care has become the accepted and standard mode of treatment in the United States for most severely ill and injured patients.

A recent NIH-sponsored consensus panel found that it is impossible to generalize about whether ICU care improves outcome for the varied ICU patient population. The panel felt that ICU intervention is unequivocally lifesaving for some conditions, particularly where there is an acute, reversible disease such as drug overdose or major trauma. There is less certainty about the effectiveness of ICU care in other conditions, particularly in the presence of a severe, debilitating chronic illness, such as cancer or cirrhosis of the liver. **Investigators believe that underlying disease is probably the most significant predictor of the outcome of ICU care, although patient age and severity of illness are also important.**

Recent data have emphasized the inverse relationship between the cost of ICU care and survival. At this time, however, there are no accepted methods for determining ahead of time which patients will benefit from additional ICU care. From a number of studies, it is clear that the sickest ICU patients, many of whom do not survive, consume a highly disproportionate share of ICU charges. Two recent studies, for example, found that 17 and 18 percent, respectively, of the ICU patient population generated half of the ICU charges. Moreover, charges do not account for the substantial cross-subsidization of costs between ICU patients. It is likely, then, that the true proportion of costs consumed by the sickest ICU patients are substantially greater than even the charge data suggest.

At the other end of the ICU patient spectrum are patients in the ICU primarily for monitoring of the development of a life-threatening complication. Some of these patients may be able to be cared for safely and more cost effectively outside of the ICU, either in intermediate care units or on regular medical floors. On the other hand, there may be a population of ICU patients who are discharged prematurely from ICUs. Research has only recently begun to better define which patients should be routinely monitored in an ICU and which would do as well or even better if cared for on other floors in the hospital.

Another consideration in deciding whether a patient should be cared for in the ICU is the reality of adverse effects of ICU care, so-called iatrogenic illness. A list of major iatrogenic complications of prolonged ICU care has been identified. Noso-

comial infections—i. e., infections that were not present or incubating at the time of hospital admission—and various serious psychological reactions are particular complications of ICU care.

Payment for ICU Services

To the extent that insurers distinguish ICU care from other hospital care for purposes of payment, the result has been to reward ICU care relative to care in intermediate level special care units or on general floors of the hospital. For example, in 1980, Medicare tightened the existing payment limits on routine bed costs but not on ICU bed costs—the so-called "section 223 limits. " Furthermore, utilization review efforts generally have not considered the appropriate level of care within the hospital.

Medicare's inpatient hospital payment policies, however, have now changed dramatically as a result of the passage of the Social Security Act Amendments of 1983 (Public Law 98-21). Under the relatively new system, hospitals receive a fixed payment per discharge based on the patient's principal diagnosis. The classification system, which identifies 467 different clinical conditions called diagnosis-related groups (DRGs) appears ill-suited for describing certain types of patients cared for in ICUs. DRG payments are based largely on a single diagnosis. Yet, ICU patients often have multiple serious underlying illnesses. For these patients, designation of a single, principal diagnosis is likely to be arbitrary, and the resources used due to the presence of additional diagnoses would not be accounted for.

In addition, the DRG scheme does not take severity of illness into account. For some diagnoses, particularly noncardiac medical conditions, the DRG category does not reflect the use of ICUs for the more severely ill patients with that principal diagnosis. For example, only ***3.5*** percent of the average total hospital stay for Medicare patients with cirrhosis (DRG 202) represent ICU days. Yet, the sickest patients with cirrhosis are among the highest cost ICU patients.

Furthermore, the outlier policy that the Health Care Financing Administration has implemented pays hospitals less than the marginal costs of caring for the sickest ICU patients. **In short, it appears that under Medicare's DRG payment system, the sicker ICU patients will be substantial financial "losers" to the hospital.**

Decisionmaking in the ICU

The new incentives of the DRG payment system may conflict with an ICU decisionmaking environment in many hospitals in which the cost of care has been of minor concern in the past. Indeed, a number of factors, some of which are somewhat unique to the ICU, have led to a decisionmaking process that often has led physicians to provide life-support care in the ICU after the initial rationale for doing so no longer exists. Factors that have created an ICU treatment imperative include:

- The highly technological nature of ICU care, which often results in focus on the technical details of treatment rather than the rationale for continued treatment.
- The nature of ICU illnesses, which often require "technologically oriented" treatment even when the primary intent is to provide comfort rather than cure to a desperately ill patient.
- Traditional moral distinctions in medicine that in some cases result in more care than the patient would choose if able to do so.
- Diffusion of decisionmaking responsibility, especially in relation to decisions to forego or terminate life-support.
- Problems of informed consent in the ICU where many patients are temporarily or permanently incompetent.
- The practice of defensive medicine by physicians, which involves taking or not taking certain actions more as a defense against potential legal actions than for the patient's benefit. Defensive medicine may be a particular problem in the ICU, because of the life-and-death nature of ICU care, the relative visibility of ICU decisions, and great uncertainty about likely court decisions on these kinds of cases.
- A payment environment which, until 1982, provided financial rewards to hospitals and physicians for provision of ICU care. Physi-

cian payment methods continue to pay generously for the procedure-oriented ICU care.
- The absence of a data base for the common ICU conditions on which to make reliable clinical predictions of individual ICU patients' chances of immediate and long-term survival.

Foregoing Life=Sustaining Treatment

The Critical Care Consensus Development Conference sponsored by NIH has concluded that it is not appropriate to devote limited ICU ***resources*** to patients without reasonable prospect of significant recovery or to simply prolong the natural process of death.

In general, a terminally ill patient's right to forego or discontinue life-sustaining treatment has been established and is usually protected by the constitutional right to privacy. Practical difficulties arise when the patient is not competent to decide, and when other decisionmakers, including physicians, families; and patient surrogates, do not agree on what medical treatment to pursue. State courts have differed on the decisionmaking procedures to use when a patient is not able to choose for himself.

Recent court decisions differ even over when a patient is considered "terminal" and over what constitutes "medical" treatment. Likewise, many courts have continued to invoke a distinction between ordinary and extraordinary care, while some have explicitly rejected the distinction.

Possible Future Steps

Because of the increasing burden of medical care costs on individuals and on society as a whole, it is likely that the funds available for intensive care will be much more strictly limited than in the past. Because Medicare's DRG payment system in general makes many ICU Medicare patients financial losers for the hospital it may, therefore, alter the prevailing provider attitudes about the appropriateness and extent of ICU care in individual situations.

In recent years, the number of ICU beds has expanded to meet increased demand for beds, except in public hospitals in financial distress or at times when there was a shortage of ICU nurses to staff available beds. In the future, there will need to be greater attention paid to how to ration ICU beds. The DRG system used by Medicare is a form of "implicit" rationing, because the payment limitations place greater pressures on physicians and hospitals to make resource allocation choices without setting "explicit" limitations on services or eligible patients. Under this form of rationing, there will be a need to consider expanding the procedural safeguards used on behalf of patients who become major financial losers for the hospital. ICU decisionmaking will become even more difficult than it has been in the past due to potential financial conflict between patients, physicians, and hospitals.

A number of steps might improve the environment for intensive care decisionmaking:

- Research on developing accurate predictors of survival for patients with acute and chronic illnesses could be expanded in order to permit better informed decisions based on the likelihood of short- and long-term survival. In the absence of valid and reliable data, hospitals could consider formalizing an institutional prognosis committee whose function would be to advise physicians, families, and patients on the likelihood of survival with ICU care.
- The suitability of the current DRG method of payment for ICUs should be tested and modified if necessary to take sufficient account of severity of illness.
- The legal system may need to recognize the possible conflict between malpractice standards which assume quality of care that meets national expert criteria, and a decisionmaking environment in which resources may be severely limited.
- Health professionals who are involved in decisionmaking on critically ill patients might benefit from more education in medical ethics and relevant legal procedures and obligations.
- The actual decisionmaking process for critically ill patients may need greater attention. For example, hospitals might explore formalizing decisionmaking committees to lessen the

burden on individuals faced with difficult choices about terminating life-support. More generally, society will need to decide how it wishes conflicts over decisions on terminating life-support to be resolved—i.e., in courts, through formal hospital committees, through government-imposed procedures which can follow fixed rules and regulations, or other, perhaps more decentralized, mechanisms.

2. Evolution, Distribution, and Regulation of Intensive Care Units

2. Evolution, Distribution, and Regulation of Intensive Care Units

THE DEVELOPMENT OF THE ICU

The intensive care unit (ICU) has been called the hallmark of the modern hospital (205), yet it is a recent development, having come into existence only in the last 25 years. The development of ICUs was preceded by the rapid growth of postoperative recovery rooms (115) following World War II. As early as 1863, however, Florence Nightingale had foreseen the utility of a separate area for observing patients recovering from the immediate effects of surgery (172).

To a large extent, the initial stimulus for a separate recovery area for specialized care was a managerial response to overwhelming medical demands. The Massachusetts General Hospital, for example, when suddenly faced with treating 39 survivors of the Boston Coconut Grove Fire in 1942, set up a makeshift "burn unit" which it maintained for 15 days, until the majority of patients had been sent home (115). In the North African and Italian campaigns of World War II, shock wards were established to resuscitate battlefield casualties and to care for injured soldiers before and after surgery (115). After the war, an acute shortage of nurses provided much of the impetus for the spread of recovery rooms in the United States.

Although recovery rooms were established initially as a means of managing large numbers of patients more efficiently, the medical benefits of better postoperative nursing care soon became apparent, and recovery rooms flourished. In 1951, only 21 percent of community hospitals had recovery rooms; a decade later, virtually all hospitals had them (205).

During the 1950s, using the recovery room as a model, a few ICUs began appearing on both sides of the Atlantic. An early version of what has become known as a respiratory ICU, for example, was set up in Denmark during the 1952 polio epidemic in Scandinavia. After 27 of 31 patients suffering from respiratory or pharyngeal paralysis at Copenhagen's Blegdam Hospital died, the hospital's senior anesthetist performed a tracheotomy on a 12-year-old girl and inserted a cuffed endotracheal tube. The patient underwent prolonged manual ventilation and survived.

With this new lifesaving, if laborious, technology in hand, a separate area to care for polio victims was established in the hospital. "At an early stage the following measures were adopted: 1) patients who were likely to develop respiratory complications were transferred to special wards for observation and recording vital signs, etc.; 2) tracheotomies were done under general anesthesia and cuffed tubes were used; 3) manual, intermittent positive-pressure ventilation was used instead of or to supplement respirators; and 4) secondary shock was treated" (121).

In addition, the hospital developed an elaborate personnel system, involving anesthetists, epidemiologists, nurses, medical students, and hospital workers, to provide continuous care for patients and to maintain the machinery being used. As a result of these measures, the mortality rate for polio victims was reduced from 87 to 40 percent.

With the exception of Danish experience, ICUs, like recovery rooms, were established initially more for managerial than for medical reasons. A major factor in their early development was the need to relieve nurses who were so busy caring for a few critically sick patients that they were neglecting the remaining patients on the wards (30). In addition, ICUs were even seen as a means of reducing the cost of medical care (115).

By the late 1950s, the rapid development of the mechanical ventilator provided the medical rationale for establishing ICUs. This life-supporting technology needed to be monitored too closely to be dispersed throughout the hospital ***(136,200).*** In a number of hospitals, the general ICU was a direct outgrowth of a respiratory ICU set up to

care for patients suffering respiratory paralysis caused by polio (36) or tetanus (155).

In 1958, only about **25** percent of community hospitals with more than 300 beds reported having an ICU. By the last half of the 1960s, most U.S. hospitals had established at least one ICU ***(205).***

ADVANTAGES AND DISADVANTAGES OF ICU CARE

Early advocates of ICUs identified a number of advantages for establishing a separate intensive care unit (frequently called an "intensive therapy unit" in England and Europe) (25,47,178,208,231):

- maintenance of high standards of care for seriously ill patients by using specially trained physicians and nurses;
- provision of more continuous observation and frequent measurements of relevant indicators of clinical condition;
- concentration of technologies in one location to avoid duplication of equipment and personnel;
- direct access to patients for major procedures and therapies, including resuscitation;
- avoidance of upsetting the regular ward routine and disturbing less ill ward patients;
- fostering high staff morale and team work; and
- opportunities for concentrated education and research.

From the outset, there was disagreement on which patients would benefit from ICU care. Early units attempted to exclude "terminal care cases, chronic cases, and disturbed or disturbing patients" (23). Some emphasized that intensive therapy should be provided to support vital functions until the underlying disease process could be corrected or run its course (200). Other early commentators saw the ICU simply as the place for the "critically ill" **(187),** or advocated the use of the ICU as a last resort for a "final desperate attempt" to save a life (36). Lack of agreement persists on which patients should have priority access to ICU care.

While the advantages of the ICU were recognized early, so were the potential disadvantages (25,64,178):

- a noisy, intrusive environment for seriously ill patients;
- interrupted continuity of medical responsibility;
- mental and physical strain on the ICU staff;
- overenergetic treatment—for both hopeless and less serious cases;
- decreased nursing skills on the general wards as the sickest patients are removed;
- potential for high cost with unfair claims on the hospital budget; and
- increased cross-infections among seriously ill patients in the same area.

Stated another way, in some situations, application of intensive care maybe unnecessary because the condition is not serious enough; unsuccessful because the condition is too far advanced; unsafe because the risk of complications is too great; unsound because it serves no useful purpose for the patient; or unwise because it utilizes too many resources **(125).**

Despite recognized patient care problems and, more recently, cost concerns, ICU beds have continued to proliferate. There is substantial evidence that, at least for some types of patients, care provided in ICUs is extremely effective. For many medical problems, care of patients outside an ICU would be unthinkable to the modem clinician. At the same time, it is remarkable that such an allpervasive and cost-generating innovation has developed primarily because of "a priori" considerations, with few critical evaluations of its effectiveness (198). The growth of ICUs has been fostered by a highly favorable reimbursement system (6o), by the development of professional medical and nursing critical care societies which constitute a strong constituency for continued expansion of ICUs ***(166),*** and by Federal policies which either

have directly stimulated ICU development (e.g., the Regional Medical Program) or have tended preferentially to exempt ICUs from expansion restraints (205).

DEFINITIONS

In the broadest sense of the term, "critical care medicine" has been used to include management of critical illness or injury at the scene of onset, during transportation to a medical facility, in the emergency department, during surgical intervention in the operating room, and finally in the hospital-based ICU (207). Some consider critical care to be the highly technical treatment that is provided to the most severely ill or injured subset of the population receiving concentrated care in a specialized unit (128,208). Thus, critical care may be considered a higher level of management than intensive care. This case study, however, will follow the lead of the 1983 NIH Consensus Development Conference on Critical Care Medicine and not distinguish the two terms (262); it will consider both intensive care and critical care to be the care provided in separate units generally known as "intensive care units."

From the original recovery rooms and ICUs, other types of units providing specialized care have evolved. In fact, the Joint Commission for the Accreditation of Hospitals provides standards for "special care units," which encompass a broader spectrum of functions than ICUs **(126).** Since the early 1960s, when the ability to identify and treat potentially life-threatening arrhythmias was first developed, most cardiac patients have been treated in coronary care units (CCUs) (59). CCUs generally developed independently of ICUs to utilize the new technology of rhythm monitoring to preserve the health of relatively stable patients, rather than to relieve nurses faced with caring for ward patients, which was the primary impetus for the development of ICUs (205). Today, CCUs treat patients with a relatively narrow range of diagnoses, primarily patients with suspected or actual heart attacks and related problems. CCU patients are not as ill, have fewer physiologic systems involved, require fewer therapeutic services ***(67),*** have better outcomes (31,249), have a greater need for a quiet, stress-free environment **(28),** and pose different evaluation and policy issues than do patients in ICUs. In short, CCUs serve a different primary function from ICUs (238), and most hospitals with more than 100 beds have separate CCUs and ICUs (4). Because they cannot afford to operate separate units, smaller hospitals frequently combine the separate functions of coronary and intensive care. As a result, some of the data sources cited in this study, including Medicare cost reports, have necessarily combined ICUs and CCUs as critical care or special care units.

In recent years, special care units have diversified in other ways (166). First, they have evolved along specialty or subspecialty lines. Thus, burn, cardiovascular surgery, pediatric, neonatal, and respiratory as well as medical and/or surgical intensive care units are now common. Neonatal, pediatric, and burn units raise distinct issues and will not be considered in this case study. Second, units have differentiated into increasingly distinct levels of intensity of care, e.g., step-down and intermediate care units. These newer types of units, usually adjacent to the coronary or intensive care unit, generally provide more concentrated nursing levels than those on the general medical or surgical floors, but they do not provide intensive therapy.

REQUIREMENTS OF AN ICU

A detailed consideration of the design, organization, staffing levels, skills, personnel policies, and other components of an ICU is beyond the scope of this study. Yet in general, all intensive care units meet these requirements:

- care for severely ill or potentially severely ill patients;
- employ specially trained registered nurses on a one-nurse to one- to three-patient basis;
- identify a physician as the director of patient care and administrator of the unit;
- have 24-hour acute care laboratory support; and
- provide a wide range of technological services, with the help of expert medical subspecialists and ancillary personnel (51,166).

While the availability of physicians in ICUs varies with the size and type of hospital, all ICUs combine intensive nursing care and constant patient monitoring (116). In community hospitals, the ICU medical director is frequently not full-time and shares patient care responsibilities with other staff physicians who also have major non-ICU responsibilities. In these units, day-to-day management and administrative decisions are made by the head nurse of the ICU (283). Large hospital ICUs tend to have full-time medical directors.

The NIH Consensus Panel has identified the minimal technological capabilities that an ICU should provide, regardless of the type of facility in which it is located (176):

A. cardiopulmonary resuscitation;
B. airway management, including endotracheal incubation and assisted ventilation;
C. oxygen delivery systems and qualified respiratory therapists or registered nurses to deliver oxygen therapy;
D. continual electrocardiographic monitoring;
E. emergency temporary cardiac pacing;
F. access to rapid and comprehensive, specified laboratory services;
G. nutritional support services;
H. titrated therapeutic interventions with infusion pumps;
I. additional specialized technological capability based on the particular ICU patient composition; and
J. portable life-support equipment for use in patient transport.

SPECIALTY V. MULTISPECIALTY ICUs

Since their development two decades ago, hospitals have differed on whether to establish one or more multispecialty ICUs to treat the range of seriously ill medical and surgical patients or to set up separate ICUs for patients with similar problems **(208).** For reasons of efficiency and economy, smaller hospitals generally have a combined medical and surgical ICU. The smallest hospitals also combine coronary care with intensive care in a single unit (4).

Larger hospitals, particularly teaching hospitals, often have separate general medical and surgical units as well as separate subspecialty units for specific types of medical problems, e.g., cardiac surgery and respiratory care. The Massachusetts General Hospital, for example, has nine separate subspecialty ICUs ***(248).*** However, even hospitals of similar size and type have adopted different approaches to the issue of multispecialty v. separate specialty ICUs (136).

The major rationale for multispecialty ICUS is a medical one, namely, that regardless of the underlying disease, many life-threatening physiological disturbances are quite similar in seriously ill patients (43,208,265). Thus, a basic purpose of ICU care is to support general physiologic responses to stress in order to provide time for a specific therapy for the underlying illness to take effect (89,116,199,222). At times, ICUs primarily treat physiologic disturbances, not diseases; they save lives primarily by supporting oxygenation, often with respirators (209), and by prevent-

ing circulatory collapse and shock (222). Since physiologic complications are similar regardless of precipitating factors, there is a strong medical rationale for multispecialty intensive care provided by comprehensively trained generalists (8).

Increasingly, concerns about efficiency and rising costs have supported maintaining multispecialty units rather than separate subspecialty units. With multispecialty units, there maybe less duplication of expensive equipment, although ICUs generally do not utilize "big ticket" technologies (6). More importantly, because of highly variable clinical demands for ICU care, ICU occupancy can vary dramatically, and combining medical and surgical specialty and subspecialty units permits greater efficiency in the use of personnel, particularly nurses, which is a major cost factor in ICUs (212).

Traditionally, however, demand for ICUs has developed along subspecialty lines, usually in response to the availability of new medical technology. For example, the mechanical respirator led to the respiratory ICU, and the advent of coronary artery bypass surgery led to the postcardiac surgery ICU. In addition, specialists often feel that physicians trained in other fields do not have sufficient understanding and skill to care for patients with particular "subspecialty" problems. Indeed, some have advocated a separate surgical ICU for each surgical specialty in a large hospital (81). Others feel that nursing personnel skilled in one subspecialty, such as cardiology, may be unsuited by temperament, motivation, and training for work in other subspecialties (147).

In short, the debate over the desirability of generalists v. specialists which exists in medicine generally is also being waged in the intensive care world. The trend, which is supported by the Society for Critical Care Medicine, is to cross traditional departmental and specialty lines and to create a "multidisciplinary specialty" equally skilled at caring for medical and surgical problems (95,274). An attempt to define the boundaries of critical care medicine by examination and prescribed training has recently been developed by the American Board of Medical Specialties (8). In 1980, the Boards of Internal Medicine, Pediatrics, Anesthesiology, and Surgery joined together to offer a certificate of special competence in critical care medicine (95). This examination has yet to be given. In 1982, some 50 fellowship programs in critical care medicine in the United States were training approximately 150 physicians to become critical care generalists (91,92). Another 36 programs were training fellows in pediatric critical care medicine. Despite the new cadre of critical care generalists, however, many hospitals continue to maintain separate specialty and subspecialty ICUs along departmental lines.

DISTRIBUTION OF ICU BEDS

It is difficult to estimate precisely the number of ICUs and ICU beds in this country because of the ways in which hospitals report their bed capacity. This is particularly a problem with smaller hospitals, which may designate their ICUs as CCUs or mixed ICU/CCUs in the annual American Hospital Association (AHA) survey. In addition, the annual AHA survey includes multiple ICUs reported from single hospitals. From 1981 AHA survey tapes, it can be estimated that 78 percent of short-term general hospitals have at least one ICU or CCU, and that 93 percent of hospitals larger than 200 beds have a separate ICU (106). Overall, in 1982, 5.9 percent of the total hospital beds in non-Federal, short-term community hospitals were ICU and CCU beds. This figure does not include pediatric ICU beds, neonatal beds, or burn care beds, which add another 0.2 percent, 0.7 percent and 0.1 percent, respectively, to the total number ICU beds (4).

Table 1 shows the distribution of reported ICU beds by size of hospital. In general, ICU beds are fairly evenly distributed across all sizes of hospitals. In 1982, for example, hospitals larger than 500 beds, which account for 22.6 percent of total short-term general hospital beds (4), have 24.8 percent of reported ICU beds. Table 2 shows the

Table 1 .- Distribution of ICU Beds in Short-Term, Non-Federal Hospitals, by Size of Hospital, 1982

Hospital bed size	Total hospital beds	Percent of total	Total ICU/CCU beds	Percent of total
<100	146,706	14.5	5,889	9.9
100-199	195,425	19.3	10,677	17.9
200-299	179,312	17.7	11,302	18.9
300-399	144,012	14.2	9,312	15.6
400-499	120,682	11.9	7,692	12.9
>500	229,043	22.6	14,826	24.8
Total	1,015,180	99.3	59,698	100.0

SOURCE: American Hospital Association, *Hospital Statistics,* 1983 edition.

Table 2.-ICU/CCU Beds as Percent of Total Beds by Hospital Size for Short-Term Nonfederal Hospitals, 1982

Hospital bed size	Percent ICU/CCU beds
<1oo	4.0
100-199	5.5
200-299	6.3
300-399	6.5
400-499	
>500	: : :
Total	5.9

SOURCE: American Hospital Association, *Hospital Statistis,* 1983 edition,

Table 3.–Distribution of ICU and CCU Beds, by Region, 1981

Region	Per 10,000 population	Per 100 hospital beds
New England		5.8
Middle Atlantic	; : :	
South Atlantic	2.9	: : :
East North Central	3.3	6.7
East South Central		5.3
West North Central	; : ;	5.0
West South Central	2.6	5.2
Mountain	2.6	6.2
Pacific	2.7	7.0
Total	2.9	5.9[a]

[a]Hospital data in this table includes Federal hospitals and specialty service short-term hospitals.

SOURCE: American Hospital Association, *Hospital Statistics,* 1982 edition; and U.S. Department of Commerce, Bureau of the Census, *State and* Metropolita *Area* Data Book, 1982,

percent of ICU/CCU beds as a percentage of total beds by hospital size in 1982. For hospitalsof200 beds or more, the ICU/CCU bed percentage is very consistent.

Table 3 indicates the distribution of combined, non-Federal intensive and coronary care bedsby region as of 1981. (Coronary care beds makeup about **25** percent of the total.) There are some variations in the number of these beds as a percent of total beds, with the Pacific, East North Central and Mountain States having the highest percentages. However, as Russell pointed out, the distribution of ICU/CCU beds is much more uniform when considered in relation to population, rather than to hospital beds **(205).**

Finally, as shown in table 4, the distribution of ICU beds varies somewhat according to hospital sponsorship.

Table 4.—Percentage of ICU/CCU Beds in Short-Term Hospitals, by Hospital Sponsorship, 1976 and 1982

Type of hospital	Percent of hospital beds that are ICU or CCU beds 1976	1982
Nongovernment not-for-profit	5.0	6.2
Investor owned (for-profit)	4.4	5.4
State and local government	4.2	5.1
All non-Federal	4.7	5.9
(Federal hospitals)[a]	(3.7)	(3.4)

[a]Reporting from Federal hospitals includes hospitals other than short-term general hospitals, including long-term care facilities. Percentages of ICU/CCU in Federal hospitals are not strictly comparable to those in non-Federal hospitals.

SOURCE: American Hospital Association, *Hospital Statistics,* 1977 and 1983 editions.

EXPANSION OF ICU BEDS

While the number of community hospital beds increased only about ***6*** percent between 1976 and 1982, reported ICU and CCU beds in community hospitals increased by ***29*** percent, or an average of almost 5 percent a year. Moreover, over half of that reported increase occurred between 1979

to 1981. In this 2-year span, reported ICU beds increased 14.3 percent and reported CCU beds grew 15.4 percent (4), despite the absence of any dramatic medical breakthroughs that would explain such a sharp rise. While the number of coronary artery bypass graft surgery procedures performed in the country was increasing by perhaps *20* percent a year during these years (257), the increase in the number of such operations could explain only a very small increase in ICU beds.

One can speculate, therefore, that the Medicare policy implemented in 1980 (73) that tightened limits on routine bed charges—commonly known as the "section 223 limits"—but not on special care bed charges or ancillary services, created a strong stimulus for hospitals to add more ICU beds (60) or, perhaps, to reassign beds to special care where possible. The most dramatic rise in ICU/CCU beds between 1979 and 1981 occurred in hospitals with more than 500 beds, which accounted for almost 55 percent of the total increase in ICU/CCU beds in these two years (4). In 1982, the number of ICU/CCU beds increased 4 percent, while total community hospital beds increased only 1 percent. Thus, while ICU bed expansion has continued at a much faster rate than hospital beds generally, the pace of growth found in 1980 and 1981 has slowed. ,

REGULATION OF ICUs

Along with the medical and organizational reasons for their expansion, ICUs and CCUs were encouraged by the Federal Government in the 1960s initially in the Regional Medical Programs (205).

