Cardiovascular Workforce Assessment

Final Report

Prepared for:

American College of Cardiology and the
American College of Cardiology Foundation

Submitted by:

The Lewin Group, Inc. and
Association of American Medical Colleges

March 2, 2009

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Table of Contents

EXECUTIVE SUMMARY

Between December 2007 and October 2008, The Lewin Group and the Association of American Medical Colleges (AAMC) conducted an assessment of the supply and demand for cardiologists for the American College of Cardiology (ACC) and the American College of Cardiology Foundation. Most prominently, our findings from this assessment indicate that there is currently a substantial shortage of cardiologists and that this shortage will increase over the next 20 years.

The current shortage exists across all cardiology subspecialties assessed in this study. However, our projections indicate that if current levels of fellowship completion by subspecialty persist, in 2025, supply and demand for clinical cardiac electrophysiology and pediatric cardiology will be near equilibrium and the shortage of interventional cardiologists will be similar to the current level. In contrast, the shortage of general cardiologists will increase from about 1,700 in 2008 to about 16,000 in 2025.

The increasing shortage of general cardiologists is attributable to the aging of the U.S. population and the general cardiology workforce. The aging of the U.S. population is anticipated to result in a substantial increase in demand for general cardiology services. We estimate a 2.8% annual increase in demand or a 60% increase overall between 2008 and 2025. Meanwhile, 43% of general cardiologists are currently over the age of 55 and our projections assume that all of these physicians will retire over the next 20 years. Because such a large share of the general cardiology workforce is anticipated to retire, the number of fellows completing training will not be sufficient to maintain the size of the general cardiology workforce. We project that the number of active full-time equivalent (FTE) general cardiologists will shrink from about 16,600 in 2008 to about 13,000 in 2025.

In the next several sections, we provide an overview of current supply and demand. Then, we present supply and demand projections for 2008 through 2025 by subspecialty. In the remaining sections, we present an overview of our descriptive and economic analysis on the following topics: subspecialty choice, retirement, practice efficiency, and international medical school graduates (IMGs), women, and underrepresented minorities (URMs)[1] in cardiology.

A. Current Supply

Based on analysis of the American Medical Association (AMA) Masterfile with adjustment for retirement, Figure E-1 displays the current number of active cardiologists in the United States. This figure indicates that 64% of cardiologists are general cardiologists.

[1] URMs refers to Black, Hispanic and Native American physicians.

Figure E-1: Number of Cardiologists, 2008 by Specialty

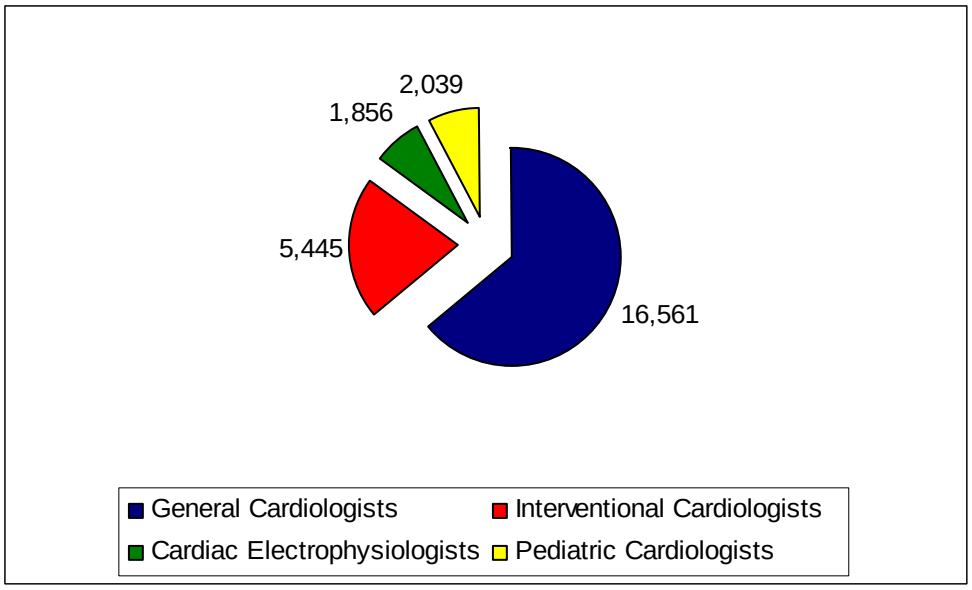
