



## **Report to Congress**

# **The Critical Care Workforce: A Study of the Supply and Demand for Critical Care Physicians**

REQUESTED BY: SENATE REPORT 108-81, SENATE REPORT 109-103  
AND HOUSE REPORT 109-143

---

Elizabeth M. Duke  
Administrator, HRSA

**TABLE OF CONTENTS**

**EXECUTIVE SUMMARY ..... III**

**INTRODUCTION ..... 1**

    THE CRITICAL CARE PHYSICIAN WORKFORCE AND PHYSICIAN MODELING ..... 2

**CHAPTER 1: WORKFORCE ISSUES IN CRITICAL CARE ..... 6**

    SPECIALTY HISTORY..... 6

    GROWTH OF PULMONOLOGY AND CRITICAL CARE MEDICINE..... 6

**CHAPTER 2: SUPPLY ..... 12**

    THE CURRENT SUPPLY OF PHYSICIANS TRAINED IN CRITICAL CARE ..... 12

    NEW ENTRANTS TO THE CRITICAL CARE WORKFORCE ..... 17

    RETIREMENT OF CRITICAL CARE PHYSICIANS ..... 21

    PHYSICIAN SUPPLY MODEL PROJECTIONS ..... 22

**CHAPTER 3: DEMAND ..... 24**

    CURRENT UTILIZATION OF CRITICAL CARE SERVICES..... 25

    PHYSICIAN DEMAND MODEL PROJECTIONS..... 26

**CHAPTER 4: COMPARING ESTIMATES OF SUPPLY AND DEMAND ..... 29**

    COMPARING THE PSM/PDM AND THE COMPACCS PROJECTIONS ..... 29

    WHY CRITICAL CARE DEMAND ESTIMATES ARE UNIQUE ..... 30

**CHAPTER 5: SUMMARY AND IMPLICATIONS..... 32**

    ADEQUACY OF CRITICAL CARE PHYSICIAN SUPPLY: IMPLICATIONS FOR VULNERABLE POPULATIONS ..... 32

    AREAS FOR FUTURE RESEARCH..... 32

**Key Acronyms**

ABIM	American Board of Internal Medicine
ACCP	American College of Chest Physicians
AHA	American Hospital Association
AMA	American Medical Association
ATS	American Thoracic Society
CCA	Critical Care Anesthesiologists
CCM	Critical Care Medicine
CCP	Critical Care Pulmonologists
CCS	Critical Care Surgeons
COMPACCS	Committee on Manpower for the Pulmonary and Critical Care Societies
GME	Graduate Medical Education
HRSA	Health Resources and Services Administration
ICU	Intensive Care Unit
IM	Internal Medicine
IMG	International Medical Graduates
PDM	Physician Demand Model
PSM	Physician Supply Model
SCCM	Society for Critical Care Medicine

## EXECUTIVE SUMMARY

Patients in acute care hospitals receive over 18 million days of care in intensive care units (ICU) each year, with related health care costs estimated to be almost one percent of U.S. gross domestic product. The demand for ICU services is projected to grow rapidly during the next decade as the average acuity of hospitalized patients rises with growth in the elderly population. The ability of critically ill patients to receive adequate care depends upon a number of factors, including the availability of highly trained health care professionals.

Organizations such as the Leapfrog Group have promoted the increased use of critical care physicians (intensivists), in ICUs as a growing body of research finds that greater use of intensivists results in improved patient outcomes. A report by the Committee on Manpower for the Pulmonary and Critical Care Societies (COMPACCS, Angus et al., 2000) projected a growing shortfall of intensivists unless changes are made to increase the number of physicians trained in critical care.

In June 2003, in response to concerns about the widening gap between the size of the Nation's aging baby boom population and the number of pulmonary and critical care physicians, Congress asked the Health Resources and Services Administration (HRSA) to examine the adequacy of the critical care workforce. HRSA maintains physician workforce supply and demand models developed to assess the adequacy of supply for many physician specialties. Working with the American College of Chest Physicians, HRSA and its consultants updated the physician workforce models to include critical care physicians.

Currently, intensivists direct the care of only one third of critically ill patients. In recent years, however, the proportion of patients receiving care under the direction of an intensivist has increased dramatically and this trend will likely continue. An upper bound on the demand projections assumes that intensivists direct the care of approximately two thirds of patients in the ICU, while a lower bound assumes that intensivists will continue to direct the care of only a third of critically ill patients. Our analysis supports the findings that demand for intensivists will continue to exceed available supply through the year 2020 if current supply and demand trends continue.

The intensivist supply and demand projections reported by COMPACCS are the only recent projections available for comparison. The COMPACCS findings also suggest a growing shortage of intensivists, but the projections differ in several respects from our more recent projections. First, the COMPACCS study uses a broader definition of intensivists to include pulmonologists who spend part of their time providing critical care services. Second, the

baseline supply projections show little growth, whereas the number of fellows in critical care started to increase in the years between the COMPACCS study and our more recent projections. Third, the COMPACCS study identified the potential growth in demand for intensivists beyond the one third of critically ill patients currently cared for by intensivists. Their demand projections assume that current patterns of intensive service utilization and delivery will continue in future years; growth is based entirely on the growing and aging U.S. population. If the trend towards greater utilization of intensivists in ICUs were taken into account, the COMPACCS demand projections would likely underestimate requirements for intensivists.

Despite the differences between our projections and the COMPACCS projections, the approach used by COMPACCS is methodologically sound and the data collected through their survey provides important insights on the practice behavior and retirement patterns of physicians providing critical care services. Many of the findings from the COMPACCS study and survey provide estimates of important parameters used in the HRSA physician workforce models.

Vulnerable populations, particularly the uninsured and those located in rural areas, likely have limited access to intensivist services. Moreover, many critically ill Americans may receive less than the evolving standard of care because of an inability of smaller hospitals and those serving vulnerable populations to sustain ICUs in which intensivists are always available to direct care. Because a large proportion of critical care fellows are international medical graduates (IMGs), the shortage of intensivists is worsened by an inability of many qualified IMG intensivists to remain in the United States because of visa restrictions (data on the actual numbers of IMGs who return to their home countries are not available). Furthermore, the profession has had difficulty attracting qualified applicants from U.S. medical schools and retaining practicing physicians. We note that our study focuses on the adequacy of intensivist supply to provide adult critical care. Population projections suggest a large increase in demand for such services due to an aging population.

### **Specific Findings and Conclusions:**

The supply of intensivists (those physicians who identify themselves primarily as critical care physicians and have completed a critical care fellowship) will likely grow by about 48 percent—from 1,900 to 2,800—between 2000 and 2020 if current supply trends continue. While the focus of this study is intensivists, some pulmonologists also provide critical care. Such pulmonologists average spending less than a quarter of their time in ICUs. HRSA's physician workforce models separately track supply and demand for pulmonologists, but do not track the amount of critical

care provided by pulmonologists. This study assumes that pulmonologists will continue to provide the same proportion of critical care estimated by the COMPACCS study.

- Because critical care is a relatively new and growing specialty, the intensivist workforce is relatively young. Around 2020, the intensivist workforce will likely stabilize as the number of intensivists retiring will approximately equal the number of new intensivists.
- The growth and aging of the population alone will increase demand for adult intensivist services by approximately 38 percent—from 1,900 to 2,600 between—2000 and 2020. This increase represents a lower bound on expected growth in demand and assumes that intensivists continue to treat only a third of critically ill patients. Further, it assumes that supply and demand were in balance in 2000.
- If the proportion of ICU patients whose care is directed by an intensivist were to increase from one third to a more optimal level of two thirds, then intensivist requirements would grow from a need for 3,100 FTE intensivists in 2000 to 4,300 by 2020. This represents a shortage of about 1,200 intensivists in 2000, growing to 1,500 in 2020, or 129 percent above the projected supply. The upper bound on the demand projections reflects the large potential growth in utilization of intensivist services—especially in metropolitan areas.
- Lifestyle issues associated with critical care as it is currently practiced present a barrier to increasing the number of practicing intensivists. Reimbursement for critical care is also perceived by those in the profession as inadequate, making critical care less attractive to newly trained physicians.
- Critical care remains an evolving specialty. A significant body of literature indicates that the current supply of practicing intensivists is lower than what is required to care for patients in U.S. ICUs. The evidence indicates that patient outcomes are improved when intensivists are available around-the-clock for patient consultation.
- Organizational changes in the way that care is provided to critically ill patients have the potential to improve patient access to cost-effective and quality care—especially in rural areas. One example is the increased use of electronic ICUs where specialist physicians and nurses monitor and help treat critically ill patients in widely scattered hospitals.

In summary, we project that if current trends continue, the growing supply of intensivists will be insufficient to provide the optimal level of care to future populations through 2020. A lower bound of projected demand assumes that all growth in demand for intensivist services is due to the growth and aging of the population but the recent growth in intensivist involvement in ICU

care suggests that this lower estimate is highly unlikely. Total employment opportunities will likely grow faster than this lower bound as hospitals increasingly staff their ICUs with intensivists. An upper bound on the demand projections would occur if intensivists direct the care of two thirds of patients admitted to the ICU. The likely demand for intensivists will likely lie somewhere between this upper and lower bound, suggesting the need to increase intensivist supply and to continue monitoring trends in supply and demand.

## INTRODUCTION

The sickest patients in U.S. hospitals are cared for in intensive care units (ICU). The number of patients cared for in ICUs is projected to grow rapidly during the next decade as the average acuity of hospitalized patients rises with growth in the elderly population, who consume the greatest amount of health care services. In the U.S., patients in ICUs currently receive over 18 million days of care every year, with related health care costs estimated to be almost one percent of U.S. gross domestic product.<sup>1</sup> The ability of these critically ill patients to receive appropriate care depends upon access to hospitals with appropriate facilities as well as the availability of highly trained health care professionals.

In 2000, Derek Angus and his colleagues on the Committee on Manpower for the Pulmonary and Critical Care Societies (COMPACCS) presented a detailed analysis of the critical care physician (or “intensivist”) workforce that provides care to patients in ICUs.<sup>2</sup> The report, published in the *Journal of the American Medical Association (JAMA)*, reviewed the data supporting the increasing likelihood of a shortage of physicians adequately trained to care for the sickest patients in the U.S. health care system. The COMPACCS study concluded that, if current trends in the utilization and supply of intensivist services continued, a severe shortage of intensivists would materialize within the next decade. The study also found that two-thirds of critically ill patients did not receive care from intensivists (which in the COMPACCS study also includes pulmonologists who spend some time in ICUs).

Medicine and medical care has evolved considerably over the last century in both inpatient and outpatient settings. Primary care physicians generally directed care for patients inside and outside of hospitals in consultation with appropriate specialists. However, the greater trend towards specialization of the physician workforce over time has changed the roles of both generalist and specialist physicians. In the inpatient setting, the physician directing care (“attending”) during a course of hospitalization has traditionally guided this care regardless of the unit in which a patient is cared for, including the ICU. A 1998 survey of U.S. ICUs found that the care of critically ill patients was directed by full-time intensivists for 23 percent of patients and intensivists were consulted for another 14 percent; other patients were cared for by

---

<sup>1</sup> Green TP. What is best for patients is best for the intensive care unit. *Critical Care Medicine*. 2001; 29(10): 2038-39.