In the 1970s, State certificate-of-need (CON) statutes were passed in most States. CON statutes require a prior determination by a governmental agency that certain major capital expenditures or changes in health care facilities are needed (19). Early evaluations showed that CON programs helped forestall the addition of general hospital and long-term care beds (19). However, ICU beds have generally been approved by CON agencies.

In addition, Salkever and Bice (211) found that while CON programs controlled expansion in bed supply to some extent, they stimulated other types of hospital investment. Specifically, they found that assets per hospital bed, for equipment and other nonlabor products, actually increased as a result of CON. A subsequent, more definitive study confirmed the findings that the CON requirement generally has been successful in limiting the number of beds, but not the intensity of resource use or costs *(188).* Ironically, the threat of CON review may have encouraged hospitals to convert low-asset routine care beds into comparatively high-asset ICU beds (166).

Equipment used in ICUs rarely requires CON approval. The national threshold for requiring CON approval in the National Health Planning and Resources Development Act of **1974** (Public Law **93-641)** was **$150,000, and** most ICU equipment is well below that level. The cost per bed of typical ICU cardiac monitoring equipment in 1978, for example, ranged from $6,000 to $8,500 (6). A new ICU respirator costs between $10,000 to $15,000 (87).

The construction costs of each patient unit in the ICU was estimated to cost between $44,ooo and **$75,000** in **1978** dollars (6), Renovation costs were much less. Thus, hospitals with sufficient capital can escape CON review altogether by gradually expanding and upgrading already existing ICUs (119,166). As was noted earlier, hospitals reported about a 15-percent increase in ICU beds between 1979 and 1981, a time when CON programs were functioning in virtually every State. The current trend toward raising CON thresholds practically assures that CON regulation of ICUs will remain a minor issue.

3.
Cost of ICU Care

3. Cost of ICU Care

COMPONENTS OF ICU COSTS

The cost of intensive care units (ICUs) can be divided into the direct costs of operating the ICU and the indirect costs for *central services* that are allocated to the ICU **(6).** Sanders estimates (212) that for Massachusetts General Hospital in Boston about 65 percent of ICU costs (for labor, equipment, etc.) are direct, and that about 35 percent of costs (for hospital overhead, housekeeping, etc.) are indirect.

Direct costs include fixed costs and variable costs. Fixed costs exist no matter how many patients are treated in the ICU and include depreciation for the cost of construction, renovation, and equipment, as well as equipment maintenance (6). Variable costs are dependent on the volume of services provided. Some variable costs, such as personnel costs, are fixed over a specific range in patient volume, but change when the patient vol*ume exceeds* the range. Other variable costs, such as nondurable equipment and oxygen, are dependent directly on total patient days (6). Data from both foreign and domestic ICUs indicate that **50 to 80** percent of direct costs are variable personnel costs, primarily for nursing (42,101,155, 212). On average, ICUs use almost three times as many nursing hours per patient day as do general floors (205).

COSTS OF AN ICU DAY

It has become increasingly clear that hospital charges do not represent the true costs of providing hospital services (80). Generally, charges are greater than operating costs, in order to pay for bad debts, to support nonreimbursable educational and preventive health programs, and to pay for costs disallowed by cost-based insurers, including many Blue Cross plans, Medicaid, and Medicare (80). For example, by analyzing cost and billing data, the Health Care Financing Administration has calculated the national ratio of allowable Medicare inpatient operating costs to Medicare inpatient charges at 0.72 (74).

ICUs are different from most hospital services (including generaI room and board'), however, in that charges for ICU room and board are often set below cost (6,212,240). In one detailed econometric analysis, ICU charges for room and board in one hospital were found to be only slightly more than half of calculated costs (109). ICU data from U.S. hospitals consist mostly of room and board charge data, unadjusted for actual cost. The charges or costs for the ancillary services used by ICU patients are not matched to their ICU stays, because hospitals report their charges for the various ancillary services by department, not by site of patient location. If one considers only ICU room and board charges in estimating ICU costs, one may significantly underestimate the relative costliness of ICU care, then, because ICU charges underestimate ICU costs and because the costs of ancillary services that are performed when patients are in the ICU are not included.

With the exception of certain administrative costs that support ICU physician staff, the costs of physician services to ICU patients generally are not included in hospital cost reports or in hospital charges. As will be discussed further in chapter **6,** there is reason to believe that ICU patients receive a greater intensity of billable physician services than non-ICU patients.

Cost data from other countries provide an opportunity to determine relative costliness of ICU v. non-ICU care, particularly in countries where hospitals receive operating budgets. In those fixed revenue systems, hospitals do not need to charge more than costs in some departments to make up

[1]Overall, room and board charges make up slightly less than half of total hospital inpatient charges; the rest is made up of various categories of ancillary services.

for losses in other departments. Estimates of costs for a day of ICU care compared to a day of ward care have ranged from a 2.5:1 ratio in France (182), to 3:1 in Canada and Australia (29,89), and to 4:1 in Great Britain (174). An attempt in the early 1970s to estimate actual costs (including ancillary services) in the United States yielded an estimate of 3.5:1 in a large, teaching hospital (97). But anecdotal reports now suggest that relative costs of ICU to non-ICU care in some institutions are as much as 5:1 (93).

Numerous U.S. studies of the per diem charge ratio for room and board in the ICU compared to non-ICU floors have shown a range of 2:1 to 2.5:1 in small community hospitals **(43,140) to** about 3:1 in large community and teaching hospitals (140).

The Equitable Life Assurance Hospital Daily Service Charge Survey of 2,519 hospitals in 1982 (71) showed an average charge of $408.50 for an intensive care bed and $167.50 for a private bed, a ratio of about 2.5:1.

Patients in ICUs have a relatively greater percentage of their charges attributed to ancillary services than to accommodations compared to general floor patients. In a recent study of a large-sized community hospital, for example, 45.7 percent of the total charges for ICU patients were for room and board, while 57.1 percent of the total charges for non-ICU patients were for room and board (175). Generally speaking, the more acutely ill the patient, the greater the percentage of the bill attributable to ancillary services (49,67,162,271).

In short, ICU patients consume more direct resources, mostly for nursing, than regular floor patients, as well as a greater proportion of ancillary services, particularly laboratory and pharmacy services (49,101) than regular floor patients.

TOTAL NATIONAL COSTS OF INTENSIVE CARE

There is a notable lack of precision in estimates of the portion of hospital care costs that can be attributed to intensive care. In a major review of ICUs in Technology *in Hospitals* **(205),** Louise Russell provided a method for indirectly estimating the national cost of ICU care. Recent reviews using Russell's method (described in app. B) estimate that 15 to **20** percent of total costs of hospital care can be attributed to intensive care **(40, 136,206).**

Before refining and updating this estimate, it is important to present the alternative ways of analyzing the costs of intensive care, including calculations of: 1) the direct and indirect costs of operating an ICU; 2) the total hospital costs, including the costs of ancillary services as well as ICU costs, incurred by patients when they are in the ICU; 3) the total hospital costs attributable to patients who spend any time in ICUs; and 4) the incremental cost generated by ICUs above the cost that a hospital would have to absorb for treating very sick patients who would remain in the hospital even if ICUs did not exist. The last definition is particularly relevant to this case study, since it is consistent with the concept that the ICU is a separate technology, independent of the patients treated in it.

Estimates of the total hospital cost of patients when in an ICU (Definition 2) and of the incremental costs of operating an ICU (Definition 4) are probably the most relevant in terms of public policy considerations, but are not easily made from available hospital accounting sources **(267).** The direct and indirect costs of an ICU (Definition 1) and the total costs of intensive care patients (Definition **3)** are more easily estimated from hospital accounting data, but have much more limited policy relevance.

Based on these considerations, estimates of the percentage of total national inpatient hospital costs attributable to intensive care according to the different definitions can be made:

- **Definition 1:** The direct and indirect costs of running the ICU, as reflected in charges for ICU room and board—8 to 10 percent.
- **Definition 2:** The total hospital costs of patients when in the ICU—14 to 17 percent.

- **Definition 3:** The total hospital costs for patients who spend any time in the ICU during a hospitalization—28 to 34 percent.
- Definition 4: 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—cannot be estimated.

The assumptions underlying the estimates and the calculations are available in appendix B.

Given these percentages, one can estimate the national cost of adult intensive care. It should be emphasized that these estimates necessarily include the costs of coronary care, but not those costs associated with most physician services, neonatal, pediatric, or burn units, or the provision of intensive care in Federal hospitals, operated mainly by the Veterans Administration and the Department of Defense. In 1982, total national expenditures for hospital care were $136 billion, of which 84 percent were for acute care in community hospitals—or $114 billion (87a). Since an estimated 87 percent of community hospital costs are inpatient costs (4), $13 billion to $15 billion were spent **in 1982 for costs associated with patients in adult ICUs and coronary care units, according to Definition 2 above.**

25-338 0 - 84 - 3

4
Utilization of ICUs

4
Utilization of ICUs

INTRODUCTION

For a number of reasons, there is little systematic information about the characteristics of intensive care unit (ICU) patients, i.e., their age, sex, length of stay, and case mix. Hospitals and physicians vary considerably, for example, in the way they treat patients with the same disease. Furthermore, as was noted earlier, there is no single model of ICU organization—some hospitals have an ICU combined with a coronary care unit (CCU), while others have separate units; some combine medical and surgical ICUs, and others do not; still others have multiple subspecialty ICUs. Community hospitals, which usually do not have full-time salaried physicians, may put less sick patients in ICUs primarily to provide them with concentrated nursing care (67).

There is no national data base which describes ICU utilization in any detail. The American Hospital Association (AHA) survey data provides information only on ICU and CCU beds and days by hospital size and type (see ch. z). A more detailed profile of ICU patients is based on published studies from individual hospitals. A compilation of many, but not all, such studies is presented in table 5. It should be emphasized that these studies are from teaching hospitals and large community hospitals and may not be representative of the ICU care provided in small community hospitals.

Recently, the Health Care Financing Administration (HCFA) has developed a profile of Medicare hospital utilization, including ICU/CCU utilization, based on its short-stay hospital inpatient stay record file for 1979 and 1980 (111,112). This file, called the MEDPAR file[1], is generated by linking information from three HCFA master program files for a 20-percent sample of Medicare beneficiaries. The MEDPAR file is the only data base which provides population-based rather than hospital-based ICU utilization data, and, of course, it only profiles the Medicare population.

[1]The MEDPAR file also contains billed charge data and clinical characteristics, such as principal diagnosis and principal procedure, in addition to utilization data.

UTILIZATION BY TYPE OF ICU

Surgical ICU patients tend to be younger (49, 155,175,227), to have more limited or reversible diseases with reasonably well-defined therapeutic endpoints (50,56,129,175,178), and to be more homogeneous than medical ICU patients (49). Even so, there are substantial differences among surgical ICU patients. The patient profile of surgical trauma patients, for example, differs significantly from that of postcardiac surgery patients. Trauma patients on average are younger and have longer ICU stays than postcardiac surgery patients.

Medical ICU patients tend to be older, have more progressive, chronic diseases (29,174,248, 265) and have more concurrent illnesses (265). These differences must be kept in mind when evaluating reports of utilization and outcome from particular ICUs.

ICU ADMISSION RATES

It is not known what percentage of the population, or even how many hospitalized patients are placed in an ICU for any defined period of time. Relman suggests that 15 to 20 percent of all patients are cared for in an ICU or CCU at some point during their hospital stay (195).

According to the 1979 MEDPAR sample, 18 percent of Medicare patients who were discharged

Table 5.—Summary of Selected ICU Studies

Study author*	Country	Type of ICU	Dates of data collection	Number in study	Mean age	ICU LOS	Percent ICU mortality	Percent hospital mortality for ICU patients
Safar	U.S.	M-S	1959-1961	561	—	—	30.3	—
Bates	Canada	R	1958-1962		48.0	—	43.0	—
Boyd	U.S.	M-S	1963	336	—	5.0	21.0	
Crockett	G.B.	M-S	1963-1965	608	44.3	—	18.0	
Callahan	U.S.	M-C	1964-1966	1,000	—	3.9	10.7	
BMA [a]	G.B.	M-S	1966-1967	5,521	—	4.0	14.7	
Rogers	U.S.	R	1965-1968	200	—	—	18.0	26.0
Carroll	U.S.	M	1968	95	54.0			—
Skidmore	G.B.	M-S	1965-1969	1,162	—	—	29.8	—
Safar and Grenvik (1971)	Us.	M-S	1965-1970	4,918	—	—	18,5	—
Pessi	Finland		1965-1971	1,001	50.0	6.2	20.1	28.9
Spagnolo	U.S.	i	1970-1971	231	56.0	4.8	28.0	47.0
Bell	G.B.	M-S	1966-1972	2,896	45.2	4.4	16.6	
Petty (1974)	U.S.	M-S	1964-1973	1,598		—	25.3	—
Nun	G.B.	M-S	1970-1974	422	—	—	16.4	
Turnbull	U.S.	M-S(ca)	1971-1974	1,035	—	5.2	22.3	38.6
Tagge (1975)	U.S.	M-S	1972-1974	2,878	63.0	—	8.2	—
Tomlin	G.B.	M-S	1973-1976	1,718		3.0	13.5	19.7
McLeave	Australia	M-S	1975-1976	843	53.0	3.4	14,4	
Vanholder	Belgium		1976	380	53.0	—	32.6	42.6
Chassis	U.S.	M,R	1977	489	54.0	5.1		14.0
Byrick	Canada		1978	58	59.1	8.0		—
Fedulo	U.S.		1978	182	65.0		21.0	29.0
Porno	U.S.	M-S	1978	558	54.7	3.6	11.7	17.3
Thibault	U.S.	M-C	1977-1979	2,693	60.0	3.4	6.0	10.0
Legal	France	M-S	1978-1979	228	50.0	—		34.0
Murata	U.S.	M	1979	149	62.7	3.9	16.7	26.8
Hauser	U.S.	M	1978-1980	724	—	—	19.3	—
Franklin	U.S.	M	1979-1980	512	—	—	26.0	—
Knaus, et al. (CCM,1982) [b]	U.S.	M-S	1980-1981	1,408	54.0	4.1		16.9

*Full citations found in References section.
[a]weighted average from 14 ICUs.
[b]Weighted average from 6 ICUs.
KEY: M-S Medical-Surgical ICU; M Medical ICU; M-C Medical-Cardiac ICU; R Respiratory ICU; S Surgical ICU.

SOURCE: Office of Technology Assessment.

from the hospital used intensive or coronary care. Fifteen percent used both general ward and ICU/CCU beds, while 3 percent used only ICU/CCU beds. As table 6 indicates, use of ICU/CCU beds by Medicare patients does not vary significantly by hospital size, except for hospitals under 100 beds. Table 6 also shows that there is little variation in ICU use by Medicare patients by size of hospital when ICU/CCU use is considered as a percentage of the patients' total charges. Interestingly, there was also little variation in ICU/CCU charges as a percent of total charges by type of hospital sponsorship (not shown); 7 percent of all charges for Medicare patients in voluntary,

Table 6.—Use and Percentage of Hospital Charges incurred in ICUs and CCUs for Medicare Beneficiaries Discharged From Short-Stay Hospitals, 1979

Hospital bed size	Percent using ICU/CCU	Percent total charges incurred in ICU/CCU
1-99 beds	12	5
100-199 beds	18	7
200-299 beds	20	8
300-499 beds	19	8
>500 beds	20	7
All hospitals	m	7

SOURCE: C. Helbing, "Medicare: Use of and Charges for Accommodation and Ancillary Services in Short-Stay Hospitals, 1979," Office of Research, Health Care Financing Administration, U.S. Department of Health and Human Services, undated.

proprietary, and public, non-Federal hospitals were room and board charges for ICU/CCUs.

Given the significant regional variations in the concentration of ICU/CCU beds (see ch. 2), it is not surprising that utilization of ICU/CCU beds by Medicare patients also varied somewhat according to region (see table 7). Perhaps part of the explanation for the higher per diem costs and shorter lengths of stay in ICUs on the west coast is a result of the greater use of relatively costly ICU/CCUs in that region **(255).**

There are also variations by State in the use of ICU/CCUs by Medicare patients; with a range from 12 percent of Medicare hospital discharges in Louisiana, Kansas, and South Dakota, to **27** percent in Connecticut.

Table 7.—Use and Percentage of Hospital Charges Incurred in ICUs and CCUs for Medicare Beneficiaries Discharged From Short-Stay Hospitals, by Geographic Region, 1979

Region	Percent using Icwccu	Percent total charges incurred in ICU/CCU
New England	20	*7*
Middle Atlantic	19	*7*
South Atlantic.	18	*7*
East North Central ., ., .	17	*7*
East South Central	15	*6*
West North Central	15	*7*
West South Central	15	*6*
Mountain	18	*7*
Pacific ... , ...	23	10

SOURCE: C. Helbing, "Medicare: Use of and Charges for Accommodation and Ancillary Services in Short-Stay Hospitals, 1979," Office of Research, Health Care Financing Administration, U.S. Department of Health and Human Services, undated.

SEX AND AGE DISTRIBUTION OF ICU USE

Studies of ICU patients demonstrate a remarkably consistent male to female ratio of about 3:2 (16,47,56,67,146,175,178,248). Only Chassin reports a slight female predominance (40). In general, the ratio represents the prevalence of serious cardiovascular diseases among males and females under the age of 70. Above that age, female representation in ICUs increases (248).

A major issue with respect to Medicare is the representation of elderly people in ICUs. With aging comes an increase in the incidence of critical illness. Thus, elderly people might be expected to require more intensive care than their proportion of the general population (34) and, possibly, more than their proportion of the hospitalized population (76,175). On the other hand, to the extent that ICU beds are in short supply (248,265) or that poor patient prognosis is considered (34,54,56,76), elderly patients might receive less intensive care than younger patients.

In the United States, the representation of elderly patients in ICUs seems to be the same or only slightly more than as it is in the hospital as a whole (76,139,175). Data from ICUs do not address the effect of screening on the basis of age that may take place prior to ICU entry. Speculation on the extent of such screening differs (33,76,137). The recent HCFA MEDPAR data is somewhat helpful on this issue. As table **8** shows, use of ICU/CCUs by elderly people does not vary from that of the general population until age 85. Even for people 85 and older, however, the decrease in ICU/CCU use is slight.

Once in the ICU, elderly patients generally *re*ceive more interventions than younger patients (34). However, when an attempt is made to control for acute severity of illness, the age of ICU patients does not appear to be a factor in the amount of resources expended in the ICU (137, 140). Rather, health status, independent of age,

Table 8.-Use and Percentage of Hospital Charges Incurred in ICUs and CCUs for Medicare Beneficiaries Discharged From Short-Stay Hospitals, by Age, 1980

Beneficiary age group	Percent using ICU/CCU	Percent total charges incurred in ICU/CCU
<65	18	7
65-69	18	8
70-74	18	7
75-79	18	7
80-84	17	7
>85	15	6
Total all ages . . .	18	7

SOURCE: C Helbing, Supervisory Statistician, Office of Research, Division of Beneficiary Studies, Health Care Financing Administration, U.S. Department of Health and Human Services, personal communication, June 6, 1983. Data derived from the MEDPAR file.

seems to be the key factor influencing the use of ICU resources once the patient is in the ICU (33,137).

Age does appear to be an important determinant of ICU admission in other countries. While the populations are not strictly comparable, table 5 clearly demonstrates a younger mean age of ICU patients in foreign countries. Knaus compared the ICUs in five U.S. teaching hospitals and seven French teaching hospitals and found that 45.5 percent of U.S. emergency ICU admissions were **60** years or older compared to only 31 percent of the French patients **(142).** Vanholder in Belgium acknowledged that when there is a lack of space in the ICU, older patients are less apt to be admitted (265). With many fewer ICU beds per capita available in Britain, age appears to be a primary factor for limiting access to the scarce ICU beds (1).

When they were first developed, use of renal dialysis machines were rationed partly on the basis of age, and it has been suggested that age was similarly a factor in the United States in rationing scarce beds in the early days of ICUs (248). In fact, as can be seen in table 5, in the last 15 years or so, there has been no dramatic trend toward older ICU patients even though the mean age of the population has increased. Unfortunately, data on the age of ICU patients in the late 1950s and early 1960s, when ICUs were first opened, are not available. In addition, there appears to be no consistent age difference in ICU use based on size or type of hospital. Finally, it should be pointed out that mean ages reported in ICU studies are a few years lower than the median ages (248).

ICU CASE MIX

Diagnoses

One characteristic of the ICU, particularly in comparison to other special care units (i.e., coronary, burn, and neonatal units), is the wide variety of underlying diseases that are present. As Chassin emphasized, medical ICUs treat a wide spectrum of illnesses; any specific disease represents a very small proportion of the total number of diseases that are present **(40,238,265).** Similar findings have been described for mixed ICUs and nonsubspecialty surgical ICUs **(49,54,129, 139).** Even respiratory ICUs treat a variety of primary diseases (10,29).

In surgical ICUs in major regional centers, trauma patients may represent **40 to 50** percent of the ICU population **(129,178).** In other surgical ICUs and mixed ICUs, trauma victims represent a much smaller percent of the overall ICU population (139), but are still a large proportion of the most critically ill patients (54). Trauma patients are much younger than the overall ICU profile **(54,129).**

There is no accepted classification scheme that describes the clinical characteristics of ICU patients. Perhaps the major problem with identifying ICU case mix is the fact that many critically ill patients have multiple underlying medical problems which interact to produce severe physiologic complications. Vanholder found, for example, that, excluding coronary care patients, each patient in his ICU had an average of **4.39** significant, distinct diagnoses (265). Questionable diagnoses, disorders not likely to have vital consequences, and previous diseases that had been cured at the time of admission to the ICU were not included in his calculation. The sicker the patient, the more likely it is that the ICU is treating failure of major organ systems, in addition to the underlying disease or the disease that precipitated the failure.

Other Case Mix Parameters

Recognizing that the complexity and severity of illness of ICU patients are generally not reflected by the primary diagnosis, other descriptions of ICU case mix have been used. Patients can be grouped according to those referred directly from emergency rooms, those transferred from the regular hospital floors, and those transferred from other hospitals (31). Interhospital ICU transfer of patients is relatively infrequent

in the United States, but common in some other countries (81,142,146).

ICU admissions can be characterized as emergency or elective, the latter usually referring to postoperative admissions. Medical ICU admissions are usually emergencies, whereas the majority of surgical admissions are elective (49, **52,227),** unless the hospital is a major trauma center. Elective, postoperative patients may, nevertheless, be critically ill, or at least need close monitoring and observation (54).

ICU patients can be characterized as those requiring close observation and monitoring and those requiring intensive therapy. As was pointed out earlier, there is no general agreement on how to classify patients into these groups. Some have employed subjective medical assessments of severity of illness and treatment needs (42,163,179). Others have employed objective measures of therapeutic resource use developed by Cullen and colleagues at Massachusetts General Hospital in Boston to separate patients into discrete groups requiring different personnel and treatment requirements (51,129,144). Recent work has attempted to ascribe a severity-of-illness score to each patient and has found a good correlation between scores of severity and treatment requirements (144,270).

Because authors use varying approaches to describe the intensity of ICU therapy, it is difficult to summarize the data. Nevertheless, it would appear from the literature—most of which is from teaching or major community hospitals—that **patients receiving the most concentrated intensive treatment, involving fairly continuously direct physician involvement and various forms of life support, represent less than half and sometimes as little as** 10 **to 20 percent of the ICU patient population** (54,129,144). At the other end of the spectrum, **patients who receive technical monitoring and nursing care but only routine physician care probably represent about 20 to** 30 **percent of patients in general ICUs** (136,137,178,246,269). The remaining 30 to 70 percent of ICU patients are those that receive actual therapeutic intervention to maintain and stabilize one or more physiologic functions, but do not require constant physician involvement in their care or nurse-to-patient ratios of greater than 1:1. The percentage of "monitor patients" is much higher in ICUs that also serve a CCU function (31,249).

Because most research has come from teaching hospitals, the pattern of case mix in community hospitals may be different, although anecdotal reports do not indicate a consistent difference between teaching and community hospitals (67, 163,175).

Readmission

Recently, attention has focused on the fact that high-cost users of hospital care are often patients with chronic illnesses who have repeated hospital admissions (161,218). This pattern is being increasingly recognized for intensive care as well (231,248). As might be expected, readmission to the same unit are less frequent for surgical ICU patients (178). In a 5-year period, almost 19 percent of all patients seen in a major teaching hospital medical/cardiac ICU were readmissions, and 6 percent were patients readmitted to the ICU during the same hospital stay (so-called "bounce backs") (248).

Length of Stay

The mean length of stay (LOS) in an ICU for all Medicare ICU/CCU patients in 1980 was **4.2** days (112). The LOS in ICUs is about 0.5 days longer than in CCUs (49). The LOS is reportedly longer in non-U.S. ICUs (29,88,142,178), probably because there are fewer monitor patients in these ICUs. The average LOS in U.S. hospitals has been notably stable over the past 15 years (see table 5).

As expected, mean LOS is significantly longer than median LOS (42). The mean does not reflect the great variation in LOS of ICU patients. In a study of 1,001 consecutive patients in a surgica] ICU, Pessi **(178)** found that 27 percent stayed less than 2 days, while 15 percent stayed longer than 10 days. In one medical ICU, Chassin (40) found that 10 percent stayed longer than 10 days. ICU stays of more than a month are not uncommon (49).

While the mean hospital LOS before the recent changes in Medicare reimbursement in U.S. hos-

pitals was 7.6 days (4) and 10.4 days for Medicare patients (113), ICU patients have significantly longer total hospital stays. From the few reports that present both ICU and total hospital LOS, there is significant variation in hospital LOS, presumably because of case mix differences (40,49, 175). Part of the variation in published studies may also represent the general pattern of shorter hospital lengths of stay on the west coast (256).

5 .

Outcomes of Intensive Care: Medical Benefits and Cost Effectiveness

5

Outcomes of Intensive Care: Medical Benefits and Cost Effectiveness

DIFFICULTIES IN ASSESSING EFFECTIVENESS

Evaluating the effectiveness of the care provided in the general adult intensive care unit (ICU) presents a number of problems. Unfortunately, it is difficult to separate the intensity of the care from the setting in which it is provided **(97,98),** and therefore, to know whether the same care would have been equally effective whether it was provided in an ICU or in a general hospital floor.

Theoretically, at least, intensive therapy could be provided on regular medical floors (120). In fact, there are institutional differences about who is treated in ICUs and for how long (142). Moreover, the level and style of intensive care for similar health problems differ significantly among ICUs (67). These differences have developed because of the particular circumstances of individual hospitals, rather than because established criteria were available **(247).**

For some complex medical problems, many physicians feel that the necessary care can only be provided in an ICU (65). In the late 1960s and 1970s, admission to an ICU became routine for a number of medical problems, despite the lack of evidence that ICU care improved outcome. There have been no prospective clinical trials in which patients with similar problems were randomly allocated to two groups, one of which was treated in an ICU while the other received intensive care outside the ICU (98,222). There is general agreement that such randomized studies would be unethical (262,279), and it is felt that for many problems, treatment in an ICU is necessary if a patient is to have a chance of survival (50).

Since, as noted, randomized clinical trials of ICUs are considered by many to be unethical, most ICU outcome studies have been historical controls and pre-ICU / post-ICU designs (166). These types of studies, however, have been seriously flawed by the absence of acceptable criteria for stratifying ICU patients by diagnosis and severity of illness to assure comparability of patient populations between different ICUs and in the same ICU over time (226,248,281).