<sup>2</sup> Angus DC, Kelley MA, Schmitz RJ, White A, Popovich J, for the Committee on Manpower for Pulmonary and Critical Care Societies. Current and Projected Workforce Requirements for Care of the Critically Ill and Patients With Pulmonary Disease: Can We Meet the Requirements of an Aging Population? *JAMA*. 2000; 284: 2762-2770. See also: Schmitz R, Lantin M, White A. Future Needs in Pulmonary and Critical Care Medicine. Abt Associates Inc. study conducted for the American College of Chest Physicians, American Thoracic Society, and Society for Critical Care Medicine. November, 1998.

primary care physicians who have not completed critical care fellowships.<sup>3</sup> Though it is unclear why intensivists do not direct care for more critically ill patients, Buchardi and Moerer suggest that this may be due to the fact that “many primary physicians resist relinquishing authority for their patients, and intensivists may tend to exclude the primary physicians from decision-making.”<sup>4</sup>

The COMPACCS study found that the demand for critical care services would increase rapidly due to the aging and expanding of the population. Meanwhile, the supply of physicians trained to provide these services would remain constant through 2030, making it unlikely that intensivists would be able to care for a greater proportion of critically ill patients. In addition, the growing body of literature linking full-time intensivist staffing with improved outcomes for ICU patients has increased the demand for physicians trained in critical care. Hospitals have also been encouraged to make organizational changes to their ICUs by employer groups and other payers of health care.

In June 2003, in response to concerns about the widening gap between the size of the Nation's aging baby boom population and the number of pulmonary and critical care physicians, Congress asked the Health Resources and Services Administration (HRSA) to examine the adequacy of the critical care workforce. HRSA maintains several health workforce models to assess the adequacy of future physician and nurse supply in different specialties and settings. Working with the American College of Chest Physicians (ACCP), HRSA updated its physician workforce models to add critical care as a separate specialty. The purpose of this report is to assess the current and future adequacy of supply of critical care physicians. Our analysis supports the findings that demand for intensivists will continue to exceed available supply through the year 2020 if current supply and demand trends continue.

## **The Critical Care Physician Workforce and Physician Modeling**

According to the American Medical Association (AMA), over 750,000 allopathic and osteopathic physicians were actively practicing medicine in the U.S in 2003, with fewer than 5,000 trained and certified in critical care. The two major research questions guiding this study are (1) do we currently have a sufficient supply of intensivists, and (2) will supply be sufficient over the next decade or two?

The factors affecting the supply of, and demand for, physician services are complex and dynamic. In this report we provide a brief description of the assumptions, methods and data used

---

<sup>3</sup> Burchardi H and Moerer O. Twenty-four hour presence of physicians in the ICU. *Critical Care* 2001; 5:131-7.

<sup>4</sup> Buchardi and Moerer, 2001.

to project the future supply of and demand for intensivist services. A more detailed description of HRSA's workforce models is available in other reports.<sup>5</sup>

Workforce projections provide an indication of the magnitude of likely imbalances in supply and demand in future years, and thus are useful for planning purposes. Projections of physician shortages and surpluses have influenced policies and programs for over 100 years, helping to determine the number and specialty composition of physicians being trained.<sup>6</sup> The Flexner Report in the early 1900's is considered the first major attempt to systematically analyze the adequacy of the physician workforce; the one outcome of this study was a relative downsizing of the physician workforce between 1900 and 1930, with a decrease from 175 to 125 physicians for every 100,000 persons.<sup>7</sup> In 1932, a national Commission on Medical Education called for a further reduction in the size of the physician workforce. In the late 1950's, the Bayne-Jones and Bane reports from the U.S. Office of the Surgeon General projected an impending physician shortage. By 1960, immigration restrictions on physicians were relaxed. This was followed by an expansion of the Nation's medical schools, an increase in government funding for medical education, and the creation of policies and programs that encouraged immigration of foreign-trained physicians. Efforts to increase the physician supply were so successful that by the late 1970's experts were predicting a growing oversupply of physicians.

Though the Graduate Medical Education National Advisory Committee in 1980 projected a surplus of physicians (particularly specialists) by 2000, the number of physician trainees continued to rise until the early 1990's. The expanding enrollment in health maintenance organizations (HMOs) during the 1980's and 1990's prompted re-examination of the adequacy and composition of the physician supply. Subsequent models and their projections assumed that the U.S. would move quickly to a more primary care-oriented system with more efficient delivery of health care services. As a result, most models predicted that the United States would have a large surplus of specialists by 2000.<sup>8</sup> New medical graduates became less likely to enter fellowships after residency training, particularly those in internal medicine.<sup>9</sup> By the late 1990's, however, the trend towards greater specialization returned. In 1998, only 43 percent of residents

---

<sup>5</sup> See, for example, *Physician Supply and Demand Projections: 2000 to 2020*. HRSA report prepared by The Lewin Group and Altarum, 2005.

<sup>6</sup> Blumenthal D. New Steam from an Old Cauldron — The Physician-Supply Debate. *N Engl J Med*. 2004; 350:1780-1787.

<sup>7</sup> Blumenthal (2004).

<sup>8</sup> COGME Eighth Report. *Patient Care Physician Supply and Requirements: Testing COGME Recommendations*. Rockville, MD: Public Health Service, 1996.

<sup>9</sup> Grosso LJ, Goode LD, Kimball HR, Kooker DJ, Jacobs C, and Lattie G. The subspecialization rate of third year internal medicine residents from 1992 through 1998. *Teach Learn Med*. 2004; 16(1):7-13.

in internal medicine went on to subspecialize; by 2003, that proportion had increased to over 66 percent.<sup>10</sup>

In contrast to the widely held consensus of the mid-1990's that the United States would have a surplus of specialists, a growing number of researchers have suggested that growth in the number of specialists,<sup>11,12,13</sup> not primary care physicians, will be especially important in meeting the demands of an aging and expanding population.<sup>14,15</sup> The recent discussions regarding the adequacy of the future supply of physicians have centered around the theory that economic growth is a major determinant of growth in per capita demand for physician services, and that continued economic expansion will contribute to a significant shortage of physicians—particularly specialists—over the next decade. While these theories are still being debated in the literature, new concerns about the shortage of physician specialists have rarely informed the debate about the demand for individual specialties with detailed analysis or projections.

Few analyses have rigorously examined the adequacy of physician supply in critical care. In the late 1990's, the American Thoracic Society (ATS), the American College of Chest Physicians (ACCP), and the Society of Critical Care Medicine (SCCM) formed the Committee on Manpower for the Pulmonary and Critical Care Societies which examined the supply of, and demand for, intensivists and pulmonologists. The study projected a large increase in demand after 2007 (based primarily on the aging of the U.S. population) and relative shortages in the supply of these physician specialists.

COMPACCS estimated a shortage in the number of available intensivist hours of care equal to 22 percent of demand by 2020 and 35 percent by 2030.<sup>16</sup> In their analysis, the shortage became more severe if the demand for intensivist care was extended to a greater proportion of ICU patients. Alternative scenarios modeling changes in the variables affecting demand for critical care services, including greater managed care penetration, had little impact on this shortage.

This shortage was projected based upon best available data at the time of the study, including the number of physicians choosing pulmonary and critical care specialties, and the expectation that

---

<sup>10</sup> Clayton C. Presentation at the Alliance for Academic Internal Medicine—Lewin Forum on the Future of the Healthcare Workforce. September 14, 2004. Washington, DC.

<sup>11</sup> Council on Graduate Medical Education, Sixth Report. *Managed Health Care: Implications for the Physician Workforce and Medical Education*. Rockville, Md.: Public Health Service, 1995.

<sup>12</sup> Council on Graduate Medical Education, Fourth Report. *Recommendation to Improve Access to Health Care through Physician Workforce Reform*. Rockville, Md.: Public Health Service, 1994.

<sup>13</sup> Council on Graduate Medical Education, Draft Report. *Physician Workforce Policy Guidelines for the U.S. 2000-2020*, 2003.

<sup>14</sup> Institute of Medicine. *Primary Care: America's Health in a New Era*. Washington, DC: National Academies Press, 1996.

<sup>15</sup> Cooper, Richard A. There's a Shortage of Specialists: Is Anyone Listening? *Acad Med*. 2002 77: 761-766

<sup>16</sup> Angus et al. (2000).

these numbers would remain stable over time. The study also tested several scenarios affecting both supply (changing assumptions about number of hours worked, age of retirement, distribution of time between clinical and other activities) and demand (changing assumptions about penetration of managed care, growth in outpatient care, and other factors). The COMPACCS study anticipated many of the changes in the workforce and the delivery of health care, though some changes (such as the prominent role of intensivists and critical care in the quality movement) were unforeseen.

The methods and assumptions used in the COMPACCS study are similar to those used in the Physician Supply Model (PSM) and Physician Demand Model (PDM) developed by HRSA. Historically, the PSM and PDM modeled the supply of, and demand for, pulmonologists separately from other specialties, but grouped intensivists with several other smaller specialties into its “other internal medicine specialties” category. The revised PSM and PDM have expanded the number of individual physician specialties modeled, creating the capability to project the future supply of and demand for intensivists.

Using findings from the literature, original research, and projections from the PSM and PDM, this report examines the current and future supply of physicians who provide care to critically ill patients; the major factors and trends affecting the demand for their services; and the likely inadequacy of their numbers through 2020. Chapter 1 reviews the history of intensivist training and practice, the issues related to the critical care workforce, and trends in the organization and delivery of critical care. Chapter 2 discusses the supply of critical care physicians, the factors affecting the availability of practicing specialists, and the projected supply of critical care physicians through the year 2020. Chapter 3 analyzes the demand for critical care physicians, its determinants, and the ratio of intensivists to population required to meet the demand for related services. The chapter concludes with projections of demand for critical care physicians through 2020. Chapter 4 compares the current projections with those of the COMPACCS study and discusses the implications of these results. Chapter 5 examines the implications for vulnerable populations, provides examples of how unmet demand has been addressed, and suggests areas for future research.

### ACKNOWLEDGEMENTS

This publication was prepared for the Health Resources and Services Administration by the Lewin Group under Contract Number HRSA-250-01-0001. Staff from HRSA's National Center for Health Workforce Analysis contributed to writing the report.

## CHAPTER 1: WORKFORCE ISSUES IN CRITICAL CARE

### Specialty History

This report considers *intensivists* to be physicians certified in critical care who primarily deliver care to patients in an intensive care unit. Most hospitals in the United States have maintained at least one ICU since the late 1960's, although the use of ICUs has continued to grow as hospital patients have become more severely ill and as technology has increased the level of care available to the most critically ill patients.<sup>17</sup> Critical care is one of the newest specialties to be certified under the American Board of Medical Specialties, with the first examination for internal medicine (IM) specialists in critical care held in 1987.<sup>18</sup> We note that our study focuses on the adequacy of intensivist supply to provide adult critical care. Population projections suggest a large increase in demand for such services due to an aging population.

Only seven percent of internists with board certification in critical care have been trained in critical care as their only subspecialty; Angus and colleagues found that the majority of those providing intensivist services trained in combined pulmonary and critical care programs.<sup>19</sup> In addition to their critical care training, intensivists have completed training in internal medicine, anesthesia, general surgery, pediatrics, or obstetrics and gynecology. Intensivists care for critically ill patients alongside nurses, respiratory therapists, pharmacists, and physician assistants.

*Pulmonologists* are certified in pulmonary medicine and are trained in the care of patients with a variety of lung and respiratory disorders. These disorders include a number of common diseases such as asthma, chronic obstructive pulmonary disease and emphysema. Pulmonologists complete a residency in internal medicine and a fellowship in pulmonary medicine either by itself or in conjunction with training in critical care.

### Growth of Pulmonology and Critical Care Medicine

Pulmonary medicine originally evolved as a specialty as physicians developed increasing interest in patients with tuberculosis. As antimicrobial therapy developed, and broader knowledge was

---

<sup>17</sup> Society of Critical Care Medicine. *Patient and Family Resources: History of Critical Care*. SCCM Web site. [http://www.sccm.org/patient\\_family\\_resources/history\\_critical\\_care/index.asp](http://www.sccm.org/patient_family_resources/history_critical_care/index.asp).

<sup>18</sup> Tobin MJ and Hines E. Pulmonary and Critical Care Medicine: A Peculiarly American Hybrid? *Thorax*. 1999; 54: 286-287.