In the coronary care unit (CCU), for example, it is felt that patients suffering myocardial infarction should be stratified into clinically coherent subpopulations based on the type of myocardial infarction suffered in order to assess outcome properly (28). The problem of stratification is especially complicated in the ICU, because patients often have multiple diagnoses, which make categorization difficult (16,265), and because their severity of illness varies (136).

There are other practical problems in conducting research on ICU outcome, including:

1. the fact that any individual institution will have a relatively small number of patients in any clinical subset;
2. the lack of a standard format for collecting data;
3. the difficult yin obtaining informed consent from ICU patients in need of immediate, lifesaving intervention **(176);** and
4. the difficulties in conducting studies that follow patients after their discharge from the hospital.

In short, because of the absence of an accepted classification scheme for stratifying ICU patients into accepted subpopulations and because prospective clinical trials have not been performed, very little is known about the effectiveness of the ICU as a distinct, discrete technology. Investigators who report on changes in ICU mortality rates or lengths of stay can only speculate on whether their patient populations have changed over time **(227,248).**

Finally, while the primary measure for assessing the effectiveness of ICUs is patient outcome, it should be recognized that the ICU as a discrete unit within the hospital may be a focus for education and research activities which have positive "trickle down" effects on care for non-ICU patients (55,86,97). At the same time, however, the presence of ICUS may adversely affect the quality of nursing care on the regular medical and surgical floors (25,136). As difficult as it is to measure the effectiveness of ICU treatment for patients in the ICU, it is nearly impossible to assess objectively the benefits or drawbacks of the ICU for the hospital as a whole.

CLINICAL OUTCOMES OF ICU CARE

Because of the varied case-mix in ICUs, it is impossible to generalize about whether ICU care improves outcome. The NIH consensus panel, which was asked to assess this issue, concluded that evidence of the benefit of ICU care was unequivocal for a portion of the heterogeneous ICU patient population (176). The NIH panel identified different outcomes for three categories of patients (176):

> First is the patient with acute reversible disease for whom the probability of survival without ICU intervention is low, but the survival probability with such interventions is high. Common clinical examples include the patient with acute reversible respiratory failure due to drug overdose, or with cardiac conduction disturbances resulting in cardiovascular collapse but amenable to pacemaker therapy. Because survival for many of these patients without such life-support interventions is uncommon, the observed high survival rates constitute unequivocal evidence of reduced mortality for this category of ICU patients. These patients clearly benefit from ICU care.
>
> Another group consists of patients with a low probability of survival without intensive care whose probability of survival with intensive care may be higher—but the potential benefit is not as clear. Clinical examples include patients with septic or cardiogenic shock. The weight of clinical opinion is that ICUs reduce mortality for many of these patients, though this conviction is supported only by uncontrolled or poorly controlled studies. Often these studies do not allow one to distinguish between ICU effectiveness and/or differences in cointerventions that do not require the ICU.
>
> A third category is patients admitted to the ICU, not because they are critically ill, but because they are at **risk** of becoming critically ill. The purposes of intensive care in these instances are to prevent a serious complication or to allow a prompt response to any complication that may occur. It is presumed that the prompt response to a potentially fatal complication made possible by continuous monitoring plus the concentration of specialized personnel in the ICU increases the probability of a favorable outcome. The risk of complication may be high (as in the patient with an acute myocardial infarction and complex ventricular ectopy) or low (as in the patient with myocardial infarction suspected because of chest pain in the absence of electrocardiographic abnormalities). Also, the differences in probability of a favorable outcome following a complication inside rather than outside the ICU may be large (as in the patient with postcraniotomy intracranial bleeding) or small (as in the patient with gastrointestinal bleeding). The strength of evidence supporting the effectiveness of the ICU varies with the probability of a complication and with the difference in expected outcome inside and outside the ICU. When the risk of complication is high and the potential gain large, a decrease in mortality is likely. Similarly, when the risk is low and the potential gain small, an observable decrease in mortality is unlikely. These patients are not likely to benefit from ICU care.

The differences in outcomes of ICU care by diagnosis has been demonstrated in all studies that have looked at the issue, from the earliest studies (17) to the most recent (248). Table 9 gives examples of specific retrospective outcome studies on the effect of ICU care for certain illnesses. (Note that contradictory findings are sometimes found for the same condition.) In general, conditions which respond well to ICU care are reversible illnesses without significant underlying chronic illness (e.g., respiratory arrests as a result of drug overdoses, major trauma, reversible neuromuscular diseases such as Guillain-Barre Syndrome, and diabetic ketoacidosis) (198,214). Conditions which generally do not respond well are exacer-

Table 9.—Retrospective Outcome Studies of ICU Care

Study	Condition
A. ***Studies showing definite reduction in mortality for condltlon:***	
Petty (1975). .	Respiratory failure treated with ventilators
Rogers.	Respiratory failure treated with ventilators
Bates	Status asthmatics and emphysema
Drake	Non-hemorrhagic strokes
Skidmore . . .	Postoperative trauma patients
Feller.	Severe burns
B. Studies showing no reduction in mortality for condition:	
Pitner.	Strokes
Piper	Drug overdose
Jennet	Head injuries with coma
Casali	Postoperative acute renal failure
Griner	Pulmonary edema
Hook	Pneumococcal bacteremia

NOTE Studies are cited in the Reference section

SOURCE Off Ice of Technology Assessment

bations of chronic conditions for which there has been no definitive treatment (e.g., cirrhosis with gastrointestinal hemorrhaging, and advanced cancer).

Most studies have looked at mortality in the ICU or in the hospital as a measure of the efficacy of ICU care. However, for some physiologic conditions, such as cardiac arrest, ICU care may be lifesaving in the short term but may not affect the ultimate course of the underlying illness (174,214). Indeed, in some instances, patients with severe underlying illnesses, such as terminal cancer and cystic fibrosis, have not been offered ICU care because of the dismal prognosis associated with the underlying illness (58,110,252,253).

Investigators have only recently begun to look at posthospital survival. As might be expected, the ability to follow patients for 6 months or longer after their ICU stay depends to a great extent on the population being studied. In general, chronically ill and medical patients are more likely than acutely ill and surgical patients to die shortly after discharge from the hospital (29,34,50,129, 146,174,175,178,248) .

FUNCTIONAL OUTCOME

Different investigators have used varying measures of functional status to gauge outcomes other than mortality. These measurements have been subjective and depend to a large extent on the patient's prehospital functional status. For patients with a chronic disability, posthospital functional status is almost never better than their prehospital functional status (34,40,146), although improvement has occasionally been found (29).

Surgical patients suffering an acute injury or illness have a reasonable chance of returning to a normal functional status (54,178). In a followup study, Cullen reported that the l-year mortality rate was similar to the rate in a previous study of similarly critically ill patients, but that the patients' quality of life as measured by the number of patients who were fully recovered or returned to full productivity was significantly improved (54,56). This finding suggests that Outcome COme measures other than survival should also be examined when determining effectiveness of ICU care.

CHARACTERISTICS OF ICU NONSURVIVORS

As noted above, certain diseases and conditions are associated with particularly high ICU mortality rates. Underlying disease is probably the most significant single predictor of outcome of ICU care (54,139). Other factors, including age and severity of illness, are important as well.

Age

A number of investigators have looked at the association of age and mortality in ICUS. Most have found a direct relationship between increasing age above **65** and hospital mortality (54,107,

116,178,214,248). In addition, for medical patients in particular, some have found that patients 70 and over who leave the hospital have very high posthospital mortality rates (29,174,248,249). Others, however, have found either a small or no association between age and survival (40,50,76, 165,265).

When an attempt is made to control for chronic health status in a multivariate logistic regression analysis, age has been found to remain a reliable independent predictor of mortality **(268).** This finding suggests that age is not simply a surrogate for chronic health status. Fedullo (76), on the other hand, suggests that with the passage of time, elderly patients have already gone through a process of selection, and therefore "healthy" elderly patients are as able as younger patients to survive an acute major illness.

Severity of Illness

Vanholder **(265)** found that ICU survivors had an average of 3.13 major diagnoses whereas nonsurvivors had 6.09 diagnoses. LeGall (146) found a strong positive correlation between the number of organ system failures and the likelihood of not surviving a stay in an ICU. In a number of settings, the George Washington University ICU Research group in Washington, DC (143) has tested an acute severity-of-illness measure based primarily on the deviation from normal of certain clinical and laboratory measurements. Using their scoring system, they found a direct relationship between acute severity of illness and ICU mortality and concluded that acute physiologic derangement (i.e., acute severity of illness) is second only to the underlying disease as a risk factor of hospital mortality (139). Less sophisticated severity-of-illness classification systems have consistently demonstrated a positive relationship between increasing severity of illness and likelihood of mortality (51,178).

Resource Use

In comparing resource use of ICU nonsurvivors to survivors, it is necessary to look at the patient's entire hospitalization, not just the stay in the ICU. In a number of studies from different types of hospitals, 25 to 40 percent of ICU patients who died in the hospital did so after they were transferred from the ICU to the regular medical floor (see table 5 in ch. 4). Presumably, many of these non-ICU deaths were anticipated and represented the transfer of "hopeless" patients out of the ICU.

It is now recognized that a significant number of deaths in the ICU occur after "no resuscitation" orders have been written. In two large medical centers, as many as 40 to 70 percent of ICU deaths occurred under these circumstances (9,96). In a large community hospital, 19 percent of ICU nonsurvivors had no hope of recovery and were in the ICU solely for terminal care (165). In short, a substantial portion of ICU care for nonsurvivors occurs after hope of recovery has been abandoned.

Some nonsurvivors have very short and some have very long ICU stays. Pessi (178) found that one-third of surgical ICU nonsurvivors died within 2 days and 80 percent died within 10 days of ICU admission. More recently, Cromwell (49) found that while 20 percent of ICU nonsurvivors died within 3 days of ICU admission, 10 percent died after 2 months in the ICU. **On average, nonsurvivors stay in the ICU about 1.5 to** 2 **times longer than survivors** (42,48,76,248)

In 1973, Civetta (42) first described the inverse relationship between ICU charges and survival. Since then, whenever it has been examined, the same relationship has been found—ICU **nonsurvivors accumulate up to two times more hospital charges than survivors** (40,49,61). Byrick (29) found the same correlation in Canada when he considered actual ICU costs rather than charges. Furthermore, nonsurvivors have incurred proportionately higher charges for ancillary services (e.g., laboratory tests, X-rays, and blood) than survivors (61,76). Only Parno (175), in a study involving a large community hospital, found no substantial difference in ICU charges between survivors and nonsurvivors.

The inverse relationship between charges and survival is not as simple as it might first appear, however. Detsky (61) looked at the relationship between charges and patients assigned to various subjective prognostic categories. He found the

highest per capita charges in two groups: survivors who initially had been thought to have a poor chance of survival, and nonsurvivors who had initially been felt to have the best chance of survival. Predicted nonsurvivors who died and predicted survivors who lived consumed fewer resources. The two groups with highest charges would logically be the ones who might benefit the most from intensive medical care.

In another study utilizing a severity-of-illness measure, Scheffler (214) found a nonlinear, U-shaped relationship between the use of resources available in the ICU and the probability of survival. The first segment—45 percent of patients and 19 percent of therapeutic interventions-exhibited an overall decrease in the probability of death as therapy increased. The second segment, found at the bend of the curve, showed little correlation between probability of death and resource use. However, in the third segment, the rising portion of the U-shaped curve, there was an overall increase in the probability of death as resource use increased. This last segment represented only 9 percent of the ICU population, but those patients consumed as much as **30** to 40 percent of the ICU resources. Thus, many patients, even the most seriously ill, may benefit from additional ICU resources applied to their care. While, in retrospect, some resources may prove to have been "wasted" in the sense that individuals did not survive despite consuming these ICU resources, it is clear that many patients do benefit from increased use of ICU resources. The patients who will benefit from additional ICU resources cannot currently be identified ahead of time with any certainty.

DISTRIBUTION OF ICU COSTS AMONG PATIENTS

The data demonstrate that a small percentage of the ICU patient population consumes a substantial proportion of total ICU resources. Cromwell's group (49) found that 1 percent of all ICU patients incurred 10 percent of hospital charges, and 5 percent of ICU patients incurred 25 percent of the charges. In Chassin's ICU study (40), 7.4 percent of the patients incurred 31 percent of the charges, and 17 percent of patients incurred so percent of the charges. The 7.4 percent subgroup averaged $63,000 in charges in 1977 dollars. In general, the high cost subgroup was broadly representative of the total ICU patient population in terms of age, diagnosis, and other patient characteristics. Similarly, Parno (175) found that 18 percent of the ICU population in his hospital generated half of the ICU charges.

In addition, it is likely that within the ICU, there is substantial cross-subsidization of charges. As noted in chapter 4, ICU populations include patients who are there primarily to be observed and monitored for the development of complications as well as patients who are receiving complex life-sustaining therapy. The nurse-to-patient ratio can vary from 1:4 or 1:5 for patients with cardiac arrhythmias to 1:1 or greater for the sickest patients (176). While a portion of fixed direct costs and allocated indirect costs should be distributed evenly among all patients, the ICU charge structure does not reflect the substantial differences in variable labor costs between patients.

The Therapeutic Intervention Scoring System (TISS) (53,130) is a relative value scale which reduces most of the tasks commonly performed within an ICU to 75 items which are assigned varying weights. It has been used as a direct measure of the use of labor in the ICU. Wagner (270) found that patients recuperating from coronary bypass surgery utilized 2.5 times more TISS points per day than ICU patients recovering from brain surgery.

The difference in labor resource use appears to be even greater for other types of patients (51,54). The distribution of TISS points suggests that all ICU patients receive a minimum amount of treatment beyond that provided on the regular wards (67). The data also suggest, however, that even if indirect and fixed ICU costs are distributed evenly among all patients, perhaps 50 percent of actual ICU resource costs—particularly labor costs—vary dramatically among patients.

25-338 0 - 84 - 4

As noted earlier, the sickest ICU patients incur substantially more total hospital charges than those who are relatively less sick. Yet, the actual cost differences between these two groups is even greater. Under the new Medicare payment system, which pays a fixed price per diagnosis regardless of actual cost of the treatment provided, hospitals 'may become more aware of the highly disproportionate share of ICU resources consumed by the most severely ill, long-term ICU patients (see ch. 6).

MONITORED PATIENTS

Increased attention has been paid recently to ICU patients who do not receive active intensive therapy but rather are monitored and observed for the development of potentially fatal complications which must be responded to promptly (176). Progress has been made in identifying the characteristics of coronary patients who do not routinely require coronary intensive care (85,90,141, 189,190), and in recognizing CCU patients who can be discharged to the general floor after 24 hours rather than the usual 3 days (163). Similarly, national and regional data on intensive care for patients with burns suggest that a substantial number of patients suffering relatively minor burns do not benefit from treatment in an intensive bum unit but receive it nevertheless (78,151).

Researchers at George Washington University (269) found that 513 of 1,148 admissions (45 percent) to a mixed medical-surgical ICU in a teaching hospital could be considered "monitoring only" patients. Using a multivariate logistic regression analysis of several variables, including a severity-of-illness measure, they found that 154 patients **(13** percent of the total ICU patient population) had less than a 5-percent predicted risk of requiring active intensive therapy. For those patients, the authors felt that the risks of iatrogenic illness' might outweigh the benefits of ICU monitoring. In fact, only of the 154 low-risk patients actually received intensive therapy, and in no case did those patients require therapy for an immediately life-endangering condition. After updating their data base and looking at preliminary data from other university hospitals, the authors concluded that all ICUs have significant proportions of predictably low-risk, monitor admissions (141). The conclusions were supported in a recent study by Fineberg that looked at patients with a risk of myocardial infarction that is low, but not low enough for home care to be desirable (about 5 percent). He calculated that admission to an intermediate care unit, rather than a CCU, was highly cost effective (79).

Others who have studied monitored patients are not as sanguine about the ability to predict low risk. In a coronary care-oriented ICU, Thibault (248) found that 1 of 10 patients admitted for careful monitoring subsequently required a major ICU intervention. Using primarily subjective criteria, he could not predict which of the monitored patients would do well.

Teplick, et al. (246), studied patients routinely admitted to a surgical ICU after uneventful, major surgery of various types. Using a fairly conservative definition of benefit, the authors found that overall, 33 percent of the patients benefited medically from an overnight stay in the ICU. There was a broad range in the percentage of patients who benefited from ICU care across types of surgery, from 44 percent of patients who had vascular surgery to no patients who had anterior cervical Iaminectomies. A number of the unanticipated complications were immediately life-threatening. Furthermore, using both a preoperative risk assessment and an evaluation of intraoperative problems, the authors were unable to identify the patients within each surgical category who were more likely than others to develop serious postoperative problems.

Another study of the same ICU, however, found that less than 1 percent of patients routinely admitted overnight to the ICU for certain other surgical conditions suffered significant adverse postoperative effects (220). These contrasting findings demonstrate the importance of stratifying even the monitored ICU patients in order to determine

'An iatrogenic illness is an illness that results from clinical therapy rather than from the patient's disease.

which subgroups of monitor patients do well without routine admission to the ICU.

Attention has also been focused recently on patients who may be discharged from the ICU prematurely. Schwartz (220) found that 15 percent of patients electively discharged from the ICU, and 23 percent of patients transferred out of the ICU because of lack of space, suffered a significant adverse effect on the surgical floor. Adverse effects included death, return to the ICU, or residence in hospital 1 month after completion of the study. The researchers also found that approximately one-third of patients undergoing abdominal vascular surgery developed serious respiratory and/or circulatory conditions after discharge from the ICU. They did not speculate on whether outcomes for these patients would have been different had the complications occurred in the ICU.

In a retrospective chart review, Franklin (82) noted that 62 percent of readmission to a mixed ICU might have benefited if they had not been discharged from the ICU initially. The authors did not indicate whether the patients readmitted to the ICU differed in any predictable manner from patients who did not need to be readmitted. Nor did the study address how many lives were lost because of early discharge. Mulley (163), who recommended identification of low-risk patients for early transfer from the ICU, acknowledged that 2 percent of the low-risk group had major complications during their stay in the ICU that would have occurred after transfer if an early transfer policy had been in effect.

By stratifying ICU-monitored patients, it may be possible to reduce or eliminate ICU stays for some patients with a low risk of resulting adverse effects. This risk may, in fact, be lower than the risk of iatrogenic ICU illness for some patients. At the same time, other moderately sick ICU patients are probably discharged too soon or not admitted to the ICU at all because of lack of bed space or recognition that the patients are at risk for serious complications. As a result, they suffer avoidable adverse health effects.

Work is *only* now beginning on attempts to predict which ICU discharge patients are most likely to suffer adverse effects on the regular medical or surgical floor.

ADVERSE OUTCOMES OF ICU CARE

Iatrogenic Illness

The possibility that the adverse effects of ICU care may outweigh the potential benefits for some patients is being increasingly recognized (176,275). However, the rates of iatrogenic illness and other untoward physical and psychological reactions to ICU care are not known with any precision (176).

As with the problems of measuring the positive effects of ICU care, it is difficult to distinguish between the negative effects that occur among critically ill patients regardless of location and those that are specific to the ICU.

An iatrogenic illness is any illness or other harmful occurrence that results from a diagnostic procedure or therapy that is not a natural consequence of the patient's diseases (239). The major iatrogenic complications that result from prolonged ICU care include nosocomial infections (defined below), stress-induced gastrointestinal bleeding, alterations of consciousness associated with metabolic disorders, coagulation disorders associated with multiple transfusions and infection, drug interactions, complications of intravascular catheterization, complications of prolonged endotracheal and nasogastric incubation, and sleep disorders and psychoses (41,275). Some of these complications, such as drug interactions and bleeding, would likely occur in seriously ill patients regardless of location. Nosocomial infections and various psychological reactions are often a result of the ICU itself.

Recently, Steel found that 36 percent of patients on the medical service of a university teaching hospital had an iatrogenic illness (239). In 9 percent of the cases, the incident was life-threatening

or produced considerable disability. In 2 percent of the cases, the iatrogenic illness was believed to have contributed to the death of the patient. The authors did not specify which problems specifically occurred within the CCU or ICU section of the medical service. Nevertheless, a number of the complications came from drugs, such as lidocaine, and procedures, such as Swan-Ganz catheterization, that are, for the most part, only used in ICUs.

In a different teaching hospital, Abramson (3) identified 145 reports of significant adverse occurrences in 4,720 ICU admissions during a 4-year period. Ninety-two of these incidents were felt to be the result of human error, and 53 were equipment malfunctions. However, 43 of the 92 incidents linked to human error involved equipment, mostly mechanical ventilators. Thus, about two-thirds of the adverse events involved the technically complex equipment used in ICUs. The incidence of equipment-related adverse occurrences would probably be much higher if the equipment and the staff operating it were dispersed throughout the hospital (208). On the other hand, ICU technology may sometimes be used unnecessarily for less sick patients, producing some incidence of avoidable iatrogenic illness (198). As noted in chapter 7, the ICU milieu provides a bias to the use of technology, which at times may be of only marginal benefit and can produce adverse reactions (242).

Finally, it is clear that the sophisticated care provided in the ICU requires skilled nurses and other technicians. Adverse effects in ICUs have been particularly noted during periods of nursing shortages (3,136). The ICU environment produces "technology-oriented" treatment protocols (100), and physicians are less apt to tailor therapy based on the specific skills of the nurse and technicians on duty or on the particular nurse-to-patient ratios during a particular shift. In other words, certain ICU monitoring and therapy protocols may work well under ideal circumstances but may be particularly subject to human and mechanical error under less favorable circumstances.

Nosocomial Infections

Nosocomial infections are infections occurring during hospitalization that were not present, and not incubating, at the time of hospital admission **(117).** All patients in an ICU are at increased risk of developing nosocomial infections (117). The rate of significant nosocomial infection in an ICU is about 20 percent, or three to four times that of a patient on a general ward (63,173). This increased rate stems in part from unalterable factors, including the severity of the underlying illness; the greater use of invasive procedures; and the greater use of prior antibiotic therapy, which may predispose a patient to a superimposed infection (63,117,192). However, at least part of the increased rate of ICU infection is due to cross-infection between very sick patients in the confined area of the ICU (63,204). Nosocomial infection "outbreaks" in ICUs are not uncommon (63). Bacterial infections may be spread directly from one person to another, often via personnel, or may require an intermediate reservoir, such as respirator nebulizers or tubing (117). While difficult to estimate precisely, the costs of nosocomial infections in terms of increased morbidity, mortality, and hospital charges are undoubtedly substantial (108).

Psychological Reactions

There is a substantial body of literature on the psychological reactions of patients in ICUs. It appears that the frequency of psychiatric syndromes is considerably less in a CCU, where patients are relatively stable, than in an ICU, where seriously ill patients suffer organic impairments of cerebral, renal, and pulmonary function (104,131,156).

The so-called "intensive care syndrome" **(156)** described a "madness," or acute delirium, that had originally been seen in the postoperative recovery room (168). However, many psychiatric syndromes have been noted, from acute anxiety, fear, and sustained tension to agitated depression and acute delirium (132).

The unique environment of the ICU has been graphically implicated as a cause of the varied and often dramatic psychological reactions:

> Immobilized, weak, inhibited from moving by a network of wires and tubes which connect every orifice in his body with bottles and machines, he lies watching the light pattern move from left to right on the monitor, disappear, then start again. He listens to the suction of the draining apparatus, the on and off of the pulmonary respirator, the hissing sound of the steam from the vaporized oxygen; steam which sometimes clouds his vision in the tent. He adds his own fantasies to this bewildering environment. Fear and tension mount . . . . In the ICU, the lights are on constantly, and there is little or no change in the level or type of sensory input. The activity, in spite of its decrease toward early morning, remains high. Hours and days merge and blend. Privacy is almost impossible. The patient is exposed; his most private acts become public. . . . Strangers control the machines. Their authority is absolute. In this seemingly irrational environment, he is deprived of any volitional control. He becomes an object rather than a participant in the struggle for life (62).

Sleep deprivation, sensory deprivation, sensory overload, medications, and various emotional factors related to coping with serious illness have been cited as causes for ICU psychiatric syndromes (38,104,131,145).

Given the dramatic behavioral responses to ICU care, it is remarkable that most patients remember very little about the "terror in the ICU" (216). In surveys taken both shortly after transfer out of the ICU and many months later, ICU patients generally remember few details of their stay (24,29, 115,127,162,216). Whether due to the serious nature of the underlying illnesses (104,127), the lack of sleep, which produces general fogginess (24,127), or a powerful psychological defense mechanism of denial called "psychoplegia" (104, 216,217), survivors of ICU care generally do not carry unique psychological scars of their ICU experience.

COST-EFFECTIVENESS ANALYSIS OF ADULT INTENSIVE CARE

Cost-effectiveness analysis (CEA) is intended primarily to measure and compare the costs of different ways of arriving at similar outcomes (256). This type of analysis has not been done for ICUs, because it is considered unethical to deny ICU care for most ICU patients (see ch. 6). The few "before ICU/after ICU" studies focused on relatively small ICU subpopulations and are clearly dated (99,183).

For the low-risk monitored patient, it may be ethically permissible to compare ICU observation with non-ICU observation to determine the cost effectiveness of ICU care. Both Mulley (163) and Wagner (269) have projected cost savings that would be generated by more selective admission and earlier discharge policies. Using conservative economic assumptions, Mulley found that a more selective policy would result in a 6-percent reduction in ICU charges. Similarly, Wagner estimated a 4-percent reduction in total ICU days with earlier discharge of low-risk patients. Neither author accounted for the possibility that earlier transfer from the unit might either increase or, conceivably, decrease the rate of major complications, which, in turn, would affect costs (163). Fineberg estimated that for patients with about a 5-percent probability of having sustained a myocardial infarction, admission to a CCU would cost $2.04 million per life saved and $139, ooo per year of life saved, as compared to care in an intermediate care unit (79). Teplick (246) concluded that routine overnight ICU admission for postoperative patients at an additional cost of $3oo would reduce overall patient costs if only 13 of the 88 routinely admitted patients in their study who benefited from the ICU were prevented from becoming critically ill.

Another factor in considering the overall cost effectiveness of earlier discharges of low-risk ICU patients is the fact that the costs of caring for these patients on the regular floors would increase, mostly because of the need for additional nursing, probably from private duty nurses (97,220). There might also be a need for additional monitoring equipment on the regular floors. Finally, projecting savings based on charges probably over-

estimates the savings from early discharge of low-risk patients because of the cross-subsidization that is reflected in the ICU charges (see ch. 6).

Attempts have been made to assess average charges necessary to achieve one survivor for various subpopulations of ICU patients. For example, Parno (175) found that hospital charges in 1978 dollars for a survivor alive 2 years after discharge averaged $15,000, with a range of $1,650 for drug overdose patients to $46,000 for renal medical patients. In a population of the most critically ill surgical ICU patients, Cullen (50) found that in 1977-78 dollars, it required $71,000 in hospital charges to achieve a survivor alive 1 year after hospital discharge. Neither additional post-hospitalization expenses nor physician charges were included in this estimate. For the category of illness that includes gastrointestinal bleeding, cirrhosis, and portal hypertension, Cullen found that it cost $260,000 to achieve one survivor.

An interesting variation on this approach is to look at "life-years" saved (134). The method is not a true cost-benefit analysis (CBA), however, since CBA requires that benefits be assigned a monetary value in order to provide a direct comparison of the costs and benefits of a particular technology (256). Assigning monetary values to the varied and controversial outcomes of the ICU has not been done. Theoretically, the life-years saved method could be extended into CBA. Recognizing that longevity is generally considered a benefit, Bendixen used the life-year saved model to view the cost of ICU care in relation to predicted remaining lifespan. He used the following equation:

$$\text{cost} = \frac{\text{(cost per day) X (duration of stay)}}{\text{(survival fraction) x (predicted remaining lifespan)}}$$

This approach assumes not only that survival is a benefit, but also that survival value is a multiple of survival time, i.e., that 2 years of survival has twice the value of 1 year of survival. The approach theoretically permits one to weigh the factors of a patient's age and the prognosis associated with chronic disease. The formula, however, does not discount the future value of costs and benefits into present dollars; in essence, it overstates the importance of predicted remaining lifespan (256).

The unavailability of disease-adjusted actuarial data for diagnostic subgroups makes prediction of life expectancy for chronic diseases inexact (215). ICU survival fraction and predicted remaining lifespan are the major determinants of cost effectiveness according to this formula. Using this approach in 1977, Bendixen estimated a cost-per-year saved of $84 for barbiturate overdose and $180,000 for hepatorenal failure.

When better estimates of life expectancy for patients with chronic illnesses become available, this cost-effectiveness approach may be more useful. Nevertheless, application of this approach documents the importance of the underlying disease process and the patient's age in determining the cost effectiveness of ICU care (215). The formula currently does not permit quantitative consideration of quality of life, which is obviously important for patients with debilitating chronic illnesses (18). Methods for adjusting life-years saved for quality of life have been attempted (213), but have been criticized as representing "bad science" and for ignoring considerations of justice and equity (7).

6
Payment for ICU Service;

6. Payment for ICU Services

TRADITIONAL HOSPITAL REIMBURSEMENT

Derzon (60) emphasized that several features of the American health financing and payment system operate to reinforce use of expensive technology, such as intensive care units (ICUs). These factors include payment certainty, consumer insurability, government assumption of risk, and benefits based on "medical" necessity. These factors have provided the major impetus to expansion of ICUs in the 1960s, 1970s, and early 1980s.

Most patients are covered for all or part of their hospital costs through private or government insurance. With the exception of small indemnity insurance companies, which pay a fixed dollar amount per day or a fixed coinsurance rate based on hospital charges, most private insurance companies pay full hospital charges, sometimes after an initial deductible. Other major payers, including many Blue Cross plans, Medicare, and Medicaid, have traditionally reimbursed hospitals on the basis of the actual cost of providing the service to their beneficiaries.

To the extent that many insurers distinguish ICU care from other hospital care for purposes of reimbursement, the result has been both to reward ICU care and to penalize intermediate level special care units. For example, until 1982, Medicare paid hospitals different per diem rates for only two levels of hospital care—routine care and "special care" (ICU and coronary care unit (CCU) care.) Levels of care below special care were reimbursed at routine care levels. The other cost-based payers have tended to follow Medicare's definitional guidelines (166). Also, in 1979 and 1980, as was noted in chapter 2, Medicare tightened existing payment limits on routine bed costs but not on ICU bed costs—the so-called "section 223 limits" (73).

Furthermore, two reimbursement mechanisms designed, in part, to curb unnecessary utilization of care (including ICU care) have no impact on ICU utilization. These mechanisms—patient copayments and utilization review—are discussed below.

Patient Copayments

Little is known directly about the effect of direct patient payments on the utilization and cost of ICU care. Cullen (56) found that only 100 of 189 seriously ill patients in a Boston surgical ICU were billed directly for any amount. The average bill for patients who did get billed was $1,856, which was equal to 9 percent of their total hospital bills. Cromwell (49) found that 80 percent of ICU patients in a different Boston teaching hospital had direct bills of less than $100, and most of the patients, 42 percent of whom had Medicare coverage, were well covered for the costs of ICU care. Only 2.5 percent of the sample had out-of-pocket bills above $3,000, and they were responsible for 67 percent of all uncovered hospital charges for ICU care. This pattern may differ in other parts of the country where private insurance coverage is not as extensive.

Finally, Cromwell found little correlation between coinsurance rates and the utilization of ICU beds and ancillary services after the completely uninsured patients were discounted. He did find, however, that patients with no insurance coverage had hospital and ICU stays about half as long as those patients with more extensive insurance coverage. Uninsured patients may exhibit a different case mix that explains at least part of the difference in utilization.

Utilization Review

Theoretically, hospital utilization review (UR) programs have the potential for limiting hospital reimbursement for ICU care by denying payments to patients "inappropriately" in the ICU. In re-

ality, hospital UR programs, administered for the last decade in accordance with the Federal Professional Standards Review Organization program, have focused almost exclusively on whether the admission is appropriate and whether the length of the hospitalization is necessary, rather than on appropriate level of care within the hospital (234). It would be most unusual for a UR committee or insurance company to deny payments for a patient in the ICU or recommend transfer to a lower cost unit in the hospital.

PROSPECTIVE PAYMENT PROGRAMS

Evidence is accumulating that State-based hospital prospective payment programs have been somewhat successful in reducing hospital cost inflation (20,45). There is almost no published data, however, on how ICUs have fared relative to other hospital services in States with prospective payment systems.

OTA'S analysis shows that between 1976 and 1981, in the eight States that had established hospital prospective payment (rate-setting) demonstration programs (Connecticut, Maryland, Massachusetts, New Jersey, New York, Rhode Island, Washington, and Wisconsin), increases in ICU/CCU beds were below the national average (4). However, some of these States, including Connecticut and Washington, had relatively high levels of ICU and CCU beds to begin with, so a decreased rate of increase may not necessarily be attributable to the State regulatory payment system.

Indeed, as demonstrated by Cromwell and Kanak (48), it is difficult to separate the effect of the presence of a State's hospital prospective payment program from many other factors that may influence hospital costs and utilization of specific technologies. These factors include the mix of hospitals, the effectiveness of a complementary certificate-of-need program, the length of time the prospective payment program has been in effect, the type of rate review, and the baseline level of costs and services. When they reviewed the period between 1969 and 1978, Cromwell and Kanak (48) did find that in some States, the presence of a prospective payment system appeared to retard the diffusion of ICUs. It should be noted, however, that their analysis looked at the diffusion of intensive and coronary *units,* not at ICU/CCU beds. By 1969, the majority of hospitals already had established ICUs (205).

There is no systematic information available on whether ICU length of stay (LOS) is reduced in States with prospective payment programs.

MEDICARE'S CURRENT INPATIENT HOSPITAL PAYMENT SYSTEM

Description

Title VI of the Social Security Act Amendments of 1983 (Public Law 98-21) provided a dramatically new payment system for Medicare inpatient hospital services. A full discussion of the implications of Medicare's prospective payment system for ICU care is beyond the scope of this case study.1 Nevertheless, a few preliminary observations on likely effects of the system on the provision of ICU care can be offered.

In brief, the current payment system is based on the concept of diagnosis-related groups (DRGs), Under this DRG system, which began to be phased in over a 3-year period on October 1, 1983, hospitals receive a fixed payment per discharge based on the patient's diagnosis. Hospitals that treat pa-

'See the Office of Technology Assessment's technical memorandum, entitled ***Diagnosis Related Groups (DRGs) and the Medicare Program:*** Implications for Medical Technology, which describes the potential impact of the new payment system on medical technology **(254).**

tients for less than Medicare's payments are allowed to keep the difference. Those hospitals that spend more have to absorb the loss.

More specifically, under the DRG payment system, rates are set for each of 470 different DRGs.[2] More complex DRGs, such as kidney transplants (DRG 302), receive much higher payments than simpler cases, such as hernia repairs (DRG 161). Certain types of cases with complications or a secondary diagnosis receive a higher payment than cases without complications. For example, heart attacks with complications (DRG 121) receive a somewhat higher payment than uncomplicated heart attacks (DRG 122).

The DRG classification system, however, does not directly take into account severity-of-illness variations of patients who have the same primary diagnosis. For example, in one teaching hospital a group of only four patients in DRG 206 (disorders of the liver, excluding malignancy, cirrhosis, alcoholism, and hepatitis, age less than 70 without complications or comorbidities) had a range of charges from $1,171 to $114,515 (118).

The U.S. Department of Health and Human Services (DHHS), which proposed the DRG-based payment system, has recognized that within some DRGs, some patients may be more severely ill (264). DHHS argues that in DRGs where severity of illness is strongly associated with treatment cost, most hospitals will have patients who exhibit a range of severity levels, thus producing on balance only minor financial advantages or disadvantages to most general hospitals. In addition, as enacted, the DRG payment system provides for additional payments in "outlier" cases—atypical cases which have particularly long lengths of stay or which are unusually expensive. For those cases, the additional costs, which must range between 5 and 6 percent of the total national payments for discharges in a year, are based on the marginal cost of care beyond established LOS or cost cutoff points.

Regulations implementing the new law were published on January 3, 1984 (75). Under the regulations, a discharge could become either a "day" outlier or a "cost" outlier. A day outlier is a discharge that exceeds the mean LOS for discharges within that DRG by the lesser of 20 days or 1.94 standard deviations. The mean LOS for each DRG are included in the regulations. If the discharge is considered a day outlier, the hospital will be paid 60 percent of the average per diem Federal rate for the excess days considered medically necessary. The 60-percent factor is intended to approximate the marginal cost of care for the excess days. However, a hospital will not be paid 60 percent of the actual costs of outlier days, but rather 60 percent of the average DRG per diem rate based on the DRG price.

Additional payments will be made for cost outliers if a hospital requests such payment and if the cost of a discharge exceeds the greater of 1.5 times the wage-adjusted Federal DRG payment or $12,000. Additional payment will equal 60 percent of the difference between the hospital's adjusted cost for the discharge and the cutoff amount. The adjusted cost will be determined by multiplying the billed charges for the covered services by 72 percent, the charge-to-cost adjustment factor. Importantly, a discharge will not be considered a cost outlier if it qualifies as a day outlier.

DHHS estimates that initially 5.1 percent of all discharges will qualify as day outliers and only 0.9 percent as cost outliers. Indeed, DHHS intentionally established criteria that would result in substantially more day outliers than cost outliers for two reasons: the information necessary to determine day outliers is automatically and routinely available in the bill processing system; and payments to hospitals that may simply be high-cost, inefficient providers of care will be minimized.

Another payment decision in the DRG payment regulations could have specific relevance to ICU care. Hospitals transferring a patient to another institution are paid a per diem rate based on the average LOS for the DRG treated. Full payment for the DRG treated is made to the hospital from which the patient is finally discharged. For example, if hospital A treats a patient in a DRG with an average LOS of 10 days for an initial 4 days and then transfers the patient to hospital B, hospital A will receive 40 percent of the DRG payment and hospital B will receive a full DRG payment, regardless of the actual LOS in hospital B.

[2]Although there are 467 DRGs for clinical conditions, there are 3 additional categories for payment purposes. Two of these categories involve reassigning the original classification and have no rates assigned.

Finally, Medicare previously reimbursed hospitals for the reasonable costs of capital, which include depreciation, interest, and rent. Under the current law, capital expenses are specifically excluded from the prospective payment system and continue to be reimbursed on a reasonable cost basis until October 1, 1986. At that time, Congress will decide whether to continue to pay reasonable costs or to incorporate payment for capital into the DRG system.

Medicare Utilization of ICUs by DRGs

Because ICU patients often have multiple diagnoses and suffer serious physiologic abnormalities that frequently do not correspond to disease entities, the DRG classification scheme may be poorly suited to describing ICU patients. Nevertheless, a preliminary analysis has been performed of the DRG case mix of Medicare ICU/CCU[3] patients based on available Health Care Financing Administration (HCFA) data for 1979 and 1980 (259,260). For the purpose of this analysis, multiple DRGs for the same primary diagnosis were combined. For example, DRGs 121 to 123—myocardial infarctions with differing clinical characteristics—were considered together.

Of the 15 DRG-based primary diagnoses with the longest average LOS in special care in 1979, 14 involved operating room procedures. The exceptions were the DRGs for myocardial infarctions. Another way to view DRG case mix is to consider special care as a percentage of total hospital stay. Of the 16 primary diagnoses in which special care represented at least 10 percent of the total hospital stay, 9 were medical diagnoses. However, these medical diagnoses were mainly for the cardiovascular system—mostly related to coronary artery disease. One can conclude that for DRGs involving certain operating room procedures and coronary artery disease, stays in special care units are standard and, therefore, captured by the DRG category. For example, 92 percent of cases for cardiac valve procedure with pump support (DRG 105) included special care. For many common surgical procedures and cardiac diagnoses, special care was utilized in more than !70 percent of cases. For the remaining, predominately medical diagnoses, the DRG category does not reflect the use of special care units for the more severely ill patients with that principal diagnosis. For example, a number of ICU studies indicate that gastrointestinal bleeding in patients with cirrhosis is one of the ICU problems associated with both long ICU lengths of stay and high cost (40,50). Yet, the DRG for this condition, "cirrhosis and/or alcoholic hepatitis" (DRG 202), has a mean special care length of 0.6 days, or only 4.5 percent of the average total hospital LOS for discharges with this DRG.

A somewhat different picture of ICU use emerges when frequency of diagnosis is taken into account. By multiplying the number of discharges in the 20-percent MEDPAR sample[4] by the average LOS in special care, the number of special care days by diagnosis can be estimated. Table 10 shows the 15 diagnoses which use the most special care days. Again, cardiovascular disease predominates. However, diseases involving operating room procedures become less important as major special care diagnoses.

Applicability of DRGs to ICUs

As noted above, the current DRG classification system may not be suitable for describing certain types of patients cared for in ICUs. DRGs are based on a principal diagnosis, with some additional categories available for patients with a single substantial secondary diagnosis, called a "comorbidity," or a significant "complication." Yet ICU patients often have multiple, serious underlying illnesses. In one study (265), ICU patients had on average over four major diagnoses, and the high-cost nonsurvivors had over six diagnoses. For these patients, designation of a principal diagnosis is likely to be arbitrary and unreliable at times. Furthermore, the additional diagnoses would not be accounted for.

As discussed earlier, many cardiac diseases, particularly those involving coronary diseases, and many of those surgical diagnoses involving operating room procedures, include stays in the ICU and CCU as a matter of routine. For exam-

[3]Available HCFA data combines ICU and CCU patients as special care patients.

[4]For a description of HCFA's MEDPAR data base, see ch. 4.

Table 10.-Estimated Number of Special Care (ICU/CCU) Days by Primary Diagnosis Based on HCFA 20-Percent Sample of Medicare Discharges, 1980[a]

Diagnosis	DRG	Special care		Routine care
		Total days	Percent of total hospital days	Total days
1. Myocardial infarctions	121-123	176,963	33 "/0	362,013
2. Atherosclerosis	132-133	103,781	14	625,450
3. Heart failure and shock	127	87,347	11	693,439
4. Pneumonia and pleurisy	89-91	78,211	13	555,115
5. Unrelated OR procedure	468	66,451	9	734,684
6. Arrhythmia	138-139	54,464	21	200,923
7. Angina	140	53,926	22	194,653
8. Ungroupable	470	51,100	6	734,684
9. Cerebrovascular accident	14	42,120	5	715,668
10. Chronic obstructive pulmonary disease	88	41,203	8	467,825
11. Pacemaker implant	115-118	37,109	30	83,586
12. Coronary artery bypass surgery	106-107	30,169	32	64,968
13. Pulmonary edema and respiratory failure	87	28,371	25	83,276
14. Major bowel OR procedure	148-149	27,191	10	242,188
15. Major reconstructive vascular procedure	110-111	20,543	18	94,077

[a]Multiple DRGs for the same primary diagnosis were combined for this analysis.

SOURCE: Office of Technology Assessment.

pie, in the United States it is standard to treat all patients with acute myocardial infarctions (heart attacks) in CCUs or ICUs. The average DRG price per discharge will reflect the portion of the hospital costs consumed in the higher cost special care unit.

However, the DRG categories for many medical diagnoses are so broad that ICU days represent only a small proportion of total hospital days. For example, in 1980, hospital stays for chronic obstructive pulmonary disease (DRG 88) and for cirrhosis of the liver (DRG 202) averaged only 0.82 and 0.60 days of intensive care, respectively (260). Yet, the sick patients within these DRGs may spend many days in the ICU and use more total hospital resources than patients within DRGs that include a much longer average special care stay. In other words, it appears that variations in severity of illness are particularly great for noncoronary, medical diagnoses that represent the medical patients in medical or mixed ICUs. Likewise, the DRG classification system does not satisfactorily account for patients with a primary surgical diagnosis who suffer major medical complications. For example, in a series of critically ill surgical patients, Cullen (54) found that renal failure (a costly medical complication) was a powerful predictor of ultimate survival. Many clinicians might agree that renal failure had become a patient's major clinical problem, but the DRG system requires that the operating room procedure take precedence in DRG assignment. The presence of renal failure, then, would not significantly affect DRG payment.

Unfortunately, there is no data base available to test whether there are systematic differences by hospital type in severity of illness in ICU populations. DHHS'S initial evaluation found that teaching hospitals do have higher costs per case, suggesting, at least in part, that they treat more seriously ill patients (75). Survey tapes of the American Hospital Association document that major teaching hospitals do have 50 percent more ICU days as a percentage of total hospital days than nonteaching hospitals (106). These additional ICU days probably explain some of the higher costs per case in teaching hospitals.

However, without an accurate severity-of-illness measure, one does not know whether the additional ICU use in teaching hospitals represents the presence of a sicker population or a different threshold for transferring and maintaining patients in the ICU. Likewise, differences in resource use between ICUs may represent differences in severity of illness or differences in intensity and style of care. Preliminary results from 15 tertiary care hospitals recently surveyed by Knaus' group at George Washington University in Washington, DC, suggest that severity of illness, in fact, ac-

counts for a substantial portion of the differences in ICU resource use for patients with the same primary diagnosis (268).

Under Medicare's DRG payment system, many costly ICU cases will likely become outliers for whom only marginal costs above a day or cost threshold are paid. As was described earlier, by design, day outliers will predominate over cost outliers. Utilizing HCFA'S 1980 MEDPAR data, OTA has estimated that 12 percent of cases involving special care would be classified as day outliers, in comparison to 9 percent of total cases. By definition, the marginal costs for day outliers are calculated based on the DRG price, not the actual cost for that patient. Yet, as was noted in chapter 3, the cost per day in the ICU is over three times greater than the cost for a general hospital day. Thus, a hospital may receive far less than the actual marginal costs for caring for a long-term ICU patient. In short, the outlier payment rules generally favor less severely ill, non-ICU, long-stay patients, such as those with strokes or certain types of cancer, over more severely ill, long-stay ICU patients.

It would appear, then, that severely ill Medicare patients, especially if they are in the ICU, will be "revenue losers" to the hospital, even with an outlier policy in effect. This fact, combined with the lack of a financial penalty for transferring patients to a second hospital, may result in more interhospital transfers of the sickest ICU patients to tertiary care hospital ICUs. A regionalized system of ICU care that is common in some parts of Europe might thereby be stimulated in the United States, perhaps desirably. It should be noted, however, that unless either a severity-of-illness measure or a different outlier policy is adopted, the tertiary care hospital receiving severely ill transferred patients will be likely to lose financially. These hospitals would then face the dilemma of either not accepting these patients in transfer or of accepting these patients into their high-quality ICUs at a financial loss. At the extreme, tertiary care hospitals could, in effect, become large ICUs (212). Public hospitals and some teaching hospitals, however, may simply be unable to sustain the costs of ICU care and be forced to ration care even more strictly than they do now (212).

The 3-year capital cost exclusion in the DRG law is not likely to affect ICUs, at least in the short run. ICU care is relatively costly largely because it is so labor-intensive. Common ICU technologies, such as cardiac monitors, respirators, pulmonary artery (Swan-Ganz) catheters, central feeding lines, etc., are labor-generating rather than labor-reducing technologies, because they require fairly constant attention.

As was noted in chapter 5, the monitor-only and other less severely ill ICU patients have been subsidizing the care of the most critically ill ICU patients. Under the DRG system, there may be a new incentive to treat monitor patients on regular floors or perhaps in intermediate care units. In addition, hospitals will attempt to pass on to charge payers the unreimbursed cost of ICU care to Medicare patients. The additional "pass-on," combined with nonadmission and earlier discharge of some of the less sick ICU patients, should result in substantially increased charges for an ICU day. The current **2.5:1** ratio of ICU bed charges to routine bed charges (71) will correspondingly rise.

In short, ICU care to Medicare patients will not be financially rewarding to hospitals under DRG payment. Almost all ICU cases are likely to be "losers" to the hospital—ICU days are about 3 to 3.5 times more costly than non-ICU days and ICU patients have longer hospital stays than non-ICU patients. The new incentives of the DRG payment system will be imposed on an ICU decisionmaking environment in many hospitals in which the costs of care had previously been a relatively minor concern. The implications of the collision between the hospital's new interest in reducing the cost of ICU care and a decisionmaking environment that results in expanding ICU care will be discussed in chapters 7 and 8.

PHYSICIAN PAYMENT

In a fee-for-service system that pays on the basis of "usual, customary, and reasonable" standards, "technological and procedural" medicine has been rewarded (202). The ICU is a focal point for technological and procedural medicine within the hospital. Incubation, use of respirators, and arterial line placement are among the many ICU procedures that generally require ICU admission and numerous followup ICU visits by the patient's primary and consulting physicians. Payment for ICU procedures and visits is generally high and is rarely questioned by insurers (166).

Patients in ICUs have multiple diagnoses and often multiple organ system failures. It is not surprising, therefore, that ICU patients have many physicians. Murata and Ellrodt (164), found in a large community hospital in which the ICU had full-time housestaff that at least one physician consultation was requested in 65 percent of the private admissions. In this study, private ICU patients had an average of nearly 2.5 physicians caring for them, in addition to round-the-clock housestaff coverage.

The situation is somewhat different in teaching hospitals and other large nonteaching hospitals. In these hospitals, there is usually one or more full-time staff physicians who help administer the ICU, provide staff education and, to varying degrees, participate in direct patient care. Although the specific payment method adopted by a particular hospital may be unique, compensation arrangements can generally be classified into one of four categories: fee-for-service, percentage of income arrangements, salary only, and combinations of the first three (77). Straight salary arrangements represent the only compensation method that does not include a financial incentive component (77). In terms of ICU care, ICU staff physicians who are not paid on strict salary basis have a financial incentive to keep the unit filled and to perform procedures and provide technical services (166). Surveys on the prevalence of various compensation methods in U.S. hospitals have not specifically included ICU physicians (77). Similarly, the extent of ICU physician double billing (submitting fees for reimbursement for professional services while receiving salaries for administrative and educational activities, which are reimbursed as a hospital cost) is unknown.

Under DRG payment, ICU staff physicians may face conflicting payment incentives unless they are paid on a strictly salary basis. Given the high costs of ICU care, it may be in a hospital's interest to increase the cost control function of ICU staff physicians and to pay them salaries as their primary form of remuneration. Hospitals could even provide incentive bonuses for reduced costs or decreased lengths of stays. In addition, hospitals which do not currently have ICU directors may find it in their economic interests to hire one to monitor the costs of care provided by private physicians who admit patients to the ICU. Thus, it is possible that a hospital's attempt to reduce hospital ICU costs, paid under Part A of Medicare, might also indirectly result in a reduction in Part B physician payments.

7

The ICU Treatment Imperative

7.
The ICU Treatment Imperative

INTRODUCTION

Medical decisionmaking involving seriously ill patients is often difficult and uncertain. In many cases, physicians do not know ahead of time whether the treatment they prescribe will benefit their patient. Physicians in the intensive care unit (ICU) frequently face the similar dilemma of not knowing whether to employ available life-support for critically ill patients and whether or when to withdraw such support when it seems clear that continued treatment will merely prolong his life with no improvement in his grave condition. One reason ICU decisionmaking is so difficult is that it is so successful; most ICU patients survive. Yet, it is also clear that in some cases ICU care is provided—at a very high cost—to patients who are beyond help. In other cases, ICU care may be immediately lifesaving but results in returning the patient either to a condition that still has a very short life expectancy or to a condition with a severely limited functional status.

At the present time, there is no reliable way to predict outcome for most critically ill patients, and therefore, it is usually reasonable and appropriate to initiate intensive care treatment for severely ill patients. However, because of certain factors somewhat unique to the ICU, care is sometimes continued beyond the point of benefit to the patient.

This chapter explores those factors—including the underlying chronic illnesses suffered by many ICU patients, the diffused nature of decisionmaking that often prevails in the ICU, the frequent inability of patients themselves to make informed choices about continuing therapy in the face of a hopeless situation, the concern over the possibility of malpractice lawsuits or even criminal prosecution and the inability to predict outcome—that often lead physicians to provide life-support after the initial rationale for doing so no longer exists. **Together, these factors create an ICU treatment imperative.**

THE HIGHLY TECHNOLOGICAL NATURE OF ICU CARE

The "technological imperative," which has been defined by Fuchs as the desire of physicians to do everything that they have been trained to do, regardless of the benefit-cost ratio (84), flourishes in the ICU. ICU technology can dramatically and consistently sustain life for long periods of time. The ICU is a prototype of what Thomas has called a "halfway technology, " one that attempts to compensate for the incapacitating effects of certain diseases whose courses one is unable to affect. It is a technology designed to make up for disease or to postpone death (250). Many of the individual technologies used in an ICU, including respirators, defibrillators, and balloon pumps, sustain vital functions but do little to correct underlying disease processes.

In a well-functioning ICU, patients rarely die immediately of respiratory failure or circulatory collapse, because the available technology can delay these complications (50). Some patients, particularly those with the common ICU problems of cardiovascular, respiratory, and necrologic failure (139) have their vital functions sustained by technology so as to forestall death, but their basic disease or diseases do not improve. For *some* disease processes, then, ICU care does not change the ultimate outcome, but rather results in a pro-

longed, yet inexorable course, with death occurring sometimes from complications of ICU care (135) or after a decision is finally made to terminate the special life-support.

Measurements and monitoring are often pursued as ends in themselves in the ICU (198). Patient care may become depersonalized. As one critical care specialist noted, the paradox is that ICU staff treasure life highly and go to any length to salvage lives, yet often ignore, or actually debase, the very qualities that render patients uniquely human (35). The technological imperative, which frequently results in more effective methods of managing very sick patients, can lead to the uncritical adoption of harmful therapies on the assumption that the most critically ill have little to lose from new approaches (198). In addition, new ICU therapies that are demonstrably efficacious in expert hands for specific problems may become widely adopted and routinely used in situations and under conditions where demonstration of their effectiveness is absent (243).

Physicians who become intensive care specialists—"intensivists" —by predilection and training are generally believers in technological intervention (95). ICU-oriented physicians naturally are believers in the highly complex technology that they have mastered and often save lives that would have been lost under non-ICU conditions. Likewise, some nurses who choose ICU-based careers tend to be therapeutic activists, not prone to accepting the inevitability of a patient's deteriorating condition (278).

The highly technical nature of ICU care itself affects the way in which life and death decisions are made. The most critically ill patients have multiple organ systems failure and receive multiple interventions. The very exacting nature of this form of patient management results in standard protocols of treatment, perhaps at increased expense (100), and in concentration on the details of treatment.