<sup>19</sup> This is partly related to the relatively recent emergence of critical care as a specialty. Fifty percent of physicians trained in pulmonary and/or pulmonary-critical care are certified in critical care; however, these physicians spend about half as much time in the ICU as their colleagues that were trained only in critical care (Angus 2000).

acquired, pulmonologists expanded their expertise to a wide variety of illnesses affecting the respiratory system.

Internists became more interested in the care of critically ill ICU patients with pulmonologists pioneering the critical care field because of their expertise in the respiratory disorders of mechanically ventilated patients. Critical care has continued to be a significant part of the scope of practice of pulmonologists throughout its development as a distinct specialty.

Mechanical ventilation was first used primarily for patients in the operating room, but became increasingly utilized in the care of patients with respiratory failure associated with a variety of illnesses. Surgical specialists, including those practicing obstetrics and gynecology, were frequently involved in the care of critically ill patients who were mechanically ventilated in both surgical and recovery rooms. ICUs became more prevalent in the 1950's as the number of ventilated patients grew and were grouped together for increased efficiency of care.<sup>20</sup> Anesthesiologists were the first physicians to take a leading role in caring for ICU patients because of their experience in the operating and recovery rooms.

Previous analysis of the critical care workforce has examined pulmonologists and critical care specialists within internal medicine as one heterogeneous group that may fulfill similar functions. However, physician certification and discipline of primary training may help to identify those physicians who deliver a significant volume of critical care services because they are associated with practice characteristics.

Internists trained exclusively in pulmonary medicine spend about 23 percent of patient care hours in the ICU, whereas those trained exclusively in critical care (without pulmonary training) spend more than 46 percent of patient care hours in the ICU.<sup>21</sup> Surgeons and anesthesiologists account for a smaller proportion of practicing intensivists, about 10 percent, and are most likely to be involved in the care of post-operative patients.

### ***Training Requirements***

While many pulmonologists are also certified as intensivists, separate training requirements exist for both certifications.

- *Critical Care Medicine* fellowships are generally 2 years, with at least 1 year of direct clinical care. The other year may be spent in research or related activities.

---

<sup>20</sup> Society of Critical Care Medicine. *Patient and Family Resources: History of Critical Care*. SCCM website. [http://www.sccm.org/patient\\_family\\_resources/history\\_critical\\_care/index.asp](http://www.sccm.org/patient_family_resources/history_critical_care/index.asp)

<sup>21</sup> Angus et al. (2000).

- *Pulmonary Disease* fellowships are also at least 2 years in duration. Pulmonologists must acquire clinical proficiency in many of the same areas as those certified in critical care. They also learn how to supervise pulmonary function tests and perform a number of other procedures specific to the respiratory system (e.g., bronchoscopy and pleural biopsy). However, the frequency and duration of caring for critically ill inpatients may be less than that for critical care fellowships.
- *Combined* pulmonary and critical care fellowships require that physicians meet the proficiency requirements of both specialty certifications. Fellowships must be at least 3 years in duration, with two of these years spent in primarily clinical activity.

The close relationship between the practice of pulmonary care and that of critical care medicine is reflected in fellowship training. This relationship may be because leaders in pulmonary medicine believe that “their survival and growth is vitally linked with critical care medicine.”<sup>22</sup> In recognition of this fact, many training programs in pulmonary medicine appended “critical care” to their name during the 1980's.

Because ICU patients are the most severely ill inpatients, they have mortality rates estimated to be between 12 and 17 percent.<sup>23</sup> Almost 500,000 people die in ICUs every year; 360,000 of these patients are not managed by intensivists.<sup>24</sup> Intensive care units have become an increasingly important part of U.S. inpatient care as less severely ill patients are cared for in the outpatient setting and inpatients are, on average, sicker than patients admitted a decade ago. ICUs are expected to become even more important as the elderly increase in number and account for a greater proportion of ICU admissions

### ***The Growing Elderly Population***

The COMPACCS study examined the supply of intensivists and pulmonologists that provide services to adults in the U.S., as well as the expected demand for those services between 1997 and 2030. In their analysis, more than half of all ICU days were found to be associated with care for patients older than 65 years of age. Some of the sickest patients—those with respiratory insufficiency, multiple organ failure, and sepsis—were most likely to be cared for by intensivists in the critical care setting.

---

<sup>22</sup> Tobin and Hines (1999).

<sup>23</sup> Al-Asadi L, Dellinger R, Deutch J, Nathan S. Clinical impact of closed versus open provider care in a medical intensive care unit. *American Journal of Respiratory & Crit Care Med.* 1996;153:A360.

<sup>24</sup> Young M, Birkmeyer J. Potential reduction in mortality rates using an intensivist model to manage intensive care units. *Eff Clin Pract.* 2000;3:284-289.

The most significant factor influencing the growth in demand for critical care services projected by the study is the aging of the population. Americans over the age of 65 consume the majority of ICU services and this group will grow both in total number and as a proportion of the population. If age-specific, per capita utilization of critical care services remains constant, COMPACCS estimated that in the absence of an increase in intensivist supply by 2020 there could be a 20 percent deficit in supply of intensivists.

### *Intensivist Staffing and Quality of Care*

Patient outcomes and the quality of care in the ICU are related to who delivers that care and how care is organized. The organization of the ICU follows three general models:<sup>25</sup>

1. *Open ICU*—an open ICU is one in which patients are admitted by an attending physician of record (such as a general internist, surgeon, or family practitioner) with intensivists available for consultation. All decisions are ultimately guided by the attending of record, even those that involve the intensivist.
2. *Intensivist co-management*—an open ICU, as above, in which patients receive *mandatory* consultation from an intensivist. While the patient is in the ICU, the primary attending of record is a “co-attending” physician that collaborates with the intensivist in the management of the critically ill patient.
3. *Closed ICU*—an ICU in which admitted patients are transferred to the care of an intensivist (or team of intensivists) assigned to the ICU on a full-time basis. In closed units, patients are admitted to the ICU only after the intensivist approves their admission.

A growing body of literature describes the economic and quality of care benefits of “closed” ICU staffing models.<sup>26, 27</sup> Despite this, intensivists currently treat only 37 percent of ICU patients.<sup>28</sup> Dedicated intensivists staff an even smaller proportion of ICUs. However, more hospitals appear to be moving towards intensivist-managed care of ICU patients in response to the evidence base as well as payer pressures.

Young and Birkmeyer estimated that 360,000 deaths occur every year in ICUs which are not managed by intensivists, and that intensivist staffing might save 54,000 lives annually.<sup>29</sup>

However, as a recent review of the evidence for the Agency for Healthcare Research and Quality

---

<sup>25</sup> Angus et al. (2000).

<sup>26</sup> Pronovost PJ, Angus DC, Dorman T, Robinson KA, Dremiszov TT, Young TL. Physician Staffing Patterns and Clinical Outcomes in Critically Ill Patients: A Systematic Review. *JAMA*. 2002;288:2151-2162.

<sup>27</sup> Al-Asadi L. et al. Clinical Impact of Closed Versus Open Provider Care in a Medical Intensive Care Unit. *American Journal of Respiratory & Crit Care Med*. 1996; 153:A360

<sup>28</sup> Kelley MA, Angus D, Chalfin DB, Edward D, Ingbar D, Johanson W, Medina J, Sessler CN, and Vender JS. The Critical Care Crisis in the United States: A Report from the Profession. *Chest*. 2004 125: 1514-1517

<sup>29</sup> Young and Birkmeyer (2000).

(AHRQ) suggested, “this analysis may underestimate the importance of intensivist-managed ICUs. In addition to mortality, other quality of care outcome measures that might be improved by intensivists include rates of ICU complications, inappropriate ICU utilization, patient suffering, appropriate end-of-life palliative care, and futile care.”<sup>30</sup>

The business community has recently responded to concerns over quality of care by creating the Leapfrog Group. Leapfrog attempts to leverage the purchasing power of Fortune 500 companies whose annual spending on health care exceeds \$45 billion. The consortium has chosen to promote three patient safety practices: the use of computerized physician order entry, the oversight of critical care physicians in the care of ICU patients (inpatient physician staffing or IPS), and the use of evidence-based hospital referral systems. The growing evidence base supporting intensivist management of critically ill patients, reinforced by major support from the Leapfrog Group, has led to increasing demand for critical care physicians in recent years.

Based upon Leapfrog estimates, the proportion of hospitals requiring that an intensivist is involved in the care of critically ill patients has more than doubled in the last 5 years. While previous estimates were that only 10 percent of ICUs met IPS standards, Leapfrog Regional Roll-Out reports indicate that 22 percent of 605 study hospitals meet standards at the present time. This estimate indicates a significant movement towards greater utilization of intensivist services. The change in ICU organization has been dramatic; many hospitals which publicly resisted the Leapfrog IPS recommendation have subsequently moved to intensivist-managed ICUs.<sup>31</sup>

Pronovost and colleagues have estimated that over \$5 billion and 53,000 lives could be saved annually if ICU physician staffing changes were implemented in non-rural U.S. hospitals.<sup>32</sup> These estimates are consistent with earlier studies examining the impact of ICU staffing changes on patient mortality.<sup>33</sup> The combined appeal of improved quality along with the potential for significant cost savings makes the movement towards closed ICU staffing likely to continue, thereby increasing demand for intensivist services in the foreseeable future. However, as the same AHRQ review noted, increasing demand for specialists in critical care medicine is likely to go unmet until a greater number of physicians are trained in this specialty.

---

<sup>30</sup> Rothschild JM. “Closed” Intensive Care Units and Other Models of Care for Critically Ill Patients. AHRQ. 1999. p. 413. Chapter 38. In “Making Health Care Safer: A Critical Analysis of Patient Safety Practices” AHRQ Evidence Report/Technology Assessment Number 43.

<sup>31</sup> Personal communication to the authors from Peter Pronovost.

<sup>32</sup> Pronovost PJ, Waters H, and Dorman T. Impact of Critical Care Physician Workforce for Intensive Care Unit Physician Staffing. *Curr Opin in Crit Care*. 2001; 7(6):456-9.

<sup>33</sup> Young M and Birkmeyer J. Potential Reduction in Mortality Rates Using an Intensivist Model to Manage Intensive Care Units. *Eff Clin Pract*. 2000; 3:284-89.

The COMPACCS analysis also projected that the anticipated shortage of intensivists becomes much more severe if a greater proportion of critical care is delivered by intensivists—as is likely to occur given current trends. The study suggests that if intensivists were to care for two-thirds of the ICU patients in the U.S., available supply would meet only half of the current demand. As is described in subsequent sections, our analysis supports the findings that demand for intensivists will continue to be greater than available supply in the next three decades.

## CHAPTER 2: SUPPLY

Historically, there has been greater consensus on physician supply projections than for demand projections. Projecting the future supply of active physicians is relatively straightforward, and is accomplished by adding annual estimates of newly trained physicians to current supply, and subtracting estimates of the number of physicians retiring. While *physician supply* refers to the number of active physicians, *effective supply* refers to the amount of services provided expressed as full-time equivalent (FTE) physicians. Projecting effective physician supply is more challenging due to the incomplete information on physician activity and behavior. The personal choices made by physicians determine the number of hours spent providing care, medical specialties chosen, productivity, work location, and retirement behavior.

Physician productivity is influenced by more than physician preferences, but also depends on external factors such as the activity of other health workers. Changes in the use of non-physician clinicians and other health professionals, technological advances, epidemiologic trends, amount of time spent with patients per visit, and changes in the health care operating environment all affect both the average number and type of patients seen per physician. For instance, the average number of patient visits declined during the 1990's, due mainly to a decline in inpatient activity, with office visits per physician remaining relatively constant.

### **The Current Supply of Physicians Trained in Critical Care**

In 2000, the base year for this analysis, 10,360 physicians reported their primary medical specialty as critical care or pulmonology as recorded in the AMA Masterfile. About 65 percent of those physicians report pulmonary medicine as their primary specialty. Among those whose practice includes critical care, 19 percent are dual trained in critical care and pulmonology (CCP), 10 percent are internists trained in critical care medicine (CCM) alone, and the remaining 6 percent are divided evenly between critical care anesthesiologists (CCA) and critical care surgeons (CCS).<sup>34</sup> For the purposes of this study, physicians are considered “intensivists” when they have received primary training in medicine, surgery, or anesthesiology, as well as 2-3 years

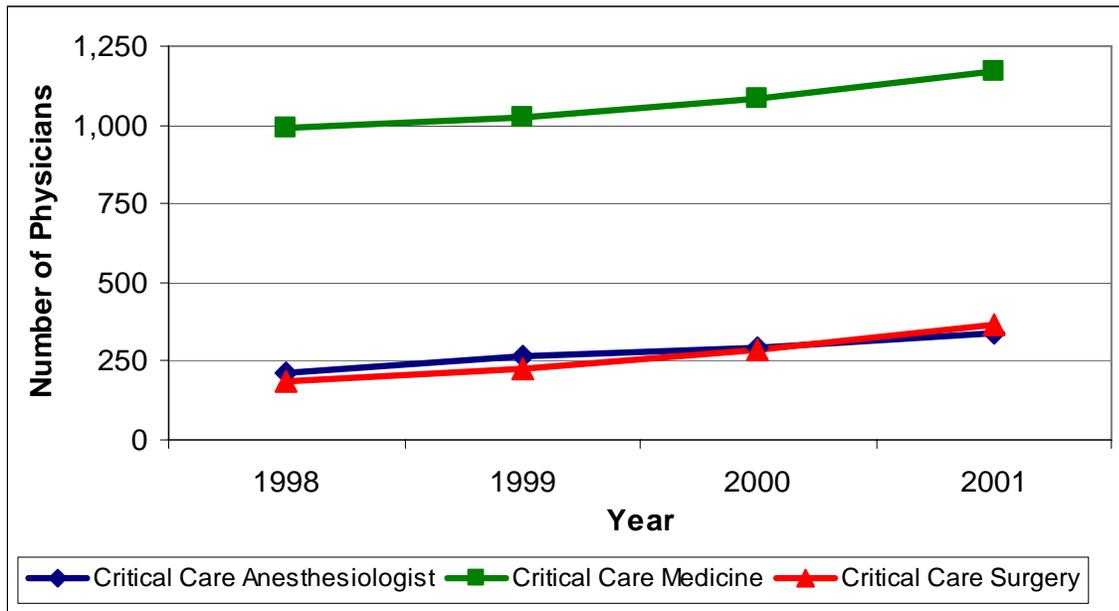
---

<sup>34</sup> Results from the COMPACCS survey indicate that in 1997 an estimated 10,244 physicians in the United States practiced as pulmonary and/or critical care specialists. Less than one tenth (9.3 percent) received their primary training in anesthesiology or surgery, and just over one half (53 percent) were certified in critical care.

of training in critical care medicine.<sup>35</sup> Exhibits 1 and 2 show the number of active physicians, by specialty, between 1998 and 2001.<sup>36</sup>

As is evident from Exhibit 2, the number of physicians self-designated as practicing “pulmonary/critical care medicine” nearly doubled in the 3-year period from 1998 to 2001.<sup>37</sup> This may reflect a shift in training programs from pulmonary medicine alone to combined pulmonary and critical care programs as well as a change in self-designation choices. However, self-designated specialty does not reveal how physicians are actually spending their clinical time. That is, whether a physician has completed a program in “pulmonary/critical care medicine” does not guarantee that he or she will spend any clinical time practicing as an intensivist.

**Exhibit 1. Number of Intensivists by Primary, Self-Designated Specialty**



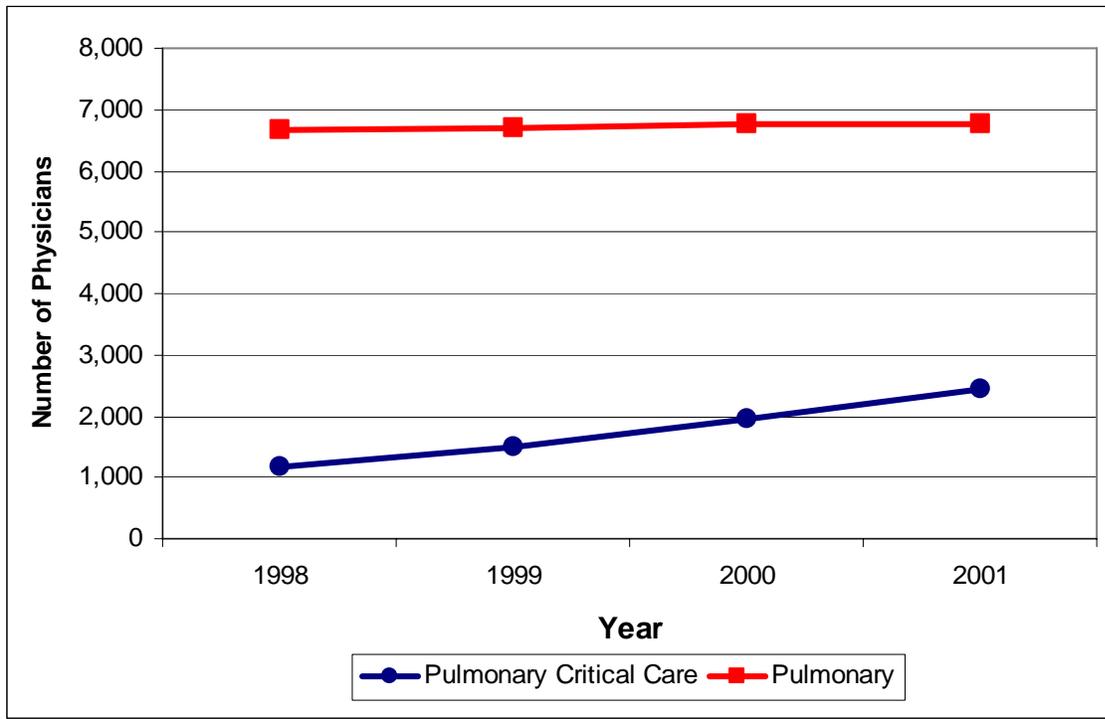
---

<sup>35</sup> Rothschild (1999, p. 413).

<sup>36</sup> Pediatric intensivists are excluded from this study; 688 new certifications in pediatric critical care were granted in the 1990’s, more than any other pediatric subspecialty except: neonatology, infectious diseases, and emergency medicine.

<sup>37</sup> AMA’s *Physician Characteristics and Distribution in the U.S.*, Editions 2000-2001, 2001-2002, 2002-2003, 2003-2004.

**Exhibit 2. Number of Self-Designated Pulmonologists and Critical Care Pulmonologists**



***Clinical Activity***

On average, 94 percent of pulmonologists and critical care physicians were engaged primarily in direct patient care (as opposed to administrative work, research, teaching, or other work) in 2000. CCP physicians were the most likely to be engaged in patient care (98 percent), versus 88 percent of those who considered themselves pulmonary specialists alone. Respondents to the 1997 COMPACCS survey worked an average of 61 hours per week and spent about a quarter (26 percent) of their time in the ICU. This proportion was less for those with pulmonary training (23 percent) and twice as high for those with training in critical care only (46 percent).

***Gender***

While women are gaining representation in critical care and pulmonary specialties, males still comprise 86 percent of pulmonologists and critical care physicians. The highest proportion of females were CCPs (23 percent) and CCAs (19 percent). Men comprised a higher proportion of CCPs (90 percent) and CCMs (83 percent). These differences may be related to the combined

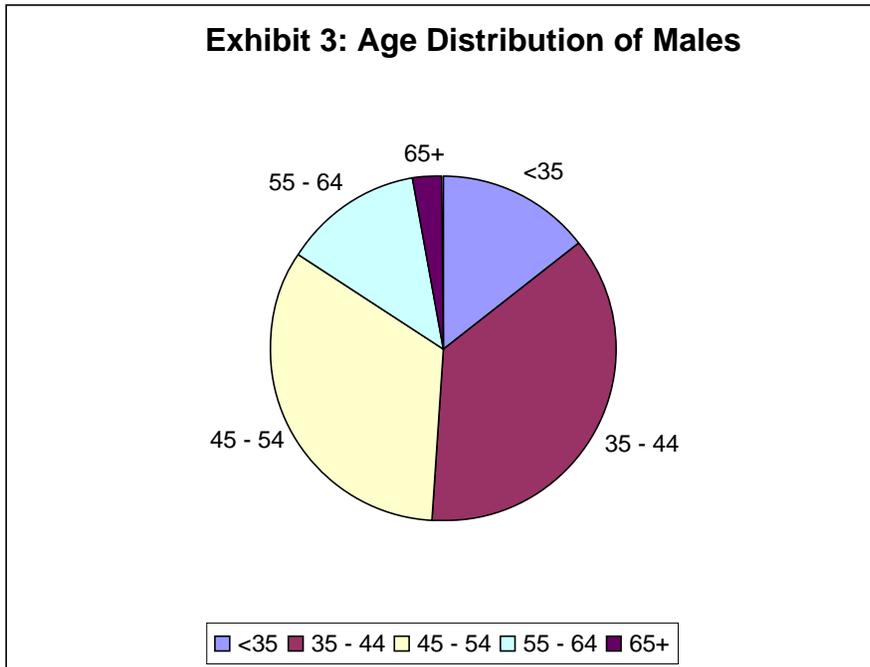
trends of increased female participation in medicine and the change in pulmonary training programs to include critical care.

During the past three decades, the proportion of graduates from U.S. medical schools who are female has risen from 10 percent to about 50 percent. Because work and retirement patterns differ systematically by gender, the increasing proportion of physicians who are female has profound implications for the overall supply of physician services. Female physicians tend to work approximately 15 percent less time in patient care than do their male counterparts after controlling for age and specialty. Female physicians are more likely than their male counterparts to choose non-surgical specialties, spend fewer hours providing patient care, are less likely to work in rural areas, and tend to retire earlier. The COMPACCS data indicate that female physicians practicing as intensivists or pulmonologists worked an average of 300 hours less per year than their male counterparts.

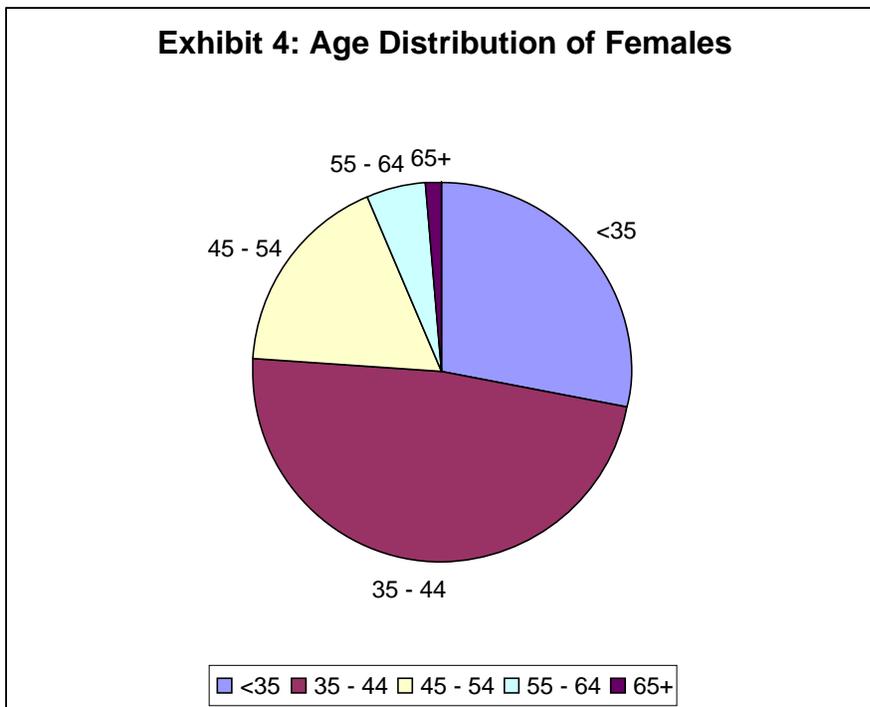
### *Age*

The majority of critical care and pulmonary physicians are between 35 and 44 years of age, reflecting the relatively new status of both specialties. Self-designated pulmonologists tend to be older than physicians practicing exclusively critical care. Approximately 64 percent of pulmonologists are over the age of 45 as compared to between 4 percent and 31 percent of the physicians for each of the other critical care specialties examined. An older cohort of pulmonologists may be accompanied by a greater likelihood of their retirement in the near future as compared to other critical care physicians. Female physicians were, on average, 2 years younger than their male counterparts, reflecting the growing trend toward feminization of the medical workforce. Approximately 46 percent of male physicians were 45 years or older versus 23 percent of females (Exhibits 3 and 4). Age is significant because it is highly correlated with retirement decisions and plays a significant role in hours worked. Physicians over the age of 65 tend to work fewer hours than younger physicians.