In such situations, the fundamental consideration of the long-term benefits to the patient receiving care is often overlooked among the seemingly endless technical decisions that are made throughout the course of an ICU stay. Yet, the most critically ill patients, who require the most concentrated focus on the details of day-to-day management, are precisely those for whom fundamental likelihood and quality of survival questions are most appropriate.

THE NATURE OF ICU ILLNESSES

As was noted in chapter 5, diseases of the cardiovascular, respiratory, and neurological systems, both medical and surgical, predominate in the ICU. Failure of these systems often results in acute respiratory distress, which is manifested by severe smothering or "air hunger, " and circulatory collapse or shock, which results in altered states of consciousness. Even when the impulse on the part of the medical professional is simply to make a desperately sick patient more comfortable and not to initiate heroic measures in an attempt to reverse the illness, that impulse may require the use of the full panoply of ICU technologies, particularly the respirator. Some patients with cancer and other chronic debilitating illnesses may be cared for outside the hospital, perhaps in hospices, with appropriate use of pain medication and emotional support. Many terminal illnesses, however, produce symptoms that cause severe distress to the patient and that are frightening to their families. The need for relief often results in hospitalization and treatment in the ICU. For example, symptoms of smothering from emphysema cannot be treated with medication alone—at least, not without the very real possibility of depressing the patient's respiration to the point of risking immediate death (102). "Naturalness," therefore, may have to be sacrificed for comfort, which at times can only be achieved with ICU management and technologies (191).

"ICU diseases" often develop rapidly-sometimes in seconds. When a severely ill, perhaps dying patient is seen in an emergency room ***or*** on a medical floor, physicians, who are often not familiar with the patient, naturally and appropriately attempt resuscitation (179). Frequently, the basic physiological and other clinical data which are necessary for a medical judgment on the severit y and likely outcome of an illness cannot be acquired before admission to the ICU (55).

With some terminal diseases there is time to anticipate and plan the degree and nature of intervention in the event of a sudden deterioration in the patient's condition. Because end-stage emphysema, severe heart disease, or generalized arteriosclerosis are, rightly or wrongly, not considered terminal diseases in the same way that cancer is, patients experiencing a sudden decompensation are routinely and responsibly treated with all available technology. Once initiated, however, treatment modalities that have been initiated primarily to respond to acute, disabling symptoms may become difficult to stop for the reasons described below.

TRADITIONAL MORAL DISTINCTIONS IN MEDICINE

Along with the notion that physicians should not "play God, " the traditional medical ethic has been to disregard subjective views of quality of life in making life and death decisions. In terms of ICU care, this general ethic has been characterized as one in which "survival is being taken as equivalent to a life saved" (64).

Underlying the other considerations which play a part in ICU decisionmaking is the generally activist attitude of many physicians, who may embody a fundamental and somewhat unique attitude of American culture. The decision to pull back is frequently more difficult to make than the decision to push ahead with aggressive support, using the complex and sophisticated medical technology available (269). As other reviewers of intensive care have observed, this attitude has been captured in T. S. Elliot's The Family *Reunion* (18):

> Not for the good that it will do
> But that nothing may be left undone
> On the margin of the impossible.

In situations where patients are in acute distress and where decisions must be made in seconds or minutes, there are powerful reasons initially to apply a lifesaving technology. Having done so, it is often quite difficult to reverse the course of treatment in the light of new information or thoughtful judgment because of traditional moral distinctions in medicine. Specifically, fundamental moral and ethical distinctions are frequently made between actively causing death and allowing it to occur by declining to intervene; between withholding and withdrawing treatment; and between ordinary and extraordinary treatment (191).

Many primary decisionmakers in the ICU feel, for example, that having decided to put a patient on a respirator, one is committed to its continued use and thus make a fundamental distinction between intentionally withholding and actively withdrawing the respirator. Likewise, while some prominent medical ethicists have abandoned the distinction between "ordinary" and "extraordinary" obligations to dying patients, physicians generally continue to use the distinction (160). The ordinary-extraordinary distinction has been affirmed consistently in Catholic moral theology, notably in a major address by Pope Pius XII in 1957 (185). Certainly, most of the public consider that there is a difference between care that is common and reasonably simple and care that is unusual, complex, expensive, and uses elaborate "unnatural" technology. Similarly, most physicians consider intravenous fluids to be ordinary and standard therapy and resuscitation an extraordinary measure (160). Other physicians, however, consider even the use of respirators and other common ICU technologies to be routine, ordinary treatment (191). Many physicians do not use the ordinary-extraordinary distinction at all, but rather fundamentally consider whether an intervention, however invasive, is "medically indicated. "

As the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research has observed, invocation of these moral distinctions is often so mechanical that it neither illuminates an actual case nor provides an ethically persuasive argument (191). Nevertheless, the moral distinctions cited above have great importance in ICU decisionmaking. Because many different individuals typically participate in ICU decisions, a range of moral attitudes are represented (278). There is a natural tendency to defer to the individual, whether physician, nurse, or family member, who firmly holds a traditional moral view.

In addition, there is still uncertainty about the legal interpretation of these moral distinctions. For example, a New Jersey appeals court recently reversed a lower court order allowing removal of a feeding tube in an extremely ill, demented patient with no hope of recovery.[1] The two courts differed in their interpretation of whether nasogastric feedings (nourishment) constituted ordinary or extraordinary treatment for this particular patient in question.

A California appellate court, on the other hand, in vacating a lower court's reinstatement of murder charges against two physicians for terminating certain treatments for a patient they diagnosed as hopelessly comatose, explicitly rejected the distinction between ordinary and extraordinary care. The court, rather, invoked an ethical measure of "proportion," writing:

> Proportionate treatment is that which has at least a reasonable chance of providing benefits to the patient, which benefits outweigh the burdens attendant to treatment. Thus, even if a proposed course of treatment might be extremely painful or intrusive, it would still be proportionate treatment if the prognosis was for complete cure or significant improvement in the patient's condition. On the other hand, a treatment course which is only minimally painful or intrusive may nonetheless be considered disproportionate to the potential benefits if the prognosis is virtually hopeless for any significant improvement in condition.[2]

Ironically, as was pointed out by the President's Commission, if there is any reason to draw a moral distinction between withholding and withdrawing treatment, it generally cuts the opposite way from the usual formulation: greater justification ought to be required to withhold treatment rather than to withdraw it (191). Whether a particular intervention will have positive effects is often uncertain until the therapy has actually been tried (50). If therapy is initiated and it then becomes clear that the patient is not benefiting from it, this is actual demonstration, rather than mere surmise, to support terminating that treatment (191). Yet, physicians who believe in a moral distinction between withholding and withdrawing treatment, or who are concerned that another individual or the courts would judge their actions based on this distinction, might choose not to utilize the lifesaving treatment in the first place out of concern that the treatment could not subsequently be readily withdrawn.

[1] See *In re Conroy*, 188 N.J. Super. 523, 532 (Ch. Div. 1983).

[2] *Neil Leonard Barber, Robert Joseph Nedjl v. Superior Court of the State of California for the County of Los Angeles;* Court of Appeals of the State of California, Second Appellate District, Civil No. 60350; Oct. 12, 1983.

THE DIFFUSION OF DECISIONMAKING RESPONSIBILITY

Because of the nature of ICU care, many professionals become important decisionmakers, including nurses who attend to the patient full time, housestaff, consultants, and the patient's personal physician. In larger hospitals, there are frequently one or more ICU-based physicians in attendance who also are involved in the decisionmaking process. In some ICUs, particularly in large, teaching hospitals, the primary legal responsibility for a patient's care is transferred to the ICU or to an ICU-oriented specialist **(165,244). often, the patient's personal physician feels intimidated by the clinical complexity and the bureaucracy perceived in the ICU and gives up an active role in decisionmaking (136). As a result, the patient's personal physician, who often has the best understanding**

of the patient's baseline medical condition, quality of life, and personal values, goals and concerns, does not participate in important decisions about the care the patient receives in the ICU (194). At the same time, physicians who do not treat many ICU patients may have unrealistic expectations about what ICUs can accomplish and do not know how or when to address fundamental issues about terminating particular kinds of care (243, 244).

Many ICU patients enter the hospital through the emergency room, often in a hospital where their personal physician, if they have one, is not on staff. Victims of acute trauma or sudden severe illness may not have a previously established relationship with the physician(s) who is caring for them.

ICUs in large hospitals utilize a team approach to individual patients, which is felt to result in a higher quality of care (207,208). Some have wondered, however, whether a patient cared for by an ICU team in fact has a doctor (212). With the team approach, decisionmaking responsibility may be diffused, and the difficult issue of terminating special care is frequently deferred or deflected. Families who are interested in addressing this painful issue may not know how to engage a diverse team of busy professionals in discussion.

With multiple professionals in decisionmaking roles, there may well be different medical and moral views expressed. Unanimity among professionals is desirable, especially when the issue is withdrawing life-support (233,243). In such situations, there is a natural tendency to defer to a member of the group who holds a traditional moral view, such as the distinction between withholding and withdrawing treatment.

Decisions not to treat a debilitated patient in a nursing home (27), not to transfer to the ICU a patient with end-stage cystic fibrosis (58) or cancer (253), *or* to choose a hospice rather than a hospital, can often be addressed privately by patients and their doctors. In the ICU, however, such important decisions are more visible and often controversial (278). When the responsible physician addresses the issue of termination of special life-support with a family or patient, for example, counterpressures from other physicians and nurses may make decisionmaking extremely difficult and emotionally charged.

PROBLEMS OF INFORMED CONSENT IN THE ICU

As the President's Commission has emphasized, the voluntary choice by a competent and informed patient should determine whether or not a life-sustaining therapy will be undertaken or continued (191). Unfortunately, the ICU environment is ill-suited to guaranteeing patient competence and to providing the necessary flow of information to ensure fully informed consent.

Case studies have demonstrated that patients in ICUs, as well as other seriously ill patients, do not always act or communicate in their own interest (124). As noted in chapter 5, ICU patients may undergo acute psychological reactions to sleep deprivation, sensory overstimulation, dependency, and nearness of death. This is true in other life-threatening situations as well, but unlike the ICU, there is usually sufficient time and a satisfactory environment in such cases for working with the patient before taking an irrevocable decision.

Moreover, ICU patients suffer from subtle, but real, metabolic disturbances which alter their judgment. They are frequently in severe, although often reversible, pain or discomfort. Furthermore, a patient on a respirator may be reasonably competent to give informed consent but unable to satisfactorily communicate his or her wishes. This is due to the extreme difficulty ICU patients experience in communicating, often because they have an endotracheal tube in their throat or have had a tracheotomy, which makes verbalizing impossible (225).

The natural response to some situations is to defer decisionmaking, particularly with respect to terminating care, until the patient is able to give informed consent. Indeed, physicians may have to salvage the life of a critically ill patient in order to obtain his or her informed consent to stop care (69). Medical professionals naturally have a bias toward supporting patient survival until it can be determined that a patient is competent and that the choice to stop treatment is truly informed (245).

When the patient lacks the capacity to give informed consent, the family is normally recognized as having the authority to make a decision on the patient's behalf. In practice, this procedure generally works well (191). Yet, in some cases, family members may have motivations which do not necessarily support the best interests of the patient (152,244) or, they may disagree among themselves. Again, because of the uncertainty of who should make life and death decisions on behalf of an incompetent patient, physicians naturally adopt a policy of continuing intensive care until resolution of disputes and roles occurs.

Finally, it has been noted that patients with serious acute illnesses are generally more passive and distant from treatment decisions than patients with chronic stable diseases (150). For many medical decisions, patients and their families can participate in decisionmaking with full appreciation of the medical issues involved. Because of the highly technical nature of ICU care, however, patients and families may not fully understand the implications of the many decisions that must be confronted in the ICU and are more prone to defer to physicians (280). In the ICU, the doctor's orientation toward the patient is to be active and in control of the situation, while the patient is passive and dependent (280). Some even consider it to be the ICU physician's responsibility to bring a family to the point where it can look at the patient's situation from the physician's perspective (278).

Whether the physician adopts a controlling attitude or not, it may nevertheless take some time for patients or their families to accept the fact that continued therapy is hopeless, and the process of informing them of the condition places the physician in a difficult position. "It is extremely difficult to tell a critically ill patient that all is not going well" (232).

LEGAL PRESSURES: DEFENSIVE MEDICINE

The past decade has seen an explosion in the number of malpractice lawsuits brought against medical professionals, particularly suits charging that a physician was negligent in his or her duty to provide adequate medical care. For this case study, malpractice is defined as a wrongful act, committed by one or more parties upon another person; the injured party may seek monetary damages from the person(s) responsible as compensation for an injury. The injured party must demonstrate that the injury was caused by conduct which failed to conform to the "standard of care" for that medical problem and that class of provider (199).

While many malpractice claims ultimately are unsuccessful, they have caused doctors and other medical personnel to become more cautious and, in effect, to practice "defensive medicine," which involves taking or not taking certain action more as a defense against potential legal liability than for the patient's benefit **(68).** Although the extent to which defensive medicine is practiced is not known, it clearly has contributed to the provision of costly, unnecessary, and sometimes hazardous medical care.

Physicians, under certain circumstances, may also be subject to potential criminal prosecution, The criminal law confines people's freedom of action in order to protect society, not simply individuals, and therefore, consent is never accepted as a defense against the crime of murder **(191).** Taking innocent human life is seen as a wrong against the entire society, not just against the dead person. As such, criminal prosecution is the ex-

elusive prerogative of the State and may be brought against a physician whose patient died because of the physician's failure to perform the duty of treating the patient according to accepted medical standards (191). Reported criminal prosecutions of health care professionals for killing patients are rare, and it is felt that merely the threat of prosecution provides appropriate protection against abuse (191).

Although all practitioners face the possibility of a malpractice suit and, to a much lesser extent, criminal prosecution, concern is certainly great among those who work with ICU patients. In large part, this is because ICU patients are critically ill, and death, therefore, is a common occurrence. Indeed, the physician may permit a patient's death by withholding or withdrawing a particular treatment or technology, an action that is likely to make the doctor feel vulnerable to subsequent legal liability. In fact, however, the legal problems with the treatment and nontreatment of terminally and critically ill patients appears to have been exaggerated—there are no known cases of liability in the United States concerning the withholding of medical care from a terminally or critically ill patient (272). Yet the physician's sense of vulnerability to malpractice litigation is likely to increase, because decisionmaking in the ICU is unusually visible. The attending physician, the patient, and the next-of-kin have direct decisionmaking responsibility, but others, including ICU staff, family members, and other physicians, who may have strong opinions on a life and death decision, are also involved, although less directly (278).

In the determination of standards of care by which to judge physician's actions, malpractice courts have traditionally imposed on physicians the duty to provide medical care at the level which is considered usual practice within their own or a similar locality. However, with the advent of standardized medical training and rapid dissemination of information, this "locality rule" has been replaced in many States by a standard of care based on the usual practice of the national medical community (199).

Thus, physicians are more likely to utilize an ICU in the first place if its use is the prevailing national standard of care for a particular medical problem, Once the patient is in the ICU, the physician's actions in this highly specialized arena are likely to be judged by often higher national standards of care than by the standard of other local practitioners. To avoid charges of negligence, physicians are likely to use ICUs more frequently and for longer periods of time than they might otherwise feel is appropriate.

Although the threat of criminal prosecution is generally remote for most health professionals, it has arisen in the context of the delivery room and the neonatal ICU, when State prosecutors found criminal intent to murder in cases involving an abortion[3] and the care of severely disabled newborns (197). Even in the adult ICU, criminal intent may be alleged by prosecutors who view actions such as failing to resuscitate, "pulling the plug," and "overdosing" with painkilling or sedating medications as intentionally causing a person's death. In **1982,** for example, homicide charges were brought against two Los Angeles physicians who withdrew intravenous fluids and nasogastric feedings from a comatose patient, with the approval of the patient's family (5,133). Although the California Court of Appeal ultimately ruled that charges against the physicians be dropped (171), the case undoubtedly caused significant concern in the medical community (169).

Defensive medicine is also a factor in decisions to use the ICU in routine, monitor cases. Where the standard in the community is to use the ICU for monitoring of specific conditions, such as postoperative neurosurgery cases or uncomplicated myocardial infarctions, individual practitioners may put themselves out on a legal limb if they choose to care for the patient outside the ICU (141).

Decisions to terminate life-support are seldom challenged in court and would seem to be reasonably well protected if the hospital has established explicit criteria and procedures for reaching such decisions and if medical personnel follow the hospital's guidelines (191). Some hospitals have formal policies for issuing "do not resuscitate" orders (191). These policies were initially adopted in the

[3] *See Commonwealth v. Edelin, 359* N.E. **2014 (Mass. 1976).**

mid-1970s (154,193,243,253) in recognition that nonresuscitation was appropriate when a patient's well-being would not be served by an attempt to reverse a cardiac arrest. Yet a recent study of nonresuscitation decisionmaking suggested that physicians frequently for-m opinions about a patient's desires for resuscitation without involving the patient or the patient's family, and often physicians take actions which do not conform to the patient's preference **(15).**

For difficult ICU decisions that do not involve resuscitation, however, physicians and staff may not have formal procedures to follow and therefore must speculate about their potential legal liability. The President's Commission survey found that only 1 percent of hospitals in this country, and just 4.3 percent of hospitals with more than 200 beds, have ethics committees to help doctors and families reach decisions about withholding or withdrawing life-support (191). That number may have increased dramatically—to perhaps **20** percent of hospitals—in the 2 years since the President's Commission survey (21). Among their other functions, these committees may provide information to the hospital's medical staff on their legal responsibilities in certain situations.

In the absence of an institutional mechanism for advising staff on the possible legal implications of their actions, physicians, understandably, tend to adopt a cautious, "defensive" approach to decisionmaking. This is especially true in hospitals where legal responsibility for care of a patient in the ICU is not turned over to an ICU-based physician. It is not unusual, for example, for patients who are "brain dead" to remain on an ICU respirator for days because of unfounded physician or hospital concern about a possible malpractice suit or criminal prosecution. Physicians may feel more confident to disconnect the respirator if hospital guidelines indicate when it is appropriate to do so. Even when a hospital does establish written guidelines and procedures for making life and death decisions, however, they are necessarily cautious and conservative in content (111). Thus, whether physicians decline to withhold or withdraw ICU technology for fear of legal liability or whether the institution provides guidelines, the result is the same: the continuation of ICU care for a longer time than is often necessary or desirable for the patient's well-being.

PAYMENT AND THE TREATMENT IMPERATIVE

Methods of hospital and physician payment described in chapter 6 have tended to be permissive factors for provision of excessive ICU care. It is unlikely that the care is performed primarily to receive greater income. Rather, the payment system has ***not*** interfered with the factors described in this section which do produce an ICU treatment imperative.

Until 1982, hospitals in States without prospective rate-setting programs were reimbursed by some insurers for actual costs of ICU care and by other insurers according to charge schedules which permitted hospitals to recoup the costs of caring for very high-cost, seriously ill ICU patients. Physician payments **based** on a usual, customary, and reasonable charge system or even on a fixed fee schedule have tended to amply reward physicians who provide technical ICU services. While the incentives for the hospital have now changed, at least for Medicare patients, physician payment systems still permit physicians to provide continued, high-level ICU care without direct consideration of the costs to either the patient or society.

THE ABSENCE OF CLINICAL PREDICTORS

As with many chronic or terminal illnesses, there is an absence of data for the common ICU conditions on which to make predictions of an individual ICU patient's chances of immediate survival, as well as the likelihood of his or her long-term survival. Probabilities based on quantitative information for populations of similar patients are used as a reference point on which to base decisions about treatment of patients (277). This approach is common for cancer, for example, where there are defined stages of disease and accumulated outcome data based on alternative modes of therapy.

Were it possible to predict which risk factors consistently yield poor outcomes, many patients might be considered unsalvageable at an earlier point in their ICU stay **(247).** With reliable predictors of ICU survival, many of the other factors that result in excessive ICU care would become less important. For example, physicians would have less concern about legal liability if reliable data were available to support their clinical judgment that special care should be terminated for a particular individual.

It has been argued that the use of predictive scores should have its greatest application to decisions involving groups of patients or on how to expend societal resources and may have more limited application to decisions involving individual patients (157). Unfortunately, accurate quantitative approaches to clinical decisions are difficult. Collecting large, accurate data bases is expensive and time-consuming; verifying their relevance to other patient populations is costly and sometimes not feasible. Data bases can rapidly become obsolete for predictive purposes once new tests or procedures become available (157). Collecting data on heterogeneous ICU populations in which diagnostic monitoring and therapeutic intervention often occur simultaneously is particularly problematic. Yet, unfortunately, as will be pointed out below, purely subjective prognostication in the ICU is especially uncertain.

In recent years, work has begun on establishing quantitative predictive models which would aid in predicting outcome of ICU care (143,223, 236,247,270). Up to this point, no such model of clinical predictions has been accepted for general ICU use (176). However, the Acute Physiology and Chronic Health Evaluation (APACHE) scale developed by Knaus and colleagues has begun to receive particular attention as an objective measure of the severity of illness of ICU patients for research and evaluation purposes, much as the Therapeutic Intervention Scoring System scale of Cullen (see ch. 5) has been used as an objective measure of ICU resource use. A recent simplification of the APACHE model may make this approach more widely useful to help physicians make more precise treatment decisions (138). By design, however, the APACHE scale is more appropriate for predicting outcomes of populations of ICU patients rather than prognosticating for individual patients.

A generally reliable predictive model is available in burn units, and has been used to make decisions about individual patients (123). Its use in clinical decisionmaking, however, has not been generally accepted by experts in the field (263).

Recently, a scale of rating the likelihood of survival for patients in coma (149) has been developed and is used in some ICUs for individual decisionmaking. For the great majority of ICU patients, however, no predictive scale is available. Even if such scales were available, it would be difficult to apply a population-based scale to individuals (229), especially where a "wrong" decision can have such profound implications.

For a patient-care area that is as technologically based as the ICU, judgments on outcome have been remarkably subjective. Subjective prognostication near the end of life is notoriously uncertain (201) and varied (177). Some feel that physicians tend to maintain overly pessimistic prognoses because patients with poor outcomes claim greater physician attention (70). Some physicians employ a strategy that has been called the "hanging of crepe, " i.e., predicting the worst so that anything less dire will be viewed as a major achievement (229). Others feel that physicians remember the

rare "miraculous" recovery, forget the more common failures, and act on that faulty memory (280).

Other problems with ICU outcome prediction include the fact that recognition of terminal patients during an acute admission is difficult (198); as noted earlier, an acute illness is often not seen in the context of the patient's overall condition. Furthermore, in many community hospitals, only a few physicians ever handle a significant number of ICU patients. Most physicians have limited experience with the relative prognoses of these very sick patients (165). Very few hospitals recognize an institutional responsibility to advise physicians, patients, and families on likely outcomes of ICU care, even for the group of patients who might be in a vegetative, nonrecoverable state (191). Opinion on likely prognosis remains an individual physician's responsibility and, not infrequently, dramatically different opinions are offered by the various physicians involved in a particular case.

Another major problem is the lack of meaningful predictors of the outcome of chronic illness (215). Many ICU patients suffer an acute, major ICU episode as part of a deteriorating chronic condition, e.g., emphysema, cancer, cirrhosis, or renal failure. Often the issue is not the likelihood of surviving the acute episode, but rather what the natural course of the illness would be even with a favorable acute recovery. As was noted in chapter 5, it is generally accepted by ICU experts that ICU care does not favorably affect the course of a chronic illness, but rather reverses an acute deterioration in the illness. Some patients, when given information about relatively poor life expectancy and quality of life, choose not to undergo temporary lifesaving treatment. For example, cancer patients, relying on population-based outcome studies, sometimes choose not to submit to active cancer therapy. For the most part, prognostic indexes, stratified by disease and severity of illness, do not exist for most other common chronic conditions (158).

Physicians have demonstrated dramatically divergent predictions of life expectancy for patients with "end-stage" diseases (177). In the absence of data on acute or chronic outcome, physicians can offer only imprecise, qualitative assessments, i.e., survival is "unlikely," "unusual," or "possible," rather than the quantitative assessments, which have probability ranges attached, i.e., "1O to 20 percent chance of one year survival" (277).

A fundamental dilemma is that the rare miraculous recovery does occasionally occur. Describing the dismal outcomes of 18 patients treated in an ICU for acute renal failure after rupture of an abdominal aneurysm, Morgan was one of the first ICU specialists to note the problem of high-cost, low-yield ICU care (162). The patients were elderly (mean age 65.2 years), with a high incidence of obesity, chronic pulmonary disease, and arteriosclerotic heart disease. Despite energetic clinical efforts and dramatically high cost per patient, 17 out of 18 died. Looked at another way, however, one survived and was able to return to his previous functional level. A retrospective review of clinical records in these cases did not permit success or failure of treatment to be predicted by any means other than actual trial.

8.
Foregoing Life - Sustaining Treatment

8. Foregoing Life-Sustaining Treatment

INTRODUCTION

Chapter 7 described the various, interrelated factors that help produce an environment in which excessive intensive care unit (ICU) care is sometimes provided. The ICU treatment imperative is now being moderated by two relatively recent developments.

First, there has been increasing recognition of the emotional torment for the patient, the family, physician, and the hospital staff, of seemingly endless ICU stays that ultimately end with the death of the patient (243,247,278). A growing humanistic concern for the patient and his family supports the need to preserve the dignity of a dying patient, and may require earlier cessation of active life-support (18).

Second, there has been a growing recognition that the high costs of treating the most severely ill ICU patients may be too high, particularly if they obviously limit the resources available to treat moderately sick patients who are more likely to benefit from intensive care (54,247).

These two developments were explicitly recognized by experts in critical care medicine at the Critical Care Consensus Development Conference convened by the National Institutes of Health (NIH). The Consensus statement on Critical Care Medicine concludes:

> It is not medically appropriate to devote limited ICU resources to patients without reasonable prospect of significant recovery when patients who need those services, and who have a significant prospect of recovery from acute] y life-threatening disease or injury, are being turned away for want of capacity. It is inappropriate to maintain ICU management of a patient whose prognosis has resolved to one of persistent vegetative state, and is similarly inappropriate to employ ICU resources where no purpose will be served but a prolongation of the natural process of death (176).

The NIH statement is significant not only because it recognizes the futility of ICU care in some situations but also because it acknowledges that ICU care is, in fact, already being rationed to some extent.

A full discussion of the difficult medical, ethical, and legal issues involved in deciding to forego life-sustaining treatment either because of the desire to permit death with dignity or because of a need to ration ICU resources is clearly beyond the scope of this case study. Readers are referred to the recently published report on this subject by the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research (191). In this chapter, a few issues of particular relevance to ICUs are briefly discussed.

THE NATURAL PROCESS OF DEATH

ICUs are uniquely capable of interfering with the natural process of death, since respirators and other ICU technologies are able to sustain vital functions long after the patient has any chance of recovery. As a consequence of these lifesaving technologies and the moral considerations involved in their use, many people today die "ICU deaths" rather than natural deaths (135). For example, once a patient has been placed on a respirator, death may occur only when the physician steps in and discontinues its use. Indeed, some ICUs are developing policies and procedures for "terminal weaning" off of a respirator, which provide for the withdrawal of a respirator in a humane and efficient manner for the acknowledged purpose of permitting the patient to die (94).

As chapter 7 pointed out, in some situations, such as when the patient's prognosis and wishes concerning treatment are not initially known, there may be greater moral justification for permitting a death by withdrawing life-sustaining treatment, than for passively allowing death to occur by withholding ICU care in the first place. The ability of ICU technologies to intervene in the natural death process is also evident in patients suffering from a severe, debilitating, chronic illness who can survive their acute illness but who can never improve beyond their original unsatisfactory functional status.