**Exhibits 3 and 4. Age Distribution of Physicians in Pulmonary and Critical Care Specialties, by Gender**



Source: COMPACCS data.



Source: COMPACCS data.

## New Entrants to the Critical Care Workforce

Physicians in the United States enter the workforce after completing the requirements for licensure in individual States. These requirements differ by location, but include the completion of a medical degree (a Doctorate of Medicine [MD] or Doctorate of Osteopathy [DO]) as well as the completion of post-graduate medical education (GME) training in an internship and residency program that ranges from 1 to 8 years. Schools of allopathic medicine graduate approximately 16,000 MDs each year. This number has been relatively stable since 1980. Schools of osteopathic medicine graduated approximately 2,600 DOs in 2001 and this number has been steadily increasing in recent years.

Almost 30,000 physicians completed their GME training and became eligible to practice a chosen specialty in 2004.<sup>38</sup> Physicians in non-surgical subspecialties (i.e., outside of family practice, general internal medicine, and general pediatrics) must complete an initial residency period before entering subspecialty training (fellowships). In 2004, 22,444 physicians were scheduled to start GME programs for the first time, the highest number on record.

Almost one-fourth of physicians in GME training programs are International Medical Graduates (IMG) who received their medical degrees abroad. Many of the 5,000 IMGs who enter U.S. GME programs each year do so under the temporary work (H) or training (J) visa programs. IMGs may remain in the United States after completing training if they are citizens or permanent residents (U.S. IMG) who graduated from medical schools in other countries. In addition, foreign IMGs can participate in the J-1 Visa Waiver Program which waives the requirements that foreign physicians return to their country for a minimum of 2 years before practicing in the U.S. This waiver is granted in exchange for a commitment to deliver primary care services to underserved communities.

The training of physicians in critical care medicine may take 10 or more years of graduate training, including 4 years of medical school, 3 or more years of residency, and 2 or more years of fellowship training in critical care (medicine, anesthesia, or surgery) or pulmonary/critical care. In 2003, 86 physicians completed training in critical care (internal medicine), 57 completed pulmonary (internal medicine), and 359 completed combined pulmonary-critical care programs.<sup>39</sup> In 1996, the COMPACCS group reported 354 graduates from pulmonary and pulmonary/critical care medicine training programs; 110 from critical care internal medicine programs; and 130 graduates from critical care programs in departments of anesthesiology and

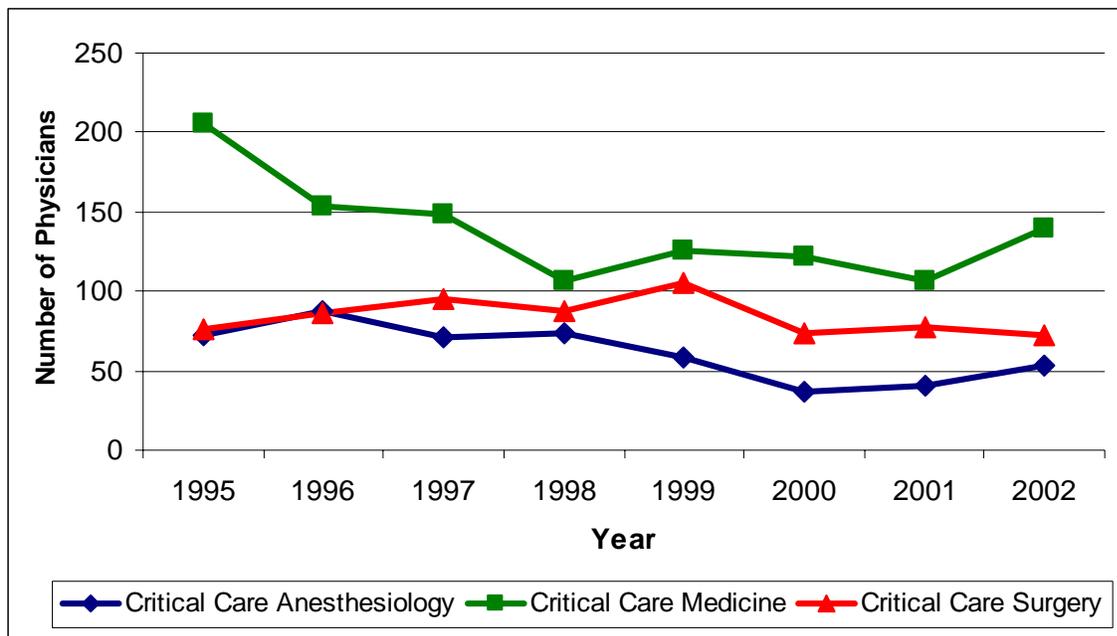
---

<sup>38</sup> Brotherton SE, Rockey PH, and Etzel SI. US Graduate Medical Education, 2003-2004. *JAMA*. 2004; 292:1032-1037.

<sup>39</sup> Appendix: Graduate Medical Education. *JAMA* 2004;292:1089—1097.

surgery (63 and 67, respectively). In the year 2002, there were 1,374 fellows in all critical care and pulmonary training programs. A majority (72 percent) of those residents were in combined pulmonary/critical care. Even if all physicians with some critical care training were to deliver critical care services, less than one percent of U.S. medical school graduates are expected to choose to practice as intensivists. Moreover, the number of filled fellowship positions in CCA, CCM, and CCS has fallen since 1995 (Exhibits 5 & 6).<sup>40</sup> In CCM alone, the number of current fellows has dropped by over 25 percent. While the number of physicians graduating has grown slightly over time, the number of newly trained critical care medicine fellows has dropped from 110 (1998) to 86 (2004) per year.

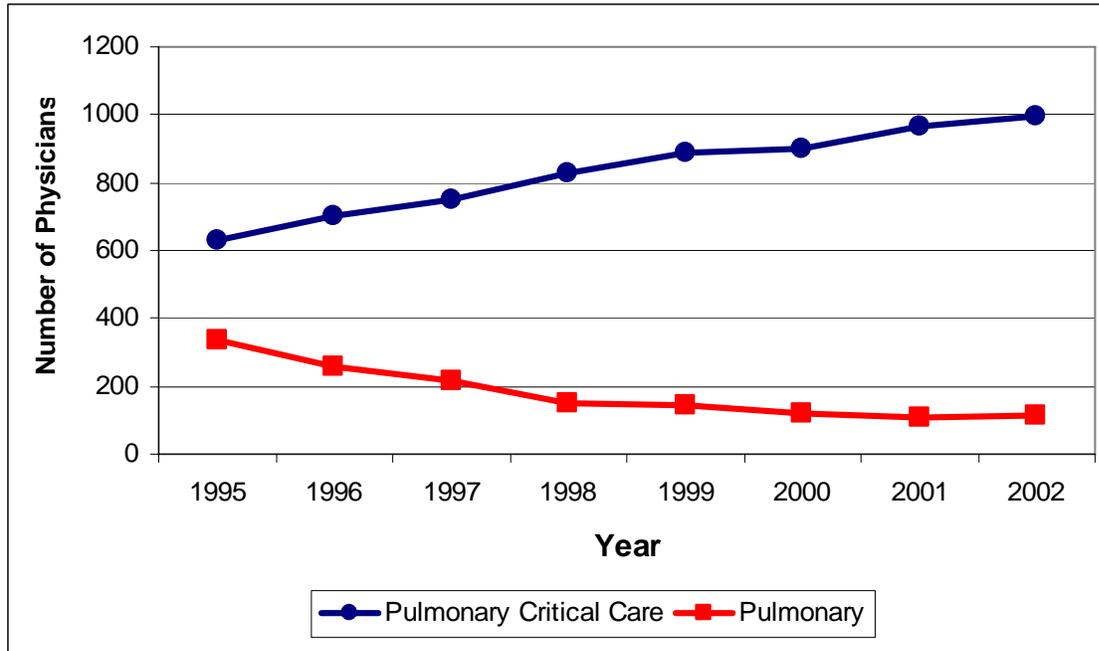
**Exhibit 5. Filled Fellowship Slots in Critical Care**



---

<sup>40</sup> *JAMA* medical education issues (Appendix II—Graduate Medical Education) 1996-2003.

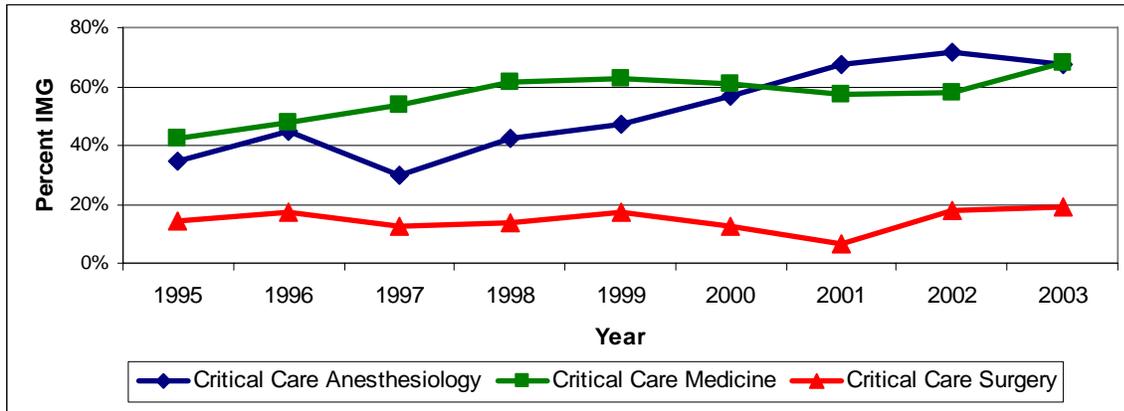
**Exhibit 6. Trainees in Pulmonary and Pulmonary/Critical Care Fellowships**



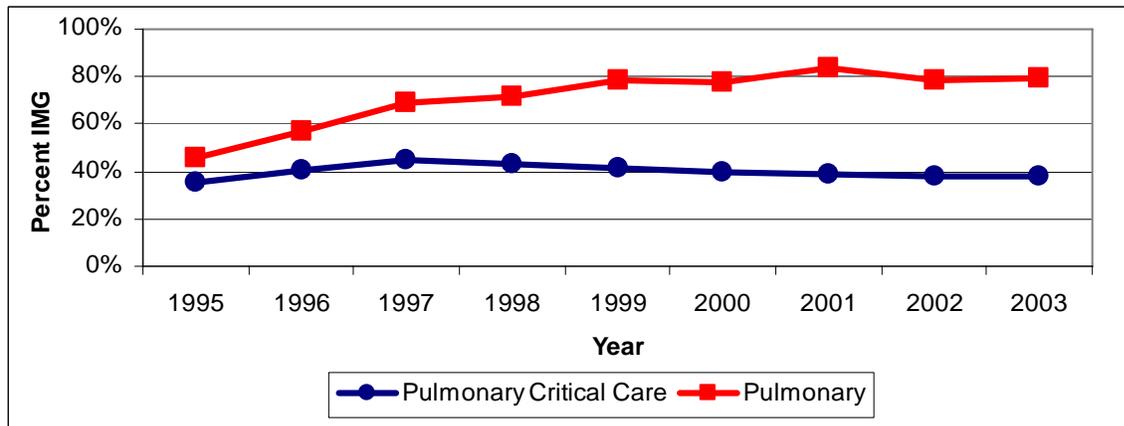
Other factors may also affect the future effective supply of intensivists, including the proportion of IMGs who fill fellowship positions. In 2003, IMGs accounted for 67.4 percent of fellows in critical care (anesthesia); 18.9 percent of critical care (surgery) fellows; and 67.8 percent of those in critical care (internal medicine) (Exhibit 7). By 2003, 79.4 percent of pulmonary (internal medicine) fellows and 38.1 percent of those in pulmonary/critical care programs were also IMGs (Exhibit 8). The country of medical school training is important because, although almost half of IMGs are actually U.S. citizens or permanent residents, physicians who train on J-1 or other visitor visas may be required to return to their country of citizenship unless they are granted a visa waiver. Relatively few physicians practicing outside of primary care qualify for such waivers.

Fewer residents are entering pulmonary fellowships alone (without critical care) with more receiving at least some part of their training in critical care. For this reason, it is more revealing to examine the number of new board certifications in critical care as displayed in Exhibit 9. The number of new board certified critical care specialists declined by almost half, from 1,135 to 660 new diplomats. This number excludes physicians trained in pulmonary medicine alone.

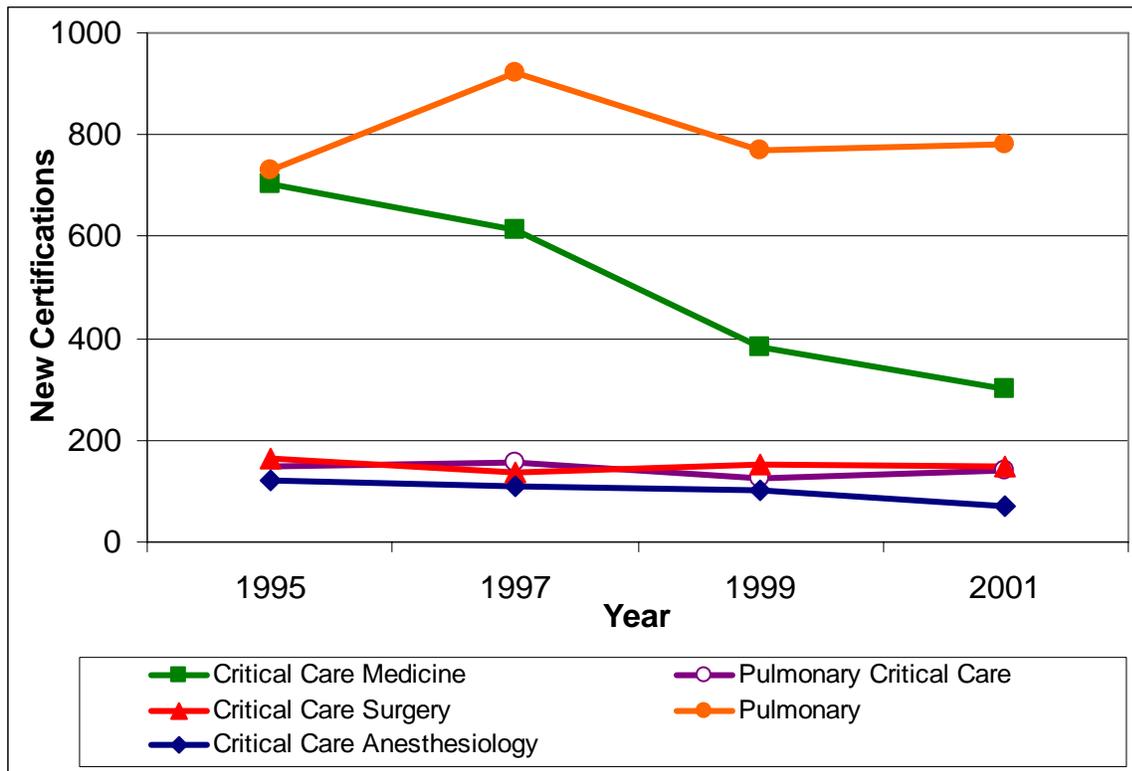
**Exhibit 7. Percent of Critical Care Fellows who are IMGs**



**Exhibit 8. Percent of Fellows in Pulmonary and Combined Pulmonary—Critical Care Training Programs who are IMGs**



**Exhibit 9. New Pulmonary and Critical Care Certifications, 1991-2001**



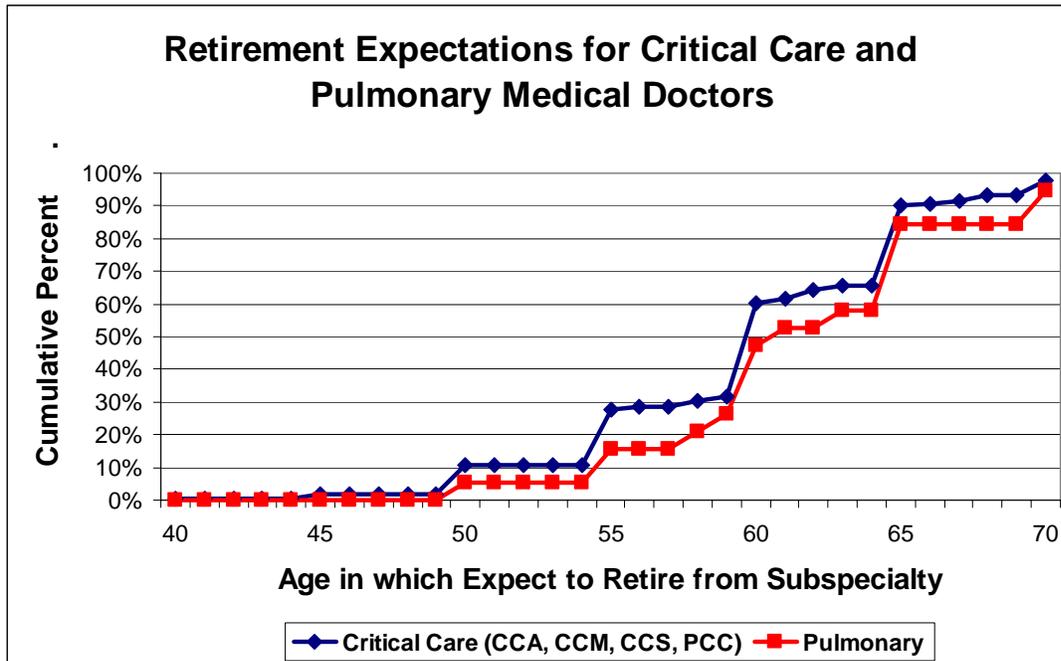
### Retirement of Critical Care Physicians

Physicians leave the workforce through retirement, mortality, disability, and career change. An accurate estimate of separation rates is crucial for projecting physician supply. Historically, estimates of physician retirement rates have come from analysis of the AMA Masterfile data.

The high stress of working in the ICU may contribute to earlier retirement by intensivists. A study measuring the prevalence of burnout in critical care examined the levels of exhaustion in a sample of members from the internal medicine section of the Society for Critical Care Medicine, over half of whom worked more than 50 percent of their time on critical care.<sup>41</sup> The authors report that a third of the respondents scored in the high range for emotional exhaustion and a fifth scored in the high range for depersonalization. In addition, over half scored in the low range for personal achievement. Original COMPACCS survey data reflects the tendency of intensivists to retire at earlier ages than pulmonologists (Exhibit 10). Over one half of intensivists expect to retire by the age of 60 and almost a third expects to retire by the age of 55.

<sup>41</sup> Guntupalli KK and Fromm RE. Burnout in the internist-intensivist. *Intensive Care Med.* 1996; 22:625-630.

**Exhibit 10. Retirement Expectations of Pulmonary & Critical Care Physicians**

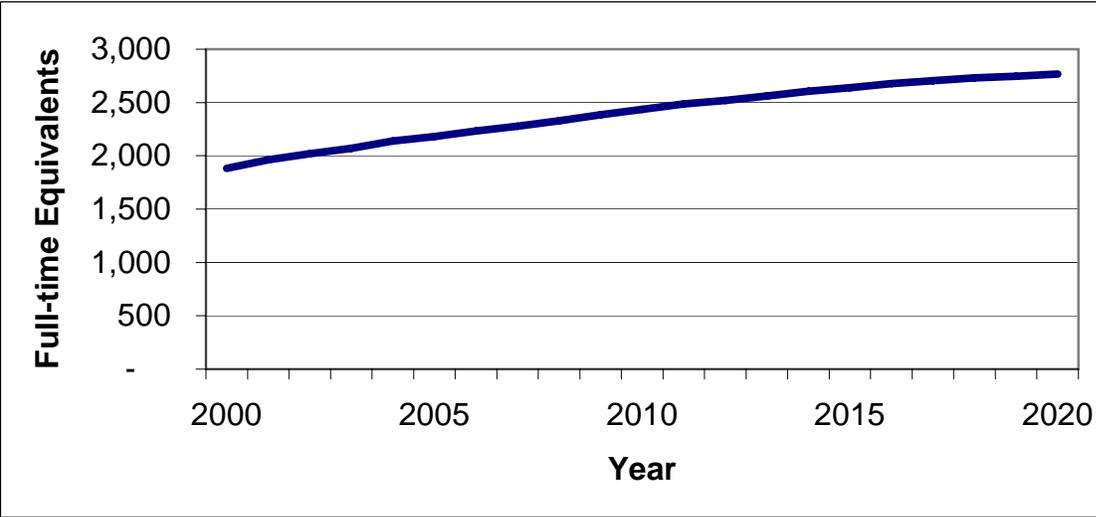


**Physician Supply Model Projections**

All of the factors described above impact the “effective” supply of physicians practicing as intensivists. Part-time intensivist practice, whether associated with age, gender, or primary specialty training area, effectively reduces the number of full-time equivalent (FTE) physicians available. For example, adding 2,000 physicians that practice as intensivists 50 percent of the time to a base of 2,000 full-time intensivists would deliver the amount of services associated with 3,000 (not 4,000) full-time intensivists.

Exhibit 11 incorporates the various elements of supply described above. Current projections of intensivist supply indicate that if current supply patterns continue, the effective supply will likely increase by approximately 48 percent between 2000 and 2020, from approximately 1,880 to 2,770, at which time the supply becomes stable. Projections beyond 2020 are unlikely to be useful given their uncertainty. Within the next 20 years, it is also likely that a plurality of current intensivists will retire as a large portion of the current supply is now between the ages of 35 and 44. Despite an overall increase in the number of graduates with critical care training in recent years, decreasing hours worked and steadily rising numbers of retirements will lead to an essentially flat number of critical care providers by 2020.

**Exhibit 11. Projected “Effective” Supply of Adult Intensivists**



## CHAPTER 3: DEMAND

The Physician Demand Model uses current patterns of health care utilization and delivery of care to project future demand for intensivist services under a baseline scenario that assumes that such patterns will continue into the future. The baseline projections are then adjusted to account for other trends—in particular, the trends towards greater use of intensivists—to estimate the total level of intensivist services that the Nation will likely be willing and able to purchase at prevailing prices in the absence of intensivist supply constraints. This adjustment to the baseline projections is in response to the growing proportion of ICU patients that are cared for by physicians trained in critical care.