In the past, pneumonia was known as "the old man's friend," because it often provided a relatively quick and painless death for those facing years of disability **(170).** Medical technology, however, has largely removed this escape hatch. As a result, extremely elderly patients and patients with a severe chronic illness frequently survive their ICU stays, often at a great expense, only to be restored, at best, to their previous state of ill health. Similarly, patients who suffer a devastating injury and illness that in the past would have been fatal are now frequently saved by excellent medical skills and modern ICU technology, only to exist in a permanent state of profound physical or mental impairment (51).

FUNDAMENTAL ETHICAL, MORAL, AND LEGAL CONSIDERATIONS

For certain categories of patients, there has been considerable discussion in medical circles about the extent to which physicians and hospitals should be obligated initially to provide and then to continue ICU care. Many ICU physicians have taken the position, for example, that a necessary prerequisite to admission to an ICU is the potential salvageability of the patient (51,176,200,238). Some feel that in cases where the patient is clearly moribund and has no chance of improving, the physician's duty is to make the patient comfortable and not to impose intensive care (51,152). Although patients' families may attempt to pressure physicians into using the ICU, the physician and the institution probably would be on safe legal ground in denying such care, assuming the facts of the case sustain their position and that the decisionmaking process was reasonable (51).

A more difficult situation arises when a patient is terminally or irreparably ill, but is considered to have a chance of surviving the present acute deterioration (51). In such situations, the fundamental decision on whether to use life-sustaining technology should, if possible, be made by the patients after they have been fully informed of their options and understand their implications (191). A terminally ill patient's right to forego or discontinue life-sustaining treatment has been established, and is usually protected by the constitutional right to privacy (191). An immediate problem is that the term "terminal" is not a standard technical term with clear and precise criteria for its definition (12). Physicians may not agree on when an illness is terminal, and some do not even use the term.

In addition, as noted in chapter 7, critically ill patients are frequently not competent to make an informed decision. This is particularly true of ICU patients who suffer subtle alterations of consciousness and develop psychological reactions to their illness or to the ICU itself. If the patient's incapacity to consent is temporary, the decision to forego the use of life-sustaining treatment may have to be postponed. If the condition is permanent, however, the question arises as to who should make the decision on the patient's behalf and on what basis (151).

The President's Commission recommended that when a patient lacks the capacity to make a decision—a common ICU occurrence—a surrogate decisionmaker should be designated. Ordinarily, this will be the patient's next-of-kin (191). Problems arise when family members disagree, are themselves incapable of good decisionmaking, or demonstrate family interests that conflict with the patient's interest **(191).** In many instances, an incapacitated patient may have no family or even

close friends who can act as a surrogate on making decisions about life-sustaining treatment.

At times, there maybe a fundamental disagreement between physicians and the patient's next-of-kin on the appropriate treatment for an incompetent, seriously ill patient. When such disagreements cannot be resolved through discussion or through a hospital-based forum such as an ethics committee, *or* when the patient is a ward of the State, the issue may have to be resolved in court. Sometimes, a physician may agree with a surrogate's decision to forego life-sustaining treatment, but, nevertheless, seek a judicial ruling for fear of criminal prosecution or civil liability (191). It should be emphasized that cases which mandate specific procedures for determining whether to continue medical treatment for an incapacitated patient have been decided by State courts. Therefore, these court-ordered remedies, which sometimes have differed in significant ways, apply only to the State in which the case was brought, unless courts in other States specifically adopt the same analysis. A discussion of the decisionmaking procedures mandated or approved by the courts in situations where a patient cannot choose for himself is beyond the scope of this case study.

It should be noted, moreover, that there is legal confusion even over when a patient ought to be considered terminally ill and over what constitutes "medical" treatment. A New Jersey appeals court, for example, overruled a trial judge's decision that would have permitted removal of a life-sustaining feeding tube from an 84-year-old woman considered to be terminally ill but not facing imminent death (241). The appeals court found that removal of a feeding tube would have inflicted new suffering from dehydration and starvation on the patient. The court found that the State has a "substantial and overriding" interest in preserving the lives of patients who are not moribund. It also seems to have found a legal difference between "nourishment" and "medical treatment ." "We hold only that when nutrition will continue the life of a patient who is neither comatose, brain dead, nor vegetative, and whose death is not irreversibly imminent, its discontinuance cannot be permitted on the theory of a patient's right to privacy, or, indeed, on any other basis. "[1] A New Jersey Supreme Court review of this finding is pending.

The California appellate court decision in the criminal case of *People v. Nejdl and Barber,* in which homicide charges were brought against physicians who withdrew nutrition in the form of intravenous fluids and nasogastric feedings from a comatose patient, significantly departs from the reasoning used by the New Jersey Appeals Court in the case cited above. The California case did not distinguish between "ordinary" and "extraordinary" care and instead defined the concept of "proportionate treatment ." The court wrote:

> Proportionate treatment is that which . . . has at least a reasonable chance of providing benefits to the patient, which benefits outweigh the burdens attendant to the treatment. Thus, even if a proposed course of treatment might be extremely painful or intrusive, it would still be proportionate treatment if the prognosis was for complete cure or significant improvement in the patient's condition.[2]

The reasoning of the New Jersey Appeals Court decision, which has been appealed to the State Supreme Court, and that of the California Appeals Court would appear to be irreconcilable. Thus, considerable legal uncertainty remains over precisely which medical therapies, if any, are considered routine or ordinary and in which clinical situations they must be provided. Treatments might be considered mandatory for some patients but not for others. Weaning a terminal patient who is brain dead off a respirator would appear to be permissible, for example, but removing a feeding tube or intravenous line might not. Likewise, physicians might be legally required to provide different treatment for patients who are seriously ill and have no chance for sustained recovery than for patients who are permanently comatose or who face imminent death.

[1] See *In re Conroy,* 188 *N.J. Super.* 523, 532 (ch. Div. 1983).

[2] See *Neil Leonard Barber, Robert Joseph Nedjl v. Superior Court of the State of California for the County of Los Angeles;* Court of Appeals of the State of California, Second Appellate District, Civil No. 60350; Oct. 12, 1983.

The use of life-sustaining technology has also been questioned for the patient who is not terminally ill but who finds the quality of life unacceptable and without any reasonable chance for improvement (51,225). Judgments about quality of life obviously reflect the values and biases of the person making the judgment (152) and therefore are relevant only if they represent the views of the patient (148). While some courts have ventured into this area (26), there is much less legal precedent on which to guide physicians about the obligation to provide ICU care for such patients, particularly where the patients are incompetent to decide for themselves (170). Because it took years for even the current level of consensus to develop regarding the possibility of foregoing care for terminally ill patients, one should expect a similar evolutionary process on the issue of foregoing life-sustaining care for those with an unacceptable quality of life.

Beginning with the enactment of the California Natural Death Act in **1976, 15 States** and the District of Columbia have enacted statutory authorization for competent individuals to write an "advance directive" which directs their physicians to forego life-sustaining treatment under circumstances in which they are both incompetent and suffering from a terminal condition **(273).** A "proxy directive" designates a surrogate of the patient's choice to make decisions for the patient if he or she is unable to do so; it maybe accompanied by an "instruction directive" which specifies the type of care the person wants to receive. In addition, 42 States have enacted "durable power of attorney" statutes, which provide authority to appoint a proxy to act after a person becomes incompetent. Although developed in the context of property law, these statutes may be used to provide legal authority for an advance directive.

There are a number of unresolved issues about how advance directives should be drafted, given legal effect, and used in clinical practice. Nevertheless, the President's Commission recommended their use as a way of honoring patient self-determination (191).

PROCEDURES FOR REVIEW OF DECISIONMAKING

The models of decisionmaking procedures for incompetent patients derived from court opinions are quite different. The New Jersey Supreme Court in the *Quinlan*[3] case invoked the presence of hospital "ethics committees" to provide consultation to an incompetent patient's guardian and specifically rejected judicial review of such decisions **(191). By contrast,** the Supreme Judicial Court of Massachusetts in the *Saikewicz*[4] case appeared to explicitly reject the New Jersey method of decisionmaking and instead has established judicial review of these decisions as the rule rather than the exception (191). However, in followup decisions, the Massachusetts court has seemingly modified its Saikewicz opinion such that only certain categories of cases would appear to require judicial review, such as when the family or the family and doctors are in disagreement or when the physicians needs, but cannot otherwise obtain, consent to a course of treatment when the patient is a ward of the State (272).

The President's Commission recommended that resorting to courts should be reserved for occasions when adjudication is clearly required by State law or when concerned parties have disagreements over matters of substantial importance that they cannot resolve. The Commission stated that ethics committees and other institutional responses can function more rapidly and sensitively than judicial review (191).

As was noted earlier, relatively few hospitals have such ethics committees, and those in existence serve various functions, ranging from formulating policy and guidelines and serving as a forum for considering difficult ethical problems, to consulting on prognosis in individual cases and, finally, to reviewing or even making treatment decisions (191). Because of the lack of general experience with ethics committees, the Commission

[3] *In re Quinlan,* 70 N.J. 10, 355A.2d 647, 699, cert. denied, 429 U.S. 422 (1976).

[4] *Superintendent of Belchertown State School v. Saikewicz, 370* N.E.2d 417,434-3s (Mass. 1977).

called for additional evaluation of various forms of formal and informal institutionally based committees before general adoption in all hospitals (191).

It should be noted that over the past 15 years, Institutional Review Boards (IRBs) have been set up to review in advance the ethical considerations of specific research involving human subjects. Although initially controversial, IRBs are now generally accepted in the biomedical research community (191).

IRBs or ethics committees have been identified in the so-called "Baby Doe" controversy, as a possible approach to aiding decisionmaking about determining medical treatment for severely handicapped newborns. While the situation of severely handicapped newborns is somewhat different from that of seriously ill adults, in part because it involves consideration of parental rights and obligations, it may be that the Baby Doe controversy will generate a heightened general interest in the role of ethics committees.

RATIONING ICU CARE

Up to now, discussion of withholding and withdrawing ICU care has focused primarily on the perceived or actual interests of the patient. However, the NIH panel has acknowledged the fact that patients who might benefit from treatment in an ICU are denied admission because beds are occupied by patients who do not have a reasonable prospect of "significant" recovery. Early analysts recognized that a few individuals consumed a dramatically disproportionate share of ICU resources and suggested that those resources be increased so as to avoid difficult choices about access (162). The President's Commission advised against limitations on access to life-sustaining care as an initial part of any cost-containment strategy (191). It argued, instead, that the first step should be the control of "small ticket" tests and treatments, such as routine blood test and X-rays, which are believed by some to be less cost effective than more dramatic forms of therapy (153), and which can be discussed in relatively dispassionate terms. Unfortunately, because marginal costs of ancillary services are much less than average costs, cutbacks on these services are not likely to have a major impact on hospital costs (1).

In addition, the care of a typical high-cost ICU patient is, to a large extent, an accumulation of small ticket items. While some efficiencies in ICU care can be achieved (227), the fact remains that the decision to initiate and continue ICU care for patients for whom recovery is unlikely, but possible, is one of the major causes of the increasing proportion of the Nation's health costs accounted for by ICUs. Despite current efforts to make health care more efficient, it seems clear that further attempts at cost-containment will encounter the reality that a large amount of medical care is consumed by patients with highly unfavorable prognoses **(219).**

"It is a basic tenet of our society that we will not give up a life to save dollars, even a great many dollars" (111). Yet, to some extent, this "lifesaving imperative" is a myth, since society's devotion to saving lives is greatest where the threat is to identifiable individuals, such as trapped " miners or the victims of catastrophic disease. Society, however, accepts the loss of many "statistical" lives **(111),** whether from the results of toxic waste or inadequate preventive health care.

Physicians usually follow the same lifesaving imperative. Many health professionals, lawyers, and philosophers have warned that while society may choose to limit medical treatments for economic reasons, it is not appropriate for physicians to do it for individual patients (17,83,152,266). They argue that the doctor-patient relationship requires an absolute commitment to do everything possible for the individual patient, regardless of the effect on society's resources.

However, most physicians by training and practice accept the fact that there are limits to the resources that society can expend on any one individual, and in some circumstances they act as society's agent in balancing the needs of their patient against the needs of other patients and so-

ciety as a whole. For example, a patient with intractable gastrointestinal hemorrhage does not receive limitless supplies of blood (152). At some point, a physician makes a decision, sometimes implicitly, that society's interest in having a supply of blood available for the community outweighs the patient's need for continued transfusions. The threshold for the decision to discontinue transfusions obviously varies, depending on factors such as the patient's underlying medical problem, age, and perceived life expectancy and the physician's point of view.

In less dire circumstances, physicians commonly weigh the value of a marginal benefit to their patients against the general cost to society. An example is the support of preventive health screening based on population-related, cost-effectiveness data. For instance, differences in the recommended intervals for screening for cervical cancer through use of the PAP test (103) are essentially based on different views of how many missed cases are acceptable on a cost-effectiveness calculation. Physicians who choose one standard over others do so with an implicit acceptance that there is some level of risk that is acceptable for an individual patient.

Physicians in health maintenance organizations (HMOs) may practice a somewhat different style of medicine, based on the reality of a fixed pool of resources. HMOs face "either-or" choices and must decide whether particular treatments, such as for catastrophic diseases, are better investments than others, such as for prenatal care (111). While the constraint of limited resources is imposed externally, HMO physicians, perhaps unconsciously, may alter their decisionmaking for individual patients in accordance with the reality of limited resources. While the HMO may exclude or limit certain benefits explicity in its contract with subscribers, it also counts on physicians to practice "cost-effective" medicine, often at a small but measurable risk to certain individual patients (22).

The clear bias in ICU decisionmaking is to initiate and continue ICU care even when it is extremely unlikely that the patient will benefit from such care. Nevertheless, because of limited ICU resources, decisions are made every day to curtail the care provided to individual ICU patients and to restrict access to ICUs. In public hospitals, difficult decisions to ration limited ICU beds have become commonplace **(186).** Even in nonpublic hospitals, rationing of ICU resources has occurred, particularly where there has been a shortage of nurses (220,230).

Up to now, shortages in ICU capacity to treat patients who might benefit from intensive care have resulted primarily from internal hospital decisions on allocation of beds and other resources between the ICU and general floors, and not from external economic restraints. As discussed in chapter 6, that will no longer be the case, however, under the Medicare's DRG hospital payment system. In the next few years, therefore, much more attention will have to be given to how ICU care should be rationed.

EXPLICIT OR IMPLICIT RATIONING OF ICU CARE?

Explicit Rationing

Provision of ICU care can involve both explicit and implicit forms of rationing. Explicit rationing of medical care generally involves direct administrative decisions on such issues as exclusion of certain types of services from insurance coverage, limitations on the availability of specific methods of care, preauthorized and concurrent review and approval for expensive treatments and procedures, required intervals between provision of specified services, and limitations on total benefits (159). In the context of the ICU, explicit rationing might include the establishment of medical criteria for treatment based on predictors of outcome for ICU care as they become available. In addition to predominately medical considerations, factors such as life expectancy, family role, and social contribution could also be formally considered **(196), although** the experience of al-

locating rare renal dialysis machines and selecting patients for kidney transplants in the 1960s on the basis of social factors was nearly intolerable to those involved (2,14) and might not be acceptable to society.

The ethical considerations of how to decide who should receive lifesaving treatment and who should not has received attention by bioethicists (13). It is relevant here to note that to avoid explicit rationing for lifesaving treatments, health planners and policymakers have tended either to approve facilities or financing mechanisms that will assure treatment for nearly everyone with a particular illness, e.g. end-stage renal disease, or they make a decision not to facilitate treatment for anyone suffering from a certain condition, e.g. patients needing heart transplants (111) except perhaps on an experimental basis (122). Since ICUs are not disease-specific, explicit rationing on the basis of disease would not seem to be an appropriate means of limiting ICU care.

Explicit rationing of ICU care might also include limits on covered benefits beyond a certain amount, or in certain clinical situations, where patients could have to bear the costs of ICU care directly. Currently, most patients have insurance coverage for most ICU costs. Many without coverage have been subsidized. In public hospitals, rationing of limited ICU beds has been based largely on a combination of medical factors, such as likelihood of successful intervention, and demographic factors, such as age, and not on considerations of ability to pay (186). There is the real question of whether society would tolerate explicit denial of "life and death" ICU care on the basis of insurance coverage or personal wealth. In recent years, Congress has considered several proposals for national health insurance that would extend coverage to everyone for catastrophic illness in order to avoid denial of care on the one hand and the possibility of extreme financial hardship and bankruptcy on the other (72).

Implicit Rationing

Implicit rationing involves limitations on the resources available to health care providers, such as fixed budgets and restrictions on sites of care or hospital beds (159). These limitations are implicit because they do not specify what services should be provided to whom or what assessments physicians should make. Instead, they achieve their effect by placing greater pressures on physicians and hospitals to make hard allocation choices. Simple reliance on the price mechanism can also be a rationing device, since everyone's ability to pay is limited at some point; for almost all *resources* in our society, price does "ration" access to goods and services. Cost-based payment for insured medical services has been a notable exception. The new DRG payment system for Medicare is a form of implicit rationing since the total payments allowed under the system are fixed, regardless of the level of services provided.

Other forms of payment limits could also require rationing. Indeed, because many people lack insurance altogether or have less than full-cost, open-ended coverage, implicit rationing occurs for many medical services today, particularly nonhospital care. It would be possible to limit total social spending on ICUs (or anything else) through the implicit rationing device of patient cost-sharing, which does not require administrative decisions. Such price-based allocation of resources can be troublesome, however, when applied to catastrophic medical care for a variety of reasons (see 111).

The cost of care for the sickest patients in the ICU is currently being subsidized to a great extent by those who are not as ill, and by the hospital. DRG fixed payments, which are not adjusted according to the severity of the illness, will often make high-cost Medicare ICU patients significant financial "losers" for the hospital. In this situation, physicians will likely feel institutional pressures not only to alter the style of ICU care they provide to reduce costs, but also to reconsider the thresholds for withholding and withdrawing ICU care from specific individuals. In addition, hospitals may limit or even reduce the number of ICU beds, thus reducing access for patients who would have received higher cost ICU care. This form of implicit rationing of ICU care raises a number of questions:

- **What protections will patients require to avoid arbitrary decisionmaking to limit care?** Will certain categories of patients, such as the elderly, the retarded, or otherwise chronically

dependent persons who might benefit from ICU care, be systematically excluded on purely economic considerations?

- **Will the potential threats of criminal prosecution and malpractice suits act as a sufficient countervailing force to the new incentives that DRGs will bring?** More specifically, will there be a fundamental conflict between traditional malpractice standards and new norms of practice that may involve limiting care more strictly? Malpractice law has traditionally judged the behavior of medical care providers almost exclusively by the customary practice of their peers, rather than by an independently determined standard of socially appropriate care (22). Malpractice law generally does not recognize varying styles of care to suit varying available resources. It remains to be seen whether courts will recognize limited available resources as a factor in determining negligence. In fact, hospitals and physicians may have new incentives not to treat very sick ICU-type patients in the first place, not only because of the directly negative economic consequences, but also because it may place them in legal jeopardy under existing malpractice standards. Once care has been initiated, the primary responsibility of the provider is to meet a high standard of care that may not be reimbursed sufficiently under the DRG payment scheme. Hospitals may decide systematically to avoid the responsibility in the first place by diverting and transferring patients elsewhere.
- **Will society tolerate different levels of ICU care based on willingness and ability to pay?** Medicare will prohibit hospitals for the most part from seeking direct payments from its patients above the allowable DRG payments (Social Security Act Amendments of **1983,** Public Law **98-21).** Can a Medicare patient in a life or death situation be denied the continued ICU care he or she desires and is willing to pay for personally, primarily through private insurance, because Medicare prohibits patient payments above the DRG limit? If not, it is likely that different types of ICUs will develop, based largely on the ability to pay.
- **Finally, what procedures should be used to assist ICU decisionmaking in an era in which at least some patients become financial "losers" for the hospital?** A number of procedural safeguards have been proposed to protect the interest of patients who have insufficient capacity to make particular decisions on their own behalf, including: 1) naming an appropriate surrogate to act on the patient's wishes or in the patient's interest; 2) establishing administrative arrangements, such as ethics committees for review and consultation of different decisions; and 3) permitting advance directives, such as living wills, through which people designate someone to make health care decisions on their behalf, and/or give instructions about their care (191). While initially proposed in the context of protecting the interests of incompetent patients, these or other procedural safeguards also appear necessary to protect the interests of competent patients who might otherwise be rationed out of the ICU. ICU decisionmaking has been difficult when there was no theoretical conflict between the interests of patient, physician, and institution. Under a prospective payment system, patients, physicians, and hospitals may have different interests.

9 Conclusions and Possible Future Steps

9. Conclusions and Possible Future Steps

Until passage of the Social Security Act Amendments of 1983 (Public Law 98-21), intensive care unit (ICU) expansion was able to proceed without major consideration of costs because of the favorable payment environment. Indeed, tightened section 223 limits on costs of routine hospital beds in 1979 and 1980 may have even stimulated ICU expansion. It would seem clear that Medicare's inpatient hospital prospective diagnosis-related group (DRG) payment system will cause hospital administrators and ICU directors to look differently at the costs of ICU care. Unfortunately, they will find no easy solutions to the cost problem, particularly if Medicare allows only relatively low rates of annual spending increases.

Under DRG payment, some savings may be generated by better organization and management of ICUs, perhaps by centralizing separate ICUs into larger, more general ICUs (212). Arguably, additional savings may be gained by substituting lower paid health personnel for nurses or physicians to provide certain ICU functions (162,212). There may be new efforts to find cost-saving technologies that can substitute for expensive ICU labor. One ICU, for example, has demonstrated a significantly decreased ICU length of stay, attributable in part to the use of computer-assisted decision algorithms (227).

In addition, it maybe possible in the near future to predict more accurately which monitored patients do not need to be in the ICU at all. Intermediate care units or other arrangements could be developed to care for these patients, probably, at a somewhat lower cost (141).

At the same time, however, it is now being recognized that some ICU patients are discharged prematurely from the ICU. One can argue that longer stays in the ICU for these patients would not only represent a more appropriate use of the ICU but also might even save the hospital money by reducing the costs of subsequently treating for these prematurely discharged patients (246).

Nevertheless, the fact remains that relatively few ICU patients are responsible for a substantial portion of ICU costs. This case study has attempted to demonstrate the clinical, moral, legal, and economic factors which currently make it difficult to decide not to treat even those patients who show little promise of benefiting from ICU care. The high-cost subgroup is spread among all ages, diagnostic groups, and disability classes (40). There are as yet no demographic identifiers or accepted general prognostic indicators which permit systematic exclusion of any of the high-cost group from ICU care. Public programs, private insurers, perhaps the public at large, but almost certainly hospital managers and providers, will face increasingly difficult decisions about who should be given ICU care and in what manner. **The process of ICU decisionmaking will become even more important when economics may dictate curtailing or even denying care to seriously ill patients.**

A number of steps might improve the environment for intensive care decisionmaking:

- **Research on developing accurate predictors of survival for patients with acute and chronic illnesses could be expanded in order to permit better informed decisions based on the likelihood of short- and long-term survival.** Since the results of outcome data will always be incomplete and subject to differing interpretations, especially in relation to an individual patient, hospitals might consider formalizing an institutional "prognosis committee" whose function would be to advise physicians, families, and patients on the likely survival with ICU care in individual situations. Such a committee or hospital function, perhaps utilizing a routinely updated national data base, obviously could also provide a similar function for non-ICU patients.
- **The suitability of the current DRG method of payment for ICUs should be tested.** If, in fact, the DRG scheme takes insufficient ac-

count of severity of illness, it is likely that some hospitals and, consequently, some ICU patients may face a degree of rationing that Congress did not envision.

- The **legal system, including legislators and the courts, may need to recognize the possible conflict between malpractice standards which assume quality of care that meets national expert criteria, and a decisionmaking environment in which resources may be severely limited.** At the same time, it must be kept in mind that the threat of both malpractice suits and criminal prosecution may become an even more important protection against arbitrary or unfair denial and termination of ICU care.
- Health professionals who are involved in making decisions regarding critically ill patients might benefit from **more education on medical ethics and relevant legal procedures and obligations.** In recent years, the journal *Critical* Care *Medicine,* published by the Society of Critical Care Medicine, has included articles and editorials on specific ethical and legal issues. Likewise, new textbooks on critical care medicine (224) have devoted chapters to specific ethical and legal issues that frequently arise in the ICU. More formal education at the graduate and postgraduate level for all health professionals who work with critically ill patients might be considered.
- **The actual decisionmaking process for critically ill patients may need greater attention.** At a time when the interests of the ICU patient, physician, and hospital were theoretically the same, i.e., under a full-cost reimbursement system, the need for formal rules and procedures for life and death decisions might not have been necessary. Even so, many hospitals found the need to establish formal procedures for "Do Not Resuscitate" orders. With a payment system that sets the interests of at least some very sick ICU patients against the immediate financial interests of the hospital, however, it may be necessary to impose additional formal protections on the decisionmaking process. Hospitals might explore formalizing decisionmaking committees or mandating second opinions to lessen the burden on individuals faced with excruciatingly difficult choices about terminating life-support. Hospitals could consider formally separating the ICU triage function from the direct patient care function, particularly with regard to the ICU Medical Director, in order to minimize potential conflicts of interest. More generally, society will need to decide how it wishes conflicts over decisions on terminating life-support to be resolved—in courts, through formal hospital committees such as ethics committees, through government-imposed utilization review procedures which can follow fixed rules and-regulations, or other, perhaps more decentralized, mechanisms.

Appendixes

Appendix Am —Acknowledgments and Health Program Advisory Committee

ACKNOWLEDGMENTS

The development of this **case** study was greatly aided by the advice of a number of people. The author and OTA staff would like to express their appreciation to the Medical Technology and Costs of the Medicare Program Advisory Panel, to the Health Program Advisory Committee, and especially to the following individuals:

Randy Bovbjerg
The Urban Institute
Washington, DC

Martha Brooks
Springfield, VA

Mark Chassin
The Rand Corp.