Projections of demand are based on current utilization patterns of physician services and expected trends in U.S. demographics, insurance coverage, and patterns of care delivery. These utilization patterns are expressed as physician-to-population ratios for each specialty and population segment defined by age, sex, metropolitan/non-metropolitan location, and insurance type. The baseline ratios are established using 2000 data. Thus, the three major components of the model are:

- Population projections by age,<sup>42</sup> sex, and metropolitan/non-metropolitan location;
- Projected insurance distribution by insurance type, age, sex, metropolitan/non-metropolitan location; and
- Detailed physician-to-population ratios.

These methods are similar to those used by the COMPACCS investigators. All of the calculations can be used to express demand as physician-per-population ratios that reflect current utilization patterns and current patterns of care.

In 2000, for the U.S. population as a whole, there were approximately 254 active physicians (MDs and DOs) engaged primarily in patient care per 100,000 population.<sup>43</sup> The aggregate estimates ranged from a low of 151 for the population age 0 to 17, to a high of 785 for the population age 75 and above. The ratios vary substantially by medical specialty and by geographic area. If the current utilization patterns remain stable, the overall aging of the population will contribute to faster growth, in percentage terms, for specialist services relative to the growth in demand for primary care services.

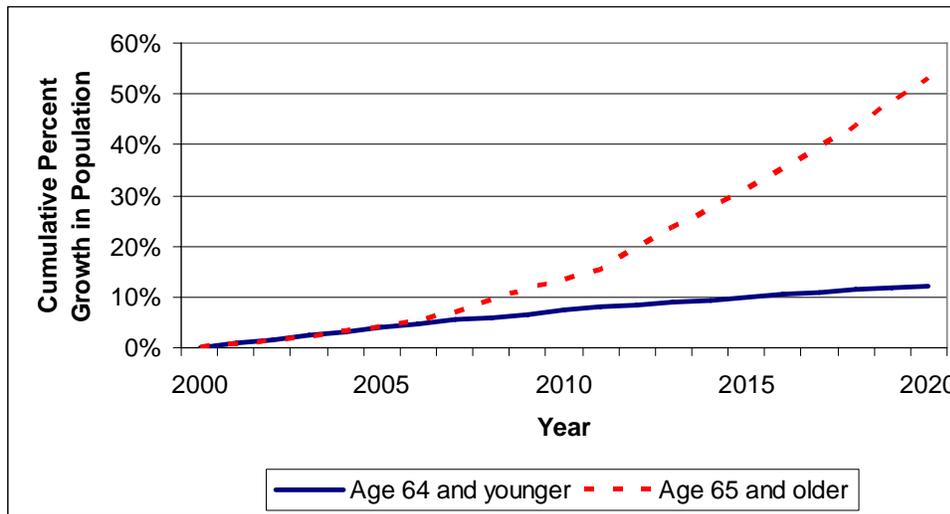
---

<sup>42</sup> The eight age categories are ages 0-4, 5-17, 18-24, 25-44, 45-64, 65-74, 75-84, and 85 and older.

<sup>43</sup> As with the physician supply estimate, this count uses American Medical Association and American Osteopathic Association Masterfile data on physicians' activity status for physicians younger than age 75.

The U.S. Census Bureau projects a rapid increase in the elderly population beginning in 2010 when the leading edge of the baby boom generation approaches age 65 (Exhibit 12). Between 2000 and 2020, the population under age 65 is expected to grow by about 10 percent, while the population age 65 and older is projected to grow by approximately 50 percent.

**Exhibit 12. U.S. Population Growth: 2000 to 2020**



Source: Analysis of Bureau of Census population projections

**Current Utilization of Critical Care Services**

Critical care is generally delivered in the inpatient setting in an ICU, although it is delivered in emergency situations throughout the hospital. ICUs may be further separated based on the type of patients treated (e.g., medical, surgical, burn units, etc.) and hospitals may have more than one such unit depending upon size, location, staffing, and other factors.

On average, patients admitted to the ICU are sicker than other patients. The overall mortality rate in ICUs (12 percent to 17 percent)<sup>44</sup> is much greater than the overall hospital average (about 1.5 percent). According to data from the American Hospital Association (AHA) Annual Survey, there were a total of 59,400 ICU beds within approximately 3,200 hospitals in 2000. The average number of ICU beds for all acute hospitals, given that the facility has an ICU, is about 18.5 beds. Some hospitals, though, have large and numerous ICUs with over 300 beds.

Medical and surgical intensive care units, as defined by the AHA, are, “staffed with specially trained nursing personnel and contain monitoring and specialized support equipment for patients who, because of shock, trauma, or other life-threatening conditions, require intensified,

---

<sup>44</sup> Al-Asadi et al. (1996).

comprehensive observation and care.” ICUs account for more than 10 percent of all hospital beds and over 4.4 million individual patient admissions.<sup>45</sup>

However, the exact number of patient days (for all payers) in intensive care units is difficult to calculate accurately because these numbers are not reported on any single, audited, mandatory database. As extracted from Medicare’s 2002 Healthcare Cost Report Information System file, there are an estimated 18 million days of ICU care every year, with slightly under 15 million of these days provided in medical and surgical ICUs, approximately 3 million days provided in coronary care units, and another 300,000 days provided in burn ICUs.

### Physician Demand Model Projections

Critical care ICD-9 diagnosis codes, collected from the AHRQ 2001 National Inpatient Sample (NIS) of the Hospital Cost and Utilization Project (HCUP), were used to study patient utilization of critical care services. Based on this analysis we estimated the number of critical care doctors per capita by age group (Exhibit 13). As the elderly constitute a larger proportion of the U.S. population, this trend will substantially increase the demand for critical care services.

#### Exhibit 13. Intensivist Utilization by Age Group, 2000

Age Category	Critical Care Physicians /100,000 Pop.
18 to 24	0.13
25 to 44	0.30
44 to 64	1.48
64 to 74	4.94
75 to 84	7.66
84+	9.44

These ratios are based upon the organization and delivery of critical care services in 2000-2001. One major determinant affecting the demand for physicians trained in critical care is the way in which such care is delivered and who delivers this care. Using the above ratios, the expected demand for intensivists given current (2000) utilization patterns is shown in Exhibit 14. This projection suggests that if demand grows only as a result of the growth and aging of the population, demand for intensivists will increase from about 1,880 in 2000 to 2,600 in 2020 (an increase of about 38 percent). This estimate of demand is based upon historical utilization patterns of intensivist services—that is, less than one-third of patients in ICUs actually receive

---

<sup>45</sup> Rothschild (1999, p. 414).

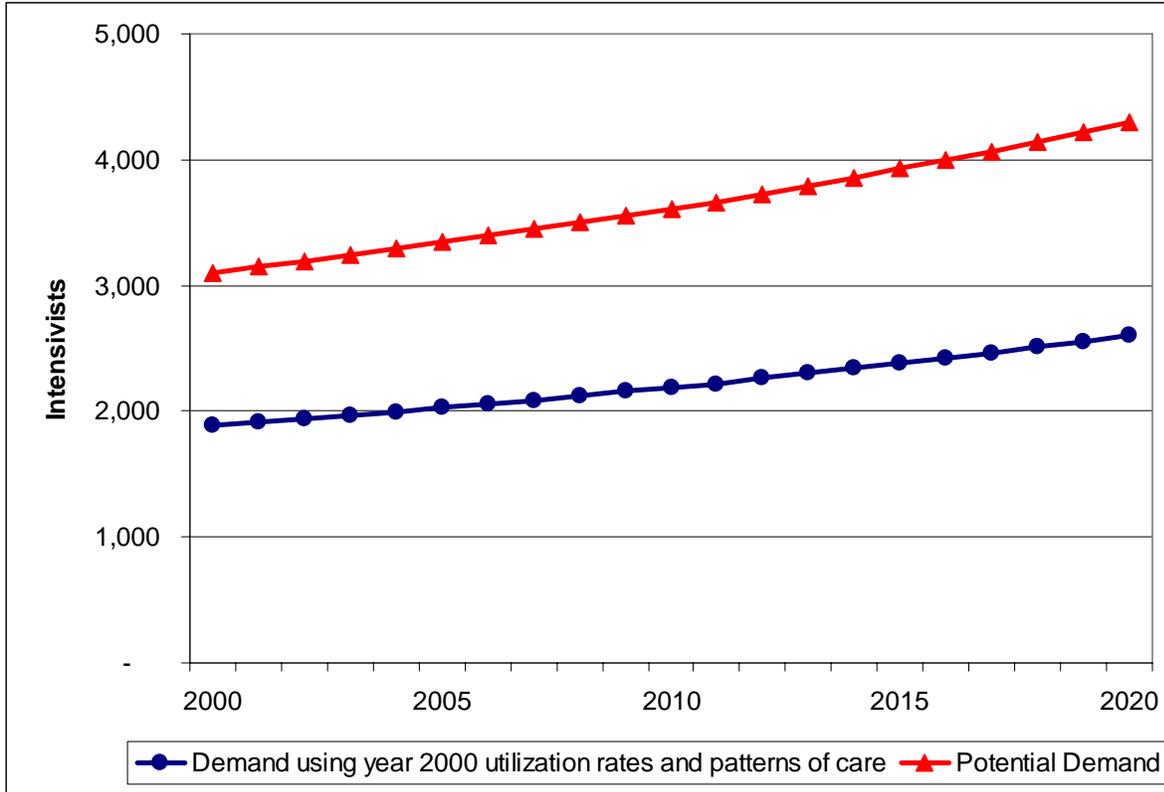
care from a specialist in critical care—and does not account for the growth in intensivist-directed critical care.

A simple way to estimate the changes in demand associated with increased use of intensivists is to calculate how many full-time equivalent intensivists are required to deliver care to critically ill patients if every patient were cared for by specialists in critical care. The COMPACCS study found that critically ill patients require, on average, 45 minutes of intensivist time, per patient day in the ICU. Because patients use approximately 18 million ICU days annually, *if only two-thirds of patients were treated directly by an intensivist*, 3,100 FTE intensivists would have been required to treat the number of ICU patients hospitalized in the year 2000—65 percent more than were available in the U.S. at that time. This estimate assumes that pulmonologists will continue to provide their current share of critical care services.<sup>46</sup> Under this scenario of “optimal utilization,” approximately 4,300 FTE intensivists would be required by 2020, representing an additional 129 percent above the supply available in 2000. If every patient were seen by an intensivist, the shortfall would be even greater.

---

<sup>46</sup> Angus et al. (2000), op. cit., state that pulmonologists provide about 53 percent, and intensivists 47 percent of all ICU hours. They report critical care and pulmonary specialists working 61 hours per week for 48 weeks (2,933 hours per year), with non-pulmonary internal medicine-based intensivists spending 46.2 percent of their total clinical time, or 1,353 hours per year in ICUs. Adjusting 18 million annual ICU days by 0.75 hours of intensivist and pulmonologist time per ICU day leaves 13.5 million ICU days per year; further adjusting ICU days by the fraction of patient care days CCMs provide (46.9 percent), and applying the hours worked per year by CCMs in ICUs yields approximately 4,685 total intensivists in demand in base year 2000. Two-thirds of this number equals 3,100 intensivists required in 2000. (Rounding accounts for slight discrepancies in calculations.)

**Exhibit 14. Projected Demand for Intensivists**



As is discussed in the following section, the current supply of intensivists is inadequate to care for critically ill patients and this shortage is likely to worsen given the growing demand for ICU care as well as the relatively slow growth in the supply of intensivists.

## CHAPTER 4: COMPARING ESTIMATES OF SUPPLY AND DEMAND

Considerable differences exist between these projections and COMPACCS' projections of the supply of and demand for intensivists—in part because the current projections model only a subset of the physicians included in the COMPACCS study consistent with a stricter definition of intensivists. The COMPACCS study used survey data from physicians trained in pulmonology, critical care, or both specialties to determine the number of physicians practicing in an ICU and the average hours per week providing critical care services. Our analysis relies on the AMA Masterfile to estimate the current intensivist supply, and the AMA data does not allow us to determine which pulmonologists provide critical care in an ICU. Consequently, the PSM and PDM projections reported here focus on self-designated critical care physicians (with the assumption that all critical care physicians who are active in patient care are providing some services in an ICU).

COMPACCS projections included pulmonologists that care for ICU patients; these physicians tend to be older and are likely to retire from the critical care workforce sooner than their purely intensivist counterparts, thereby projecting a more severe shortage of intensivists. However, the “effective” supply may be dampened by a decrease in hours worked as has been observed in the medical profession.

### Comparing the PSM/PDM and the COMPACCS Projections

The COMPACCS study starts with the assumption that in the base year (1997) intensivist supply and demand are in equilibrium. This assumption is commonly used in demand/utilization-based forecasting models, but the implication is that the projections are extrapolating year 1997 patterns of care to the future population. Growth in demand is determined primarily by a growing and aging population. Thus, the COMPACCS demand projections show relatively little growth until approximately 2010 at which time the size of the elderly population in the U.S. will start to increase dramatically. The COMPACCS supply estimates are relatively stable during the 30-year projection period.

Although the COMPACCS report was published in *JAMA* in 2000, data used in the study were from 1997.<sup>47</sup> Since 1997, the percentage of residents choosing to specialize began to change dramatically. These changes, along with the recent trends in hospital care using more intensivists, illustrate the need for frequent and regular examination of workforce projections.

---

<sup>47</sup> Pingleton SK. Committee on Manpower of Pulmonary and Critical Care Societies. *CHEST*. 2001; 120(2): 327-8.

## Why Critical Care Demand Estimates are Unique

The PDM relies on the implicit assumption that physician supply is in balance with physician demand in the base year. Inefficiencies in the market resulting from any current oversupply or undersupply of physicians will be extrapolated into the future. Consequently, projections of the future adequacy of supply are relative to recent (i.e., year 2000) conditions and may not account for current unmet demand for services. In addition, estimates for new or evolving specialties may not fully capture trends in utilization rates, thereby underestimating demand for services.

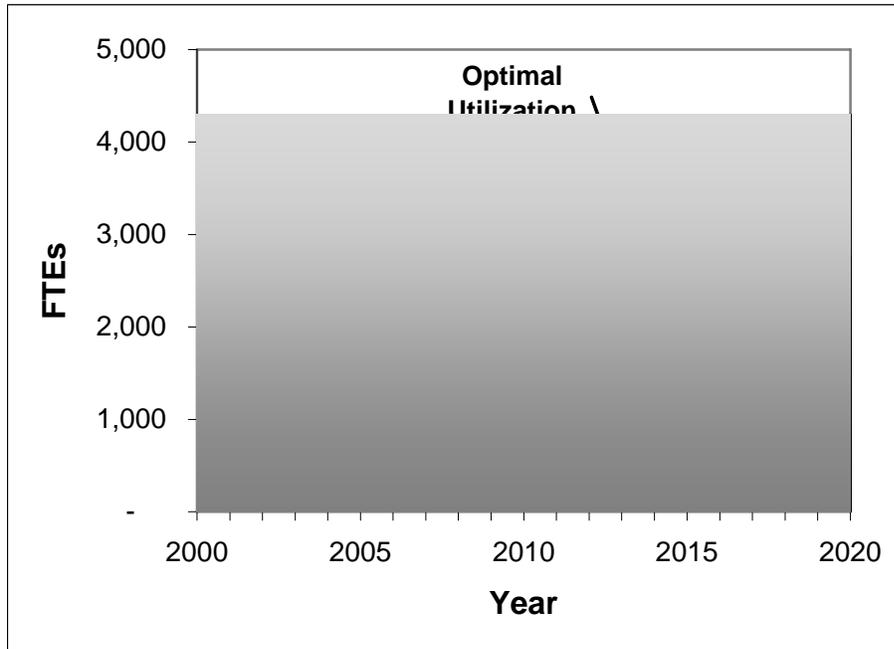
Critical care is a relatively new specialty and recent growth in intensivist utilization has dramatically outpaced the growth in demand related to a growing and aging population. If historical utilization rates are extrapolated into the future, then aggregate demand for intensivists does not appear to exceed available supply. However, recent trends suggest that a growing proportion of critically ill patients will receive intensivist services, so that current utilization and service delivery patterns underestimate the likely current and future demand.

This weakness is especially true in critical care because of the changing nature of delivery and organization of services in the ICU. It becomes particularly important in analysis of the critical care workforce because of the evidence regarding the *current inadequacy* of ICU staffing. The assumption that supply and demand are in equilibrium at baseline cannot be made for critical care practice because intensivists currently care for only one-third of critically ill patients. Given the level of evidence supporting intensivist-directed care for ICU patients, two-thirds of patients may be receiving less than optimal care. Even if only half of patients admitted to intensive care units were cared for by full-time intensivists, there would be a shortage of critical care physicians in the range of 25 percent of current supply (Exhibit 15). This shortage is despite expected modest increases in efficiency of care (i.e., decreased length of stay) for patients cared for by intensivists.<sup>48</sup>

---

<sup>48</sup> Pronovost et al. (2002).

**Exhibit 15. Projected Supply vs. Optimal Utilization for Intensivists, 2000-2020**



It should be noted that these projections, which assume a current shortage of intensivists, also differ from COMPACCS projections. The absolute magnitude of shortages remain below the level predicted by COMPACCS because Angus and colleagues utilized survey data to provide estimates of intensivists which incorporated time spent by physicians trained in critical care, pulmonology, or both. This analysis was based upon a stricter definition of intensivist and included only physicians trained in critical care. As a result, the COMPACCS study included a greater number of intensivists at baseline. The larger shortage projected in that study is, in part, due to the fact that pulmonologists tend to be older than their purely intensivist counterparts; a larger proportion of physicians practicing at baseline in the COMPACCS study were expected to retire earlier than expected in our projections.

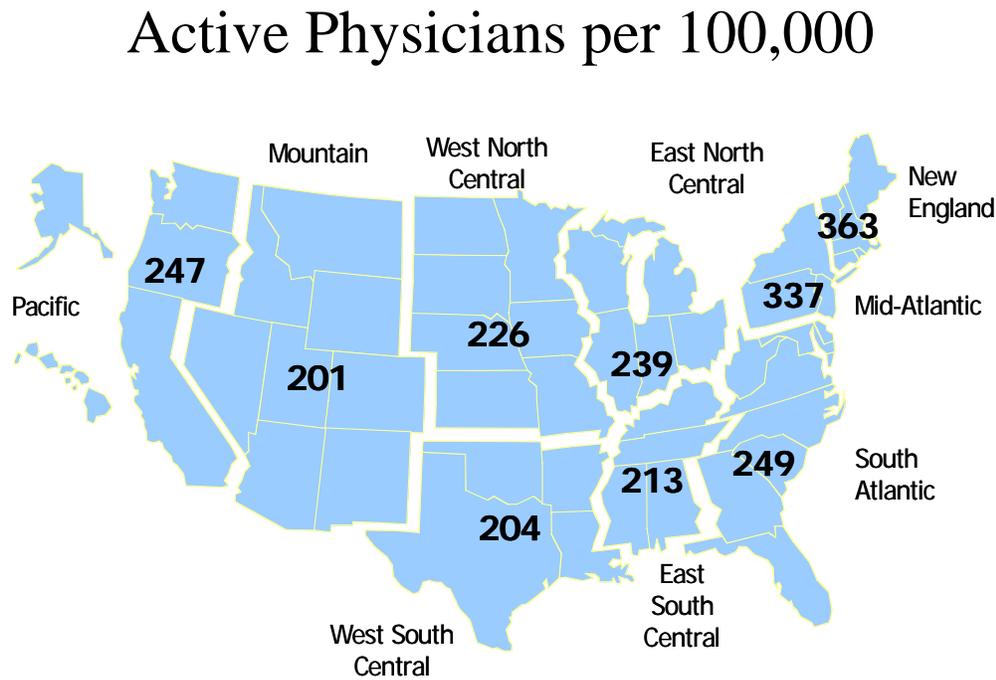
However, we believe both approaches to be methodologically sound. Because both sets of projections trend the current supply forward, they express supply (and demand) changes based upon a definition that remains consistent over time. So, while absolute shortages of intensivists as defined by COMPACCS are difficult to compare with those projected in this study, shortages of intensivists as a proportion of current supply should be comparable to one another.

## CHAPTER 5: SUMMARY AND IMPLICATIONS

### Adequacy of Critical Care Physician Supply: Implications for Vulnerable Populations

The PSM and PDM are national models that yield estimates for the U.S. population as a whole. Although they can be adapted to project supply and demand for smaller geographic regions such as States, the models do little to inform the debate regarding the future adequacy of physician supply in currently underserved areas. Past government policies to improve physician supply in underserved areas have relied in part on the assumption that physician surpluses (especially surpluses of primary care physicians) will create financial motivations for physicians to gravitate to underserved areas. The projections presented here suggest that the supply of physicians will not outpace demand through 2020, which will create little financial pressure for physicians to disperse to traditionally underserved areas. The regional differences in total per capita physician supply remain striking, as is demonstrated in Exhibit 16, with geographic differences even greater at the sub-region level.

**Exhibit 16. Regional Variation in Active Physicians per 100,000 Population**



Any shortage of health care providers is likely to be worse in areas (or for populations) that already have limited access to physicians. This concern is particularly true for access to specialists in rural areas where population size may not support specialties that rely on a large patient referral base and other members of an interdisciplinary team to deliver effective care.

In their analysis, Angus and colleagues found that intensivists were more likely to provide care in larger hospitals (greater than 300 beds),<sup>49</sup> which are less likely to be present in rural areas. This disparity may be further reinforced by the pressure from payers to improve ICU staffing in urban hospitals ahead of non-urban locations. As a previous Department of Health and Human Services report explained, “the challenge lies in understanding what these kinds of quality standards mean for rural communities and whether they are relevant. While the Leapfrog Group initially focused on urban measures, the group has recently devoted attention to consideration of patient safety standards for rural hospitals, realizing that their focus needed to be system-wide.”<sup>50</sup> However, current mechanisms of physician redistribution might be examined for opportunities to improve access to optimal patient care for underserved patients in the ICU.<sup>51</sup>

### **Areas for Future Research**

Several questions about the critical care workforce remain difficult to answer. In particular, it is unclear how care directed by intensivists leads to improved patient outcomes.<sup>52</sup> Those related specifically to critical care training might be achievable with other health care providers, such as hospitalists, or through improved nurse staffing and the availability of other specialists. Other organizational characteristics may play a significant role, such as information technology infrastructure in closed unit ICUs. Further information about critical care providers and their training are also of interest, including the distinction between pulmonologists and intensivists and how these two inter-related specialties will evolve.

In summary, we project that if current trends continue, the growing supply of intensivists will be insufficient to provide the optimal level of care to future populations through 2020. A lower bound of projected demand assumes that all growth in demand for intensivist services is due to the growth and aging of the population but the recent growth in intensivist involvement in ICU care suggests that this lower estimate is highly unlikely. Total employment opportunities will likely grow faster than this lower bound as hospitals increasingly staff their ICUs with

---

<sup>49</sup> Angus et al. (2000).

<sup>50</sup> National Advisory Committee on Rural Health and Human Services. <http://ruralcommittee.hrsa.gov/QR03.htm>

<sup>51</sup> Ewart GW, Marcus L, Gaba MM, Bradner RH, Medina JL, and Chandler EB. The Critical Care Medicine Crisis: A Call for Federal Action. *Chest*. 2004; 125: 1518-1521.

<sup>52</sup> Pronovost et al. (2002).

intensivists. An upper bound on the demand projections would occur if intensivists direct the care of two-thirds of patients admitted to the ICU. The likely demand for intensivists will likely lie somewhere between this upper and lower bound, suggesting the need to increase intensivist supply and to continue monitoring trends in supply and demand.