J. Richard Crout
National Institutes of Health

Palmer Dearing
Blue Cross/Blue Shield Association

Patricia Donovan
W a . . /s, h

Betty Draper
The George Washington University
School of Medicine

Mark Goodhart
American Hospital Association

Andria Grenedier
Alexandria, VA

Ake Grenvik
University Health Center of Pittsburgh

Stephanie Hadley
National Institutes of Health

William Knaus
The George Washington University
School of Medicine

Richard Lieberman
SysteMetrics
Bethesda, MD

Joanne Lynn
Cliften, VA

John E. Marshall
National Center for Health Services Research

Michael McMullan
Health Care Financing Administration

Lois P. Myers
University of California, San Francisco

Joseph Onek
Onek, Klein, & Farr
Washington, DC

Joseph E. Parrillo
National Institutes of Health

Steven A. Schroeder
University of California, San Francisco

Douglas Wagner
The George Washington University
School of Medicine

Donald A. Young
Prospective Payment Assessment Commission

Rebekah Zanditan
Takoma Park, MD

HEALTH PROGRAM ADVISORY COMMITTEE

Sidney S. Lee, Committee ***Chair***
President, Milbank Memorial Fund
New York, NY

Stuart H. Altman*
Dean
Florence Heller School
Brandeis University
Waltham, MA

H. David Banta
Deputy Director
Pan American Health Organization
Washington, DC

Carroll L. Estes**
Chair
Department of Social and Behavioral Sciences
School of Nursing
University of California, San Francisco
San Francisco, CA

Rashi Fein
Professor
Department of Social Medicine and Health Policy
Harvard Medical School
Boston, MA

Harvey V. Fineberg
Dean
School of Public Health
Harvard University
Boston, MA

Melvin A. Glasser***
Director
Health Security Action Council
Committee for National Health Insurance
Washington, DC

Patricia King
Professor
Georgetown Law Center
Washington, DC

Joyce C. Lashof
Dean
School of Public Health
University of California, Berkeley
Berkeley, CA

Alexander Leaf
Professor of Medicine
Harvard Medical School
Massachusetts General Hospital
Boston, MA

Margaret Mahoney****
President
The Commonwealth Fund
New York, NY

Frederick Mosteller
Professor and Chair
Department of Health Policy and Management
School of Public Health
Harvard University
Boston, MA

Norton Nelson
Professor
Department of Environmental Medicine
New York University Medical School
New York, NY

Robert Oseasohn
Associate Dean
University of Texas, San Antonio
San Antonio, TX

Nora Piore
Senior Advisor
The Commonwealth Fund
New York, NY

Mitchell Rabkin'
President
Beth Israel Hospital
Boston, MA

● Until April 1983.
● 'Until March 1984.
● **Until October 1983.
● ***Until August 1983.

Dorothy P. Rice
Regents Lecturer
Department of Social and Behavior Sciences
School of Nursing
University of California, San Francisco
San Francisco, CA

Richard K. Riegelman
Associate Professor
George Washington University
School of Medicine
Washington, DC

Walter L. Robb
Vice President and General Manager
Medical Systems Operations
General Electric
Milwaukee, W1

Frederick C. Robbins
President
Institute of Medicine
Washington, DC

Rosemary Stevens
Professor
Department of History and Sociology of Science
University of Pennsylvania
Philadelphia, PA

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.

References

References

1. Aaron, H. F., and Schwartz, W. B., *The **Painful Prescription—Rationing** Hospital Care* (Washington, DC: The Brookings Institution, 1984).
2. Abram, H. S., and Wadlington, W., "Selection of Patients for Artificial and Transplanted Organs," ***Ann. Intern. Med.*** 69:615, 1968.
3. Abramson, N. S., Wald, K. S., Grenvik, A. N. A., et al., "Adverse Occurrences in Intensive Care Units," ***J. A.M.A.*** 244(14):1582, ***1980.***
4. American Hospital Association, ***Hospital Statistics,*** 1977 to 1983 editions (Chicago, IL: American Hospital Association, 1977 to 1983).
5. ***American** Medical News*, "Court Vacates Murder Against Two MDs," Oct. 14, **1983, p.** 1.
6. Arthur D. Little, Inc., "Planning for General Medical and Surgical Intensive Care Units: A Technical Assistance Document for Planning Agencies, " prepared for the U.S. Department of Health, Education, and Welfare, publication No. (HRS) **79-14020** (Washington, DC: U.S. Government Printing Office, 1979).
7. Avorn, J., "Benefit and Cost Analysis in Geriatric Care: Turning Age Discrimination in Health Policy," N. *Engl. J. Med.* 310(20):1294, 1984.
8. Ayres, S. M., "Critical Care Medicine, " introduction in Major Issues in Critical ***Care*** Medicine, J. E. Parrillo and S. M. Ayres (eds.) (Baltimore, MD: Williams & Wilkins, **1984).**
9. Baker, R., Knaus, W. A., Draper, E. A., et al., "Initial Evaluation of No-Resuscitation Decisions, " manuscript in preparation, 1983.
10. Bartlett, R. H., Gazzaniga, A. B., Wilson, A. F., et al., "Mortality Prediction in Adult Respiratory Insufficiency," ***Chest*** 67(6):680, **1975.**
11. Bates, D. V., "Workshop on Intensive Care Units, " comments of the National Academy of Sciences, National Research Council, Committee on Anesthesia, ***Anesthesiology*** 25:192, 1964.
12. Bayer, R., Callahan, D., Fletcher, J., et al., "The Care of the Terminally 111: Mortality and Economics," N. *Engl. J. **Med.*** 309(24):1490, 1983.
13. Beauchamp, T. L., and Childress, J. F., ***Principles** of Biomedical Ethics (New* York: Oxford University Press, 1979).
14. Becker, E. L., "Finite Resources and Medical Triage, " ***Am,*** *J.* Med. 66:549, 1979.
15. Bedell, S., and Delbanco, T. L., "Choices About Cardiopulmonary Resuscitation in the Hospital—When Do Physicians Talk With Patients?" N. *Engl. J. **Med.*** 310(17):1089, 1984.
16. Bell, J. A., et al., "Six Years of Multidisciplinary Intensive Care, " *Brit. **Med.** J.* 2:483, 1974.
17. Bendixen, H. H., Egbert, L. D., Hedley-White, J., et al., *Resp. **Care*** (St. Louis, MO: The C. V. Mosby Co., 1965).
18. Bendixen, H. H., "The Cost of Intensive Care," ch. 22 in Costs, ***Risks, and Benefits** of **Surgery,*** J. P. Bunker, B.A. Barnes, and F. Mosteller (eds.) (New York: Oxford University Press, 1977).
19. Bicknell, W. J., and Walsh, D. C., "Certification-of-Need: The Massachusetts Experience, " N. *Engl. **J. Med.*** 292:1054, 1975.
20. Biles, B., Schramm, C. J., and Atkinson, J. G., "Hospital Cost Inflation Under State Rate-Setting Programs," *N. Engl. J. Med.* 303(12):664, 1980.
21. Bolsen, B., "MDs, Lawyers Probe Ethical, Legal Issues in Ending Treatment, " ***American Medical News,*** p. 17, Apr. 6, 1984.
22. Bovbjerg, R., "The Medical Malpractice Standard of Care: HMOS and Customary Practice, " ***Duke Law** J.* 1975(6), 1976.
23. Boyd, R., "Workshop on Intensive Care Units, " comments of the National Academy of Sciences, National Research Council, Committee on Anesthesia, ***Anesthesiology*** 25:192, 1964.
24. Bradburn, B. G., and Hewitt, P. B., "The Effects of the Intensive Therapy Ward Environment on Patients' Subjective Impressions: A Followup Study, " ***Intensive Care Med.*** 7:15, 1980.
25. British Medical Association, Planning Unit, report of the Working Party on Intensive Care, (1):5, 1967.
26. Brooks, T. A., "Withholding Treatment and Orders Not to Resuscitate, " ch. 10 in *Legal **and Ethical Aspects of Treating Critically and Terminally** Ill **Patients,*** A. E. Doudera and J. D. Peters (eds.) (Ann Arbor, MI: Association of University Programs in Health Administration, 1982).
27. Brown, N. K., and Thompson, D. J., "Nontreatment of Fever in Extended-Care Facilities, " N. *Engl. J. **Med.*** 300(22):1246, 1979.
28. Bulkley, B. H., "The Coronary Care Unit, " ch. 1 in ***Major** Issues **in Critical Care Medicine,*** J. E. Parrillo and S. M. Ayres (eds.) (Baltimore, MD: Williams & Wilkins, 1984).
29. Byrick, R. J., Mindorff, C., McKee, L., et al., "Cost-Effectiveness of Intensive Care for Respiratory Failure Patients, " *Crit. Care* Med. 8(6):332, 1980.
30. Cadmus, R. R., "Special Care for the Critical Case," ***Hospitals*** 20:65, 1954,
31. Callahan, J. A., Spiekerman, R. E., Broadbent, J. C., et al., "St. Mary's Hospital-Mayo Clinic

Medical Intensive Care Units: II. Patient Population," Mayo *Clin. Proc.* 42:332, 1967.
32. Campbell, D., Reid, J. M., Tefler, A. B. M., et al., "Four Years of Respiratory Intensive Care," *Brit.* Med. *J.* 4:255, 1967.
33. Campion, E. W., Mulley, A. G., Goldstein, R. L., et al., "Intensive Treatment for the Elderly," reply to Letter to the Editor, *J. A.M.A.* 247(23): 3186, 1982.
34. Campion, E. W., Mulley, A. G., Goldstein, R. L., et al., "Medical Intensive Care for the Elderly: A Study of Current Use, Costs, and Outcomes," *J. A.M.A.* 246(18):2052, 1981.
35. Caroline, N. L., "Quo Vadis Intensive Care: More Intensive or More Care?" guest editorial in *Crit. Care Med.* 5(5), 1977.
36. Carroll, D. G., "Patterns of Medical Care in a Municipal Hospital Intensive Care Unit: Convenience or Necessity?" *Maryland State* Med. *J.* 20:89, 1971.
37, Casali, R., et al., "Acute Renal Insufficiency Complicating Major Cardiovascular Surgery," *Am. Surg.* 181:370, 1975.
38, Cassem, N. H., "When to Disconnect the Respirator," *Psychiatric Ann.* 9:38, 1979.
39, Cassem, N. H., and Hackett, T. P., "Psychiatric Consultation in a Coronary Care Unit," *Ann. Intern. Med.* 75:9, 1971.
40. Chassin, M. R., "Costs and Outcomes of Medical Intensive Care," *Medical Care* 20(2):165, 1982.
41. Civetta, J. M., "The ICU Milieu: An Evaluation of the Allocation of a Limited Resource," *Resp.* Care 21(6):501, 1976.
42. Civetta, J. M., 'The Inverse Relationship Between Cost and Survival," *J. Surg. Res.* 14(3):265, 1973.
43. Civetta, J. M., "Selection of Patients for Intensive Care," in *Recent Advances in Intensive Therapy,* I. M. Ledingham (cd.) (New York: Churchill Livingston, 1977).
44 Clark, T. J. H., Collins, J. V., Evans, T. R., et al., "A Review of Experience Operating a General Medical Intensive Care Unit," *Brit. Med. J.* 1:158, 1971.
45. Coelen, C., and Sullivan, D., "An Analysis of the Effects of Prospective Reimbursement Programs on Hospital Care," *Health Care Finan. Rev.* 2:3, 1981.
46, Cohen, C. B., "Ethical Problems of Intensive Care," *Anesthesiology* 47:217, 1977.
47 Crockett, G. S., and Barr, A., "An Intensive Care Unit: Two Years Experience in a Provincial Hospital," *Brit. Med. J.* 2:1173, 1965.
48. Cromwell, J., and Kanak, J. R., "The Effects of Prospective Reimbursement Programs on Hospital Adoption and Service Sharing," *Health Care Finan. Rev.* 4(2):67, 1982.
49, Cromwell, J., Mitchell, J. B., and Windham, S. R., "The Cost Dynamics of Critical Illness," prepared by Health Economics Research, Inc., for the National Center for Health Services Research, Office of the Assistant Secretary for Health, U.S. Department of Health and Human Services, grant No. HS 04026, August 1981.
50. Cullen, D. J., "Results, Charges, and Benefits of Intensive Care for Critically Ill Patients," presentation at the National Institute of Health Consensus Development Conference, Critical Care Medicine, Mar. 7, 1983.
51. Cullen, D. J., "Results and Costs of Intensive Care," *Anesthesiology* 47:203, 1977.
52. Cullen, D. J., "Surgical Intensive Care: Current Perceptions and Problems," *Crit. Care Med.* 9:295, 1981.
53, Cullen, D, J., Civetta, J. M., Briggs, B. A., et al., "Therapeutic Intervention Scoring System: A Method for Quantitative Comparison of Patient Care," *Crit. Care Med.* 2:57, 1974.
54, Cullen, D. J., Ferrara, L. C., Briggs, B. A., et al., "Survival, Hospitalization Charges and Followup Results in Critically Ill Patients," *N. Engl. J. Med.* 294(18):982, *1976.*
55. Cullen, D. J., Ferrara, L. C., Gilbert, J., et al., "Indicators of Intensive Care in Critically 111 Patients," *Crit. Care Med.* 5:173, 1977.
56. Cullen, D. J., Keene, R., Kunsman, J. M., et al., "Results, Charges and Benefits of Intensive Care for Critically Ill Patients—Update *1983," Crit. Care* Med. 12:102, *1984.*
57. Davidson, I. A., Bargh, W., Cruickshank, A. N., et al., "Crush Injuries of the Chest: A Followup Study of Patients Treated in an Artificial Ventilation Unit," *Thorax.* 24:563, *1969.*
58. Davis, P. B., and di Sant'Angnese, P. A., "Assisted Ventilation for Patients With Cystic Fibrosis," *J, A.M.A.* 239(18):1851, 1978.
59. Day, H. W., "Effectiveness of an Intensive Coronary Care Area," *Am. J. Cardiology* 15:51, 1965.
60. Derzon, R. A., "Influences of Reimbursement Policies on Technology," in *Critical Issues in Medical Technology,* B. J. McNeil and E, G. Cravalho (eds.) (Boston: Auburn House Publishing Co., *1982).*
61. Detsky, A. S., Stricker, S, C., Mulley, A. G., et al., "Prognosis, Survival and the Expenditure

of Hospital Resources for Patients in an Intensive Care Unit," *N. Engl. J.* Meal, 305(12):667, 1981.
62. Dlin, B., Rosen, H., Dickstein, K., et al., "The Problems of Sleep and Rest in the Intensive Care Unit, " ***Psychosomatic*** 12(3):155, ***1971.***
63. Donowitz, L. G., Wenzel, R. P., and Hoyt, J. W., "High Risk of Hospital-Acquired Infection in the ICU Patient," *Crit. **Care*** Med. 10(6):355, 1982.
64. Dornhorst, A. C., comments on Intensive Care Units in Section of Anesthetics, ***Proceedings** of **the Royal Society*** of ***Medicine*** 59:1293, ***1966.***
65. Downs, J. B., "Intensive Care and the Adult Respiratory Distress Syndrome, " ch. 14 in Major Issues ***in Critical Care Medicine,*** J. E. Parrillo and S. M. Ayers (eds.) (Baltimore, MD: Williams & Wilkins, **1984).**
66. Drake, W. E., Jr., et. al., "Acute Stroke Management and Patient Outcome: The Value of Neurovascular Care Units (NCU)," ***Stroke*** 4:933, **1973.**
67. Draper, E. A., Wagner, D. P., and Knaus, W. A., "The Use of Intensive Care: A Comparison of a University and Community Hospital, "***Health Care** Finan. **Rev.*** 3:49, ***1981.***
68, ***Duke Law** Journal,* "The Medical Malpractice Threat: A Study of Defensive Medicine, " 1971: **939.**
69. Engelhardt, H. T., Jr., "Case Studies in Bioethics: Case No. **228,** A Demand to Die, " ***The Hastings Center Report*** 5:9, 1975.
70. Epstein, F. H., "Responsibility of the Physician in the Preservation of Life, " ***Arch. Intern, Med.*** 139:919, ***1979.***
71. Equitable Life Assurance Society of the United States, *Hospital **Daily service Charges, 1982,*** catalog No. **104283 (New** York: Equitable Life Assurance Society, 1982).
72. Feder, J., Hadley, J., and Holohan, J., "Insuring the Nation's Health: Market Competition, Catastrophic and Comprehensive Approaches" (Washington, DC: The Urban Institute, 1981).
73. ***Federal Register,*** 45:21582-21588, ***1980.***
74. *Federal **Register,*** 48(171):39752-39890, Sept. 1, 1983.
75. ***Federal Register,*** 49(129):27422-27463, Jan. 3, 1984.
76. Fedullo, A. J., and Swinburne, A. J., "Relationship of Patient Age to Cost and Survival in a Medical ICU," *Crit. **Care Med.*** 11(3):155, ***1983.***
77. Feldman, R., Sloan, F., Paringer, L., et al., "An Analysis of Hospitals' Methods of Compensating Physicians, " The Urban Institute, working paper No. 1302-02, supported by the Health Care Financing Administration grant No. 95-P-97176/3-o2, December 1979.
78. Feller, I., Tholen, D., and Cornell, R. G., "Improvements in Burn Care, 1965 to 1979," ***J,** A.M.A.* 244:2074, ***1980.***
79. Fineberg, H. V., Scadden, D., and Godman, L., "Care of Patients With a Low Probability of Acute Myocardial Infarction-Cost Effectiveness of Alternatives to Coronary Care Unit Admission," *N. Engl. J. **Med.*** 310(20):1301, ***1984.***
80. Finkler, S. A., "The Distinction Between Cost and Charges, " ***Ann, Intern,*** *Med.* 96(1):102, 1982.
81. France, D., and Bismuth, H., "Five Years of Experience With an Intensive Care Unit Specializing in Abdominal Surgery, " *Prog. Surg.* 15:37, 1977.
82. Franklin, C., and Jackson, D., "Discharge Decision-Making in a Medical ICU: Characteristics of Unexpected Readmissions, " *Crit. **Care*** Med. 11:61, 1983.
83. Freid, C., "Rights in Health Care—Beyond Equity and Efficiency, " *N. Engl. J. Med.* 293:241, 1975.
84. Fuchs, V. R., ***Who Shall Live? Health, Economics and** Social **Choice (New*** York: Basic Books, Inc., 1974).
85. Fuchs, R., and Scheidt, S., "Improved Criteria for Admission to Cardiac Care Units," ***J. A.M.A.*** 246:2037, ***1981.***
86. Galbally, B. P., "The Hospital Service-Targets for Tomorrow: Intensive Care—Productivity and Cost Control, " ***National Hospital*** 16:15, ***1972.***
87. Gelber, R., director of Capital Hill Hospital ICU, personal communication, July 22, 1983.
88. Gibson, R. M., Waldo, D. R., and Levit, K. R., "National Health Expenditures, 1982, " *Health **Care** Finan. **Rev.*** 5(1):1-32, fall 1983.
89. Gilligan, J. E., McCleave, D. J., Worthley, L., et al., "The Role of Intensive Care Units, " *Aust. N.Z.J. Surg.* 46(4):301, 1976.
90. Goldman, L., Weinberg, M., Weisberg, M., et al., "A Computer-Derived Protocol to Aid in the Diagnosis of Emergency Room Patients With Acute Chest Pain," *N. Engl. J. **Med.*** 307(10):588, ***1982.***
91. Greenbaum, D. M., and Holbrook, P. R., "Fellowship Programs in Critical Care Medicine—1982," *Crit. **Care Med.*** 10(5):347, ***1982.***
92. Greenbaum, D. M., and Holbrook, P. R., "Fellowship Programs in Critical Care Medicine, 1982, Addendum," *Crit. **Care*** Med. 10(11):785, 1982.
93. Grenvik, A., personal communication, Aug. 24, 1983.
94. Grenvik, A., " 'Terminal Weaning,' Discontin-

uance of Life-Support Therapy in the Terminally 111 Patient," *Crit. Care* Med. 5:394, 1983.
95. Grenvik, A., Leonard, J. J., Arens, J. F., et al., "Critical Care Medicine: Certification as a Multidisciplinary Subspecialty," *Crit. Care Med.* 9:117, 1981.
96. Grenvik, A., Pouner, D. J., Snyder, J. V., et al., "Cessation of Therapy in Terminal Illness and Brain Death," *Crit. Care Med.* 6(4):284, 1978,
97. Griner, P. F., "Medical Intensive Care in the Teaching Hospital: Costs Versus Benefits, *Arm. intern. Med.* 78(4):581, 1973.
98. Griner, P. F., "Pulmonary Edema and the Intensive Care Unit," ch. 13 in *Major issues in Critical Care Medicine,* J. E. Parrillo and S. M. Ayers (eds.) (Baltimore, MD: Williams & Wilkins, 1984).
99. Griner, P. F., "Treatment of Acute Pulmonary Edema: Conventional or Intensive Care?" *Ann.* Intern. Med. 77(4):501, 1972.
100. Griner, P. F., "Use of Laboratory Tests in a Teaching Hospital: Long-Term Trends: Reductions in Use and Relative Costs," *Ann. Intern. Med.* 90:243, *1979.*
101. Griner, P. F., and Liptzin, B., "Use of the Laboratory in a Teaching Hospital: Implications for Patient Care, Education, and Hospital Costs," Ann. *Intern.* Med. 75(2):157, 1971.
102. Guenter, C. A., and Welch, M. H., *Pulmonary* Medicine (Philadelphia: J. B. Lippincott Co., 1977).
103. Gunby, P., "Compromise Reached on Suggested Intervals Between Pap Tests," *). A.M.A. 13(244): 1411, 1980.*
104. Hackett, T. P., "The Psychiatrist's View of the ICU: Vital Signs Stable But Outlook Guarded," Psychiatric Ann. 6:10, 1976.
105. Hackett, T. P., Cassem, N. H., and Wishnie, H. A., "The Coronary-Care Unit: An Appraisal of Its Psychologic Hazards," N. *Engl. J.* Meal, 279(25): 1365, 1968.
106. Hadley, J., The Urban Institute, personal communication, June 8, 1983.
107. Halbritter, R., Haider, M., Rackwitz, R., et al., "Zur Prognose der Langzeitbeadmung auf einer internen intensiv Station," Intensive Med. 16:233, 1979.
108. Haley, R. W., Schaberg, D. R., and Crossley, K. B., "Extra Charges and Prolongation of Stay Attributable to Nosocomial Infections: A Perspective in Our Hospital Comparison," *Am. J. Med.* 70:51, *1981.*
109. Harris, J., "Price Rules for Hospitals," *Bell Journal of Economics* 10:224, *1979.*
110. Hauser, M. J., Tabak, J., and Baier, H., "Survival of Patients With Cancer in a Medical Critical Care Unit," *Arch. Intern. Med.* 142:527, 1982.
111. Havighurst, C. C., Blumstein, J. F., and Bovbjerg, R., "Strategies in Underwriting the Costs of Catastrophic Disease," *Law & Contemporary Problems* 40(4):122, autumn 1976.
112. Helbing, C., "Medicare: Use of and Charges for Accommodation and Ancillary Services in Short-Stay Hospitals, 1979," U.S. Department of Health and Human Services, Office of Research, Health Care Financing Administration, mimeograph undated.
113. Helbing, C., Supervisory Statistician, Office of Research, Health Care Financing Administration, U.S. Department of Health and Human Services, personal communication, June 6, 1983.
114. Hewitt, P. B., "Subjective Follow up of Patients From a Surgical Intensive Therapy Ward," *Brit.* Med. *J.* 4:669, 1970.
115. Hilberman, M., "The Evolution of Intensive Care Units," *Crit. Care Med.* 3(4):159, 1975.
116. Hook, E. W., Horton, C, A., and Schaberg, D. R., "Failure of Intensive Care Unit Support to Influence Mortality From Pneumococcal Bacteremia," *J. A.M.A.* 249(8):1055, *1983.*
117. Hopkins, C. C., "Identification of Infection Problems in Intensive Care Units," *Crit. Care Quarterly* 3(4):1, *1981.*
118. Horn, S. D., "Does Severity of Illness Make a Difference in Prospective Payment?" *Healthcare Financing Management,* 5:49, *1983.*
119. Howell, J. R., "Regulating Hospital Capital Investment: The Experience in Massachusetts," National Center for Health Services Research, Research Summary Series, U.S. Department of Health and Human Services publication No. (PHS) 81-3298 (Hyattsville, MD: U.S. Government Printing Office, 1981).
120. Hubner, P. J. B., Goldberg, M. J., and Lawson, C. W., "Value of Routine Cardiac Monitoring in the Management of Acute Myocardial Infarction Outside a Coronary Care Unit," *Brit. Med. J.* 1:815, *1969,*
121. Ibsen, B., "The Anaesthetist's Viewpoint on the Treatment of Respiratory Complications in Poliomyelitis During the Epidemic in Copenhagen, 1952," *Proc.* Roy. Soc. of *Med.* 47:6, *1954,*
122. Iglehart, J. K., "The Politics of Transplantation," *N. Engl. J. Med.* 310(13):864, *1984.*
123. Imbus, S. H., and Zawacki, B. E., "Autonomy for Burned Patients When Survival Is Unprecedented," *N. Engl. J.* Med. 297(6):308, 1977.
124. Jackson, D. L., and Younger, S., "Patient Au-

tonomy and 'Death With Dignity,' " *N.Engl.J. Med.* 301(8):404, 1979.
125. Jennett, B., "Resource Allocation for the Severely Brain Damaged," ***Arch.*** *Neurol.* 33:595, ***1976.***
126. Joint Commission on Accreditation of Hospitals, ***Accreditation Manual for Hospitals*** (Chicago, IL: 1980).
127. Jones, J., Hoggart, B., Withey, J., et al., "What the Patients Say: A Study of Reactions to the Intensive Care Unit, " ***Intensive Care Med.*** 5:89, ***1979.***
128. *Journal of* ***the American Medical Association,*** "Guidelines for Organization of Critical Care Units," 222(12):1532, 1972.
129. Kalla, A. H., and Voss, E. C., Jr., '% Intensive Care Unit Cost Effective?" ***The West Virginia Med.*** J.76(7):151, ***1980.***
130. Keene, A. R., and Cullen, D. J., "Therapeutic Intervention Scoring System: Update 1983, " *Crit.* ***Care Med.*** 11:1, ***1983.***
131. Kiely, W., "Critical Care Psychiatric Syndromes, " ***Heart & Lung*** 2(1):54, 1973.
132. Kiely, W. F., and Prucci, W. R., "Psychiatric Aspects of Critical Care, " ch. 4 in *Mosby's* ***Comprehensive Review*** *of* ***Critical Care,*** D.A. Zschoche (cd.) (St. Louis, MO: The C. V. Mosby Co., 1981).
133. Kirsch, J., "A Death at Kaiser Hospital," ***California 79-175,*** 1982.
134. Klarman, H. E., Francis, J. D., and Rosenthal, A. D., "Cost-Effectiveness Analysis Applied to the Treatment of Chronic Renal Disease, "***Medical Care*** 6:48, ***1968.***
135. Knaus, W. A., "Changing the Cause of Death, " editorial, J. A.M.A. 249(8):1059, **1983.**
136. Knaus, W. A., and Thibault, G. E., "Intensive Care Units Today, " in *Critical* ***Issues in Medical Technology,*** B. J. McNeil and E. G. Cravalho (eds.) (Boston: Auburn House Publishing CO., 1982).
137. Knaus, W. A., and Wagner, D. P., "Intensive Treatment for the Elderly: Comment" letter to the editor, ***J. A.M.A.*** 47:3185, ***1982.***
138. Knaus, W. A., Draper, E. A., Wagner, D. P., et al., "APACHE II: A Severity of Disease Classification System for Acutely 111 Patients, " submitted for publication.
139. Knaus, W. A., Draper, E. A., and Wagner, D. P., "Evaluating Medical-Surgical Intensive Care Units," ch. 4 in Major Issues ***in Critical Care Medicine,*** J. E. Parrillo and S. M. Ayers (eds.) (Baltimore, MD: Williams & Wilkins, 1984).
140. Knaus, W. A., Draper, E. A., Wagner, D. P., et al., "Evaluating Outcome From Intensive Care: A Preliminary Multihospital Comparison," *Crit.* Care Med. 10:491, 1982.
141. Knaus, W. A., Draper, E. A., and Wagner, D. P., "The Use of Intensive Care: New Research Initiatives and Their Implications for National Health Policy, " in *Milbank* ***Mere. Fund Q./ Health & Society*** 61(4):561, fall 1983.
142. Knaus, W. A., LeGall, J. R., Wagner, D. P., et al., "A Comparison of Intensive Care in the U.S.A. and France," *Lancet* ii(8299):642, ***1982.***
143. Knaus, W. A., Zimmerman, J. E., Wagner, D. P., et al., "APACHE-Acute Physiology and Chronic Health Evaluation: A Physiologically Based Classification System," *Crit.* ***Care Med.*** 9:591, ***1981.***
144. Knaus, W. A., Wagner, D. P., Draper, E. A., et al., "The Range of Intensive Care Services Today," *J. A.M.A.* 246(23):2711, **1981.**
145. Kornfeld, D. S., "Psychiatric View of the Intensive Care Unit, " *Brit.* ***Med.*** *J.* 1:108, ***1969.***
146. LeGall, J. R., Brun-Buisson, C., Trunet, P., et al., "Influence of Age, Previous Health Status, and Severity of Acute Illness on Outcome From Intensive Care, " *Crit.* ***Care Med.*** 10(9):575, ***1982.***
147, Lepore, M. J., and Grace, W. J., "Role of the Intensive Care Unit in Gastroenterology, " ***Am.*** *J. Gastro.* 51:493, ***1969.***
148. Levenson, S. A., List, N. D., and Zaw-Win, B., "Ethical Considerations in Critical and Terminal Illness in the Elderly, " *J.* ***Am,*** *Geriatr. Soc.* 29:563, ***1981.***
149. Levy, D. E., Bates, D., Cardonna, J. J., et al., "Prognosis in Nontraumatic Coma,"***Ann.*** *Intern.* ***Med.*** 94:293, 1981.
150. Lidz, C. W., Meisel, A., Osterweis, M., et al., "Barriers to Informed Consent," ***Ann. Intern. Med.*** 99:539, ***1983.***
151. Linn, B. S., "Costs of Inpatient Burn Care, " in ***Critical*** *Issues* ***in Medical*** Technology, B. J. McNeil and E. G. Cravalho (eds.) (Boston, MA: Auburn House Publishing Co., **1982).**
152. Lo, B., and Jensen, A. R., "Clinical Decisions To Limit Treatment, " ***Ann. Intern. Med.*** 93:764, ***1980.***
153. Maloney, T. W., and Rogers, D. E., "Medical Technology—A Different View of the Contentious Debate Over Costs," *N.Engl.J.* Med. 301(26): 1413, 1979.
154. Massachusetts General Hospital, Critical Care Committee, "Optimum Care for Hopelessly Ill Patients," N. *Engl.J.* ***Med.*** 295(7):362, **1976.**
155. McCleave, D. J., Gilligan, J. E., and Worthley, L. 1. G., "The Role and Function of an Australian Intensive Care Unit, " *Crit. Care Med.* 5(5):245, 1977.
156. McKegney, F. P., 'The Intensive Care Syndrome: The Definition, Treatment and Prevention of a New Disease of Medical Progress," Corm. ***Med.*** 30(9):633, ***1966.***
157. McNeil, B. J., and Hanley, J. A., "Statistical Ap-

preaches to Clinical Predictions, " editorial, N. *Engl, J. Med.* 304(21):1292, 1981.
158, McPeek, B., Gilbert, J. P., and Mosteller, F., "The Clinician's Responsibility for Helping To Improve the Treatment of Tomorrow's Patients, " N. *Engl. J.* Med. **302(11):630, 1980.**
159. Mechanic, D., "Approaches To Controlling the Costs of Medical Care: Short-Range and Long-Range Alternatives," N. *EngL J.* Med. **298(5):249, 1978.**
160, Micetich, K. C., Steinecker, P, H., and Thomasma, D. C., "Are Intravenous Fluids Morally Required for a Dying Patient?" *Arch. Intern.* ***Med. 143:975, 1983.***
161. Moore, F. D., and **Zook, C.** J., "High-Cost Users of Medical Care," N. ***Eng2. J. Med. 302(18):996, 1980.***
162. Morgan, A,, Daly, C., and Murawsi, B. J., "Dollar and Human Costs of Intensive Care, "]. %rg. Res. 14(5):441, 1973.
163. Mulley, A, G., Thibault, G. E., Hughes, R. A., et al., "The Course of Patients With Suspected Myocardial Infarction: The Identification of Low-Risk Patients for Early Transfer From Intensive Care," N. ***Engl. J. Med. 302(17):943, 1980.***
164. Murata, G. H., and Ellrodt, A. G., "Medical Intensive Care in a Community Teaching Hospital," ***West. ~, Med. 136(5):462, 1982.***
165. Myers, L. P., and Schroeder, S, A., "Physician Use of Services for the Hospitalized Patient: A Review, With Implications for Cost Containment," ***Milbank Mere. Fund Q./Health & Society 59:481, 1981.***
166. Myers, L. P., Schroeder, S. A., Chapman, S. A., et al., "What's So Special About Special Care?" ***Jnquiry 21:113, 1984.***
167. Nadelson, T., "Psychiatric Aspects of Intensive Care of Critically Ill Patients," in***Intensive Care,*** J. J. Skillman (cd.) (Boston: Little, Brown& Co., **1975).**
168. Nahum, L. H., "Madness in the Recovery Room From Open-Heart Surgery, or 'They Keep Waking Me Up,' " editorial, Corm.***Med.*** 29:771, ***1965.***
169. Nelson, H., "Life-Support Court Edict Leaves Physicians Cautious, " ***Los Angeles Times,*** Oct. **31, 1983.**
170. Nelson, L., "Questions of Age–Doctors Debate Right to Stop 'Heroic' Effort to Keep Elderly Alive," ***The Wall*** Street ***Journal,*** Sept. 7:1(col 1), 1982.
171. New ***York Times,*** Oct. 14, 1983, p. B5.
172. Nightingale, F., ***Notes on Hospitals,*** 3d ed. Longman, Green, Longman, Roberts & Green, p. 89, 1863.
173. Northey, D., Adess, M, L., Hartsuck, J. M., et al., "Microbial Surveillance in a Surgical Intensive Care Unit, " ***Surgery*** 139:321, ***1974.***
174. Nunn, J. F., Milledge, J. S., Singaraya, J., "Survival of Patients Ventilated in an Intensive Therapy Unit," *Brit.* Med. *J.* 1:1525, **1979.**
175. Parno, J. R., Teres, D., Lemeshow, S., et al., "Hospital Charges and Long-Term Survival of ICU Versus Non-ICU Patients," *Crit. Care Med.* 10(9):569, ***1982.***
176. Parrillo, J. E., and Ayres, S. M. (eds.), ***Major Issues in Critical Care Medicine*** (Baltimore, MD: Williams & Wilkins, 1984).
177. Pearlman, R. A., Inui, T. S., and Carter, W. B., "Variability in Physician Bioethical Decision-Making: A Case Study of Euthanasia, " ***Ann. Intem.*** *Med.* 97:420, ***1982.***
178. Pessi, T. T., "Experiences Gained in Intensive Care of Surgical Patients: A Prospective Clinical Study of 1,003. Consecutively Treated Patients in a Surgical Intensive Care Unit, " ***Ann. Chir. Gynecol. Fenn. 62:*** Suppl. 185:3, ***1973.***
179. Petty, T. L., "Don't Just Do Something—Stand There," ***Arch. Intern. Med.*** 139:920, ***1979.***
180. Petty, T. L., and Nett, L. M., "The Respiratory Care Department," in ***Intensive & Rehabilitative*** *Care*, 2d ed. (Philadelphia: Lea& Febiger, 1974).
181. Petty, T. L., Lakshminarayan, S., Sahn, S. A., et al., "Intensive Respiratory Care Unit: Review of Ten Years Experience," *J, A.M.A.* 34:233, 1975.
182. Piettre, A., "Aspects of Economics, Ethics and Civilization," *Intes. Care* Med. 3:253, 1979.
183, Piper, K. W., and Griner, P. F., "Suicide Attempts With Drug Overdose; Outcomes of Intensive vs. Conventional Floor Care, " *Arch. Intern. Med.* 134:703, 1974.
184. Pitner, S. E., and Mance, C. J., "An Evaluation of Stroke Intensive Care: Results in a Municipal Hospital," ***Stroke*** 4:737, 1973.
185. Pius XII, "The Prolongation of Life," ***The Pope Speaks,*** Vatican City, 1958.
186, Platt, R., Medical Director of Bronx Municipal Hospital, personal communication, July 8, 1983.
187, Plunkett, O., comments on Intensive Care Units in section of Anesthetics, *Proc.* ***Roy.*** *Soc. of* ***Med.*** 59:1293, ***1966.***
188. Policy Analysis Inc., ***Evaluation*** of ***Effects of Certificate-of-Need Programs,*** prepared for the Human Resources Administration, U.S. Department of Health and Human Services, contract No. 231-77-0114, 1981.
189. Pozen, M. W., D'Agostino, R, B., Mitchell, J, B., et al., "The Usefulness of a Predictive Instrument To Reduce Inappropriate Admissions to theCor-

onary Care Unit," ***Ann. Intern.*** Meal, 92:238, 1980.

190. Pozen, M. W., D'Agostino, R. B., Selker, H. P., et al., "A Predictive Instrument To Improve Coronary Care Unit Admission Practices on Acute Ischemic Heart Disease—A Prospective Multicenter Clinical Trial," *N. Engl. J. Med.* 310(120): 1274, 1984.

191. President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research, ***Deciding To Forego Life-Sustaining Treatment: Ethical, Medical, and Legal Issues in Treatment Decisions*** (Washington, DC: U.S. Government Printing Office, 1983).

192. Preston, G. A., Larson, E. L., and Stamm, W. E., "The Effect of Private Isolation Rooms on Patient Care Practice, Colonization and Infection in an Intensive Care Unit," ***Am. J. Med.*** 70:641, ***1981.***

193. Rabkin, M. T., Gillerman, G., and Rice, N. R., "Orders Not To Resuscitate," *N. Engl. J. Med.* 295(7):364, ***1976.***

194. Reichel, W., "The Continuity Imperative," editorial, *J, A.M.A.* 246(18):2065, 1981.

195. Relman, A. S., "Intensive Care Units: Who Needs Them?" *N. Engl. J. Med.* 302(17):965, ***1980.***

196. Rescher, N., "The Allocation of Exotic Medical Lifesaving Therapy," ***Ethics*** 79(3):173, ***1969.***

197. Robertson, J. A., "Legal Aspects of Withholding Medical Treatment From Handicapped Children," ch. 22 in ***Legal and Ethical Aspects of Treating Critically and Terminally 111 Patients,*** A. E. Doudera and J. D. Peters (eds.) (Ann Arbor, MI: Association of University Programs in Health Administration, 1982).

198. Robin, E. D., "A Critical Look at Critical Care," guest editorial, *Crit. Care Med.* 11(2):144, 1983.

199. Robinson, D., Abramson, N. S., Grenvik, A., et al., "Medicolegal Standards for Critical Care," *Crit. Care Med.* 8:524, ***1980.***

200. Robinson, J. S., comments on Intensive Care Units in Section of Anesthetics, *Proc. Roy. Soc. of Med.* 59:1293, ***1966.***

201. Rodman, G. H., Etling, T., Civetta, J. M., et al., "How Accurate Is Clinical Judgment?" *Crit. Care Med.* 6:127 (abstract), ***1978.***

202. Roe, B. B., "The UCR Boondoggle: A Death Knell for Private Practice," N. *Engl. J. Med.* 305(1):41-45, July ***2, 1981.***

203. Rogers, R. M., Weiler, C., and Ruppenthal, B., "Impact of the Respiratory Intensive Care Unit in Survival of Patients With Acute Respiratory Failure," ***Chest*** 77:501, ***1972.***

204. Rose, H. D., and Babcock, J. B., "Colonization of Intensive Care Unit Patients With Gram-Negative Bacilli," *Am. J. Epidemiol.* 101:495, ***1975,***

205. Russell, L. B., "Intensive Care," ch. ***3*** in ***Technology in Hospitals: Medical Advances and Their Diffusion*** (Washington, DC: The Brookings Institution, 1979).

206. Russell, L. B., "The Role of Technology Assessment in Cost Control," in ***Critical issues in Medical Technology,*** B. J. McNeil and E. G. Cravalho (eds.) (Boston: Auburn House Publishing Co., 1982).

207. Safar, P., "The Critical Care Medicine Continuum From Scene to Outcome," ch. 7 in ***Major Issues in Critical Care Medicine,*** J. E. Parrillo and S. M. Ayres (eds.) (Baltimore, MD: Williams & Wilkins, 1984).

208. Safar, P., and Grenvik, A., "Critical Care Medicine: Organizing and Staffing Intensive Care Units," *Chest* 59(5):535, 1971.

209. Safar, P., and Grenvik, A., "Organization and Physician Education in Critical Care Medicine," ***Anesthesiology*** 47:82, ***1977.***

210. Safar, P., Dekornfeld, T. J., Pearson, J. M., et. al., "The Intensive Care Unit," ***Anesthesia 16(3): 275,*** 1961.

211. Salkever, D. S., and Bice, T. W., 'The Impact of Certificate-of-Need Controls on Hospital Investment," *Milbank Mere. Fund Q./Health & Society 185, 1976.*

212. Sanders, C. A., "Hospital Management of Critical Care—I," presentation at the National Institute of Health Consensus Development Conference, Critical Care Medicine, Mar. 8, ***1983.***

213. Schelling, T. C., "The Life You Save May Be Your Own," ***Problems in Public Expenditure Analysis, S.*** Chase (cd.) (Washington, DC: The Brookings Institution, ***1968).***

214. Scheffler, R. M., Knaus, W. A., Wagner, D. P., et al., "Severity of Illness and the Relationship Between Intensive Care and Survival," ***Am.*** *J. Publ.* ***Health*** 725:449, ***1981,***

215. Schmidt, C. D., Elliott, C. G., Carmelli, D., et al., "Prolonged Mechanical Ventilation for Respiratory Failure: A Cost-Benefit Analysis," *Crit. Care Med.* 11(6):407, ***1983.***

216. Schoenfeld, M. R., "Terror in the ICU," ***Forum*** 1:14, ***1978.***

217. Schroeder, H. G., "Psycho-Reactive Problems of Intensive Therapy," ***Anesthesia*** 26(1):28, ***1971.***

218. Schroeder, S. A., Showstack, J. A., and Robert, H. E., "Frequency and Clinical Description of High-Cost Patients in ***17*** Acute-Care Hospitals, N. *Engl. J. Med.* 300:1306, ***1979.***

219. Schroeder, S. A., Showstack, J. A., and Schwartz,

J., "Survival of Adult High-Cost Patients, Report of a Follow-Up Study From Nine Acute-Care Hospitals," ~. *A.M.A.* 245(14):1446, *1981.*

220. Schwartz, S., and Cullen, D. J., "How Many Intensive Care Beds Does Your Hospital Need?" *Crit. Care Med.* 9(9):625, 1981.
221. Shapiro, A. R., "The Evaluation of Clinical Predictions," *N. Engl. J.* Med. 296(26):1509, 1977.
222. Shoemaker, W. C., "Effectiveness of the Intensive Care Unit for Management of Accidental, Traumatic and Hemorrhagic Shock," ch. 9 in *Major Issues in Critical Care Medicine,* J. E. Parrillo and S. M. Ayers (eds.) (Baltimore, MD: Williams & Wilkins, 1984).
223. Shoemaker, W. C., Appel, P. L., Bland, R., et al., "Clinical Trial of an Algorithm for Outcome Prediction in Acute Circulatory Failure, " *Crit. Care* Med. 10(6):390, 1982.
224. Shoemaker, W. C., Thompson L., and Holbrook, P. (eds.), ***Textbook on Critical Care Medicine*** (Philadelphia: W. B. Saunders, **1983).**
225. Shragg, T. A., and Albertson, T. E., "Moral, Ethical and Legal Dilemmas in the Intensive Care Unit," *Crit.* Care ***Med.*** 12:62, ***1984.***
226. Shubin, H., and Weil, M. H., "Touchstones in Critical Care Medicine-An Introduction," *Crit. Care* Med. 21:281, 1974.
227. Siegel, J. H., Cerra, F. B., Moody, E. A., et al., "The Effect on Survival of Critically Ill and Injured Patients of ICU Teaching Service Organized About a Computer-Based Physiologic CARE System," *J. Trauma* 20(7):558, 1980.
228. Siegler, M., "Critical Illness: The Limits of Autonomy," ***Hastings Center Report 7, 1977.***
229. Siegler, M., "Pascal's Wager and the Hanging of Crepe," *N. Engl. J. Med.* 293(17):853, 1975.
230. Singer, D., Carr, P., Mulley, A., et al., "Rationing Intensive Care—Physician Responses to a Resource Shortage, "N, *Engl. J. Med.* 309(19):1155, ***1983.***
231. Skidmore, F. D., "A Review of 460 Patients Admitted to the Intensive Therapy Unit of a General Hospital Between 1965 and 1969, " *Brit. J. Surg.* 60:1, 1973.
232. Skillman, J. J. (cd.), ***Intensive Care*** (Boston: Little, Brown & Co., **1975).**
233. Skillman, J. J., "Terminal Care in Patients With Chronic Lung Disease, " ***Arch. intern. Med.*** 139, ***1979.***
234. Smits, H. L., "The PSRO in Perspective," *N. Engl. J. Med.* 305(5):253, ***1981.***
235. Snyder, J. V., McGuirk, M., Grenvik, A., et al., "Outcome of Intensive Care—An Application of a Predictive Model, " *Crit. Care Med.* 9(8):598, ***1981.***
236. Society of Critical Care Medicine, Committee on Training Guidelines, P. M. Winter (Chin.), "Guidelines for Training of Physicians in Critical Care Medicine, " *Crit. Care* Med. 1(1):39, 1973.
237. Soler, N. G., Bennett, M. A., Fitzgerald, M. G., et al., "Intensive Care in the Management of Diabetic Ketoacidosis, " *Lancet* 4:951, ***1973.***
238. Spagnolo, S. V., Hershberg, P. I., and Zimmerman, H. J., "Medical Intensive Care Unit: Mortality Rate Experience in Large Teaching Hospital," *NY State J.* Med. 73:754, 1973.
239. Steel, K., Gertman, P. M., Crescenzi, C., et al., "Iatrogenic Illness on a General Medical Service at a University Hospital," N. *Engl. J. Med. 304(11): 638,* 1981.
240. Stoughton, W. V., "Medical Costs and Technology Regulation: The Pivotal Role of Hospitals, " in ***Critical Issues in Medical Technology,*** B. J. McNeil and E. G. Cravallo (eds.) (Boston: Auburn House Publishing Co., **1982).**
241. Sullivan, R., "Court in Jersey Forbids Removing Feeding Tube From Terminally Ill," New ***York Times*** July 9:1 (col. 1), 1983.
242. Swan, H. J. C., "Invasive Hemodynamic Monitoring in Critical Care Units, " ch. 12 in Major *Issues in* Critical ***Care Medicine,*** J. E. Parrillo and S. M. Ayres (eds.) (Baltimore, MD: Williams & Wilkins, **1984).**
243. Tagge, G. F., Adler, D., and Bryan-Brown, C. W., "Relationship of Therapy to Prognosis in Critically Ill Patients, " *Crit. Care Med.* 2(2):61, ***1974.***
244. Tagge, G. F., Salness, G., Thams, J., et al., "Experience With a Multidisciplinary Critical Care Center in a Community Hospital," *Crit. Care* Med. 3(6):231, 1975.
245. Tait, M., and Winslow, G., "Beyond Consent: The Ethics of Decision Making in Emergency Medicine," ***West. J. Med.*** 126(2):156, ***1977.***
246. Teplick, R., Caldera, D. L., Gilbert, J. P., et al., "Benefit of Elective Intensive Care Admission After Certain Operations, " *Anesth. Analg. 62: 572, 1983.*
247. Teres, D., Brown, R, B., and Lemeshow, S., "Predicting Mortality of Intensive Care Unit Patients: The Importance of Coma, " *Crit. Care Med.* 10(2):86, ***1982.***
248. Thibault, G. E., "The Medical Intensive Care Unit: A Five-Year Perspective," ch. 2 in Major ***Issues in*** *Critical* ***Care Medicine,*** J. E. Parrillo and S. M. Ayers (eds.) (Baltimore, MD: Williams & Wilkins, 1984).
249. Thibault, G. E., Mulley, A. G., Barnett, C. O., et al., "Medical Intensive Care: Indications, Interventions, and Outcomes, " N. *Engl. J. Med.* 302(17):938, ***1980.***
250. Thomas, L., "Notes of a Biology-Watcher: The

Technology of Medicine," *N. Engl. J. Med. 285(24): 1366,* 1971.
251. Tomlin, P. J., "Intensive Care—Medical Audit," *Anesthesia* 33:710, *1978.*
252. Turnbull, A. D., Carlon, G., Baron, R., et al., "The Inverse Relationship Between Cost and Survival in the Critically Ill Cancer Patients, " *Crit. Care* Med. 7(1):20, 1979.
253. Turnbull, A. D., Goldmeir, P., Silverman, D., et al., "The Role of an Intensive Care Unit in a Cancer Center: An Analysis of 1035 Critically Ill Patients Treated for Life-Threatening Complications, " editorial, Cancer 37:82, 1976.
254. U.S. Congress, Office of Technology Assessment, ***Diagnosis Related Groups*** *(DRGs)* ***and the Medicare Program: Implications for Medical*** *Technology,* OTA-TM-H-17 (Washington, DC: U.S. Government Printing Office, July 1983).
255. U.S. Congress, Office of Technology Assessment, *Health* ***Technology Case Study #24: Variations in Hospital Length of Stay: Their Relationship to Health Outcomes,*** OTA-HCS-24 (Washington, DC: U.S. Government Printing Office, August 1983).
256, U.S. Congress, Office of Technology Assessment, ***The Implications of Cost-Effectiveness Analysis of*** Medical ***Technology,*** OTA-H-126 (Washington, DC: U.S. Government Printing Office, August 1980).
257. U.S. Congress, Office of Technology Assessment, ***Medical Technology and Costs of the Medicare Program, OTA-H-227*** (Washington, DC: U.S. Government Printing Office, July 1984).
258. U.S. Department of Commerce, Bureau of the Census, ***State and Metropolitan Area Data Book*** *1982* (Washington, DC: U.S. Department of Commerce, 1982).
259. U.S. Department of Health and Human Services, Health Care Financing Administration, Office of Research and Demonstration, Bureau of Data Management and Strategy, "List of Diagnosis Related Groups (DRGs) With Relative Values, Average Length of Stay (ALOS), and Percent of Adjusted Charges Per Discharge for Ancillary Services, " 1979 data.
260, U.S. Department of Health and Human Services, Health Care Financing Administration, Office of Research and Demonstration, Bureau of Data Management and Strategy, "Routine and Special Care Arithmetic Mean Length of Stay for Outlier and Non-Outlier Cases, " Oct. *27, 1983.*
261. U.S. Department of Health and Human Services, Health Care Financing Administration, Office of Research and Demonstration, Bureau of Data Management and Strategy, "20 Percent Sample Discharges by Diagnosis Related Group Adjusted Sample," June 21, 1983.
262. U.S. Department of Health and Human Services, National Institutes of Health, Consensus Development Conference Statement, "Critical Care Medicine," Mar. 7-9, 1983.
263. U.S. Department of Health and Human Services, National Institutes of Health, Consensus Development Conference statement, "Supportive Therapy in Burn Care, " Nov. 10-11, 1978.
264. U.S. Department of Health and Human Services, ***Report to Congress: Hospital Prospective Payment for Medicare*** (Washington, DC: U.S. Department of Health and Human Services, December 1982).
265. Vanholder, R., and Colardyn, F., "Prognosis of Intensive Care Patients: Correlation of Diagnosis and Complications to Patient Outcome, " Acta *Clinica Belgica* 35(5):279, *1980.*
266. Veatch, R, M., ***A Theory of Medical Ethics (New*** York: Basic Books, 1981).
267. Wagner, D. P., "National Costs of Intensive Care," unpublished manuscript, undated.
268. Wagner, D. P., Knaus, W. A., and Draper, E. A., "Case Mix, Resource Costs, and Severity of Illness, " unpublished manuscript draft, 1983.
269. Wagner, D. P., Knaus, W. A., Draper, E. A., et al., "Identification of Low-Risk Monitor Patients Within a Medical-Surgical Intensive Care Unit," ***Medical Care*** 21:425, *1983.*
270. Wagner, D. P., Knaus, W. A., and Draper, E. A., "Statistical Validation of a Severity of Illness Measure, " ***Am. J. Pub. Health*** 73(8):879, 1983.
271. Wagner, D. P., Wineland, T. D., and Knaus, W. A., "The Hidden Costs of Treating Severely 111 Patients: Charges and Resource Consumption in an Intensive Care Unit, " *Health* ***Care*** *Finan. Rev.* 5(1):81, *1983.*
272. Wallace-Barnhill, G. L., Roth, M. D., Armstrong, C. J., et al., "Health Care Law Update: Legal Protection for Critical Care Physicians: State of the Art in Termination of Life Support and Living Will Legislation, " *Crit. Care* Med. 12:56, 1984.
273. Wanzer, S. H., Adelstein, S. J., Cranford, R. E., et al., "The Physician's Responsibility Toward Hopelessly Ill Patients, "N, *Engl. J. Med.* 310(7): 455, 1984.
274. Weil, M. H., "The Society of Critical Care Medicine, Its History and Its Destiny, " *Crit. Care Med.* 1(1):1, 1973.
275. Weil, M. H., and Rackow, E. C., "Critical Care

Medicine—Caveat Emptor," *Arch. Intern. Med.* 143:1391, 1983.

276< Weinberg, S. L., "Intermediate Coronary Care: Observations on the Validity of the Concept," Chest 73:154, 1978.

277< Weinstein, M. C., and Fineberg, H. V., Clinical ***Decision Arudysis*** (Philadelphia: W. B. Saunders, 1980).

278. Weiser, B., **"AS They Lay Dying, "** ***Washington Post*** **[Apr.** 17: Part I, 1 (co]. 1), 1983; Apr. 18: Part II, 1 (col. 2), 1983; Apr. 19: Part III, 1 (col. 1), 1983; Apr. 20: Part IV, 1 (col. 4), 1983; Apr. 21: Part V, 1 (col. 5), 1983.]

279. Williams, S. V., "Can Randomized Trials of Intensive Care Meet Ethical Standards?" in Critical ***Issues in Medical Technology,*** B. J. **McNeil and E. G. Cravalho (eds.) (Boston: Auburn House Publishing Co.,** *1982).*

280. **Wilson, J. B., "Medical Dilemmas in Terminal Care," in** *Death by Decision* **(Philadelphia: Westminster Press, 1975).**

281. **Wilson, R. F., "Development and Cost Effectiveness of Surgical Intensive Care Units, " in Crit. Care *Meal,,* program abstract from the National Health Institute of Health Consensus Development Conference, Mar. 8, 1983.**

282. **Young, W. R., "It's a Miracle That We Save Any of Them," Life** *Magazine,* **Dec. 2, 1966.**

283. **Zimmerman,** J. E., **"Administrative Structure of a Critical Care Unit, " ch. 25 in *Major Issues in Critical Care Medicine,*** J. **E. Parrillo and S. M. Ayers (eds.) (Baltimore, MD: Williams & Wilkins, 1984).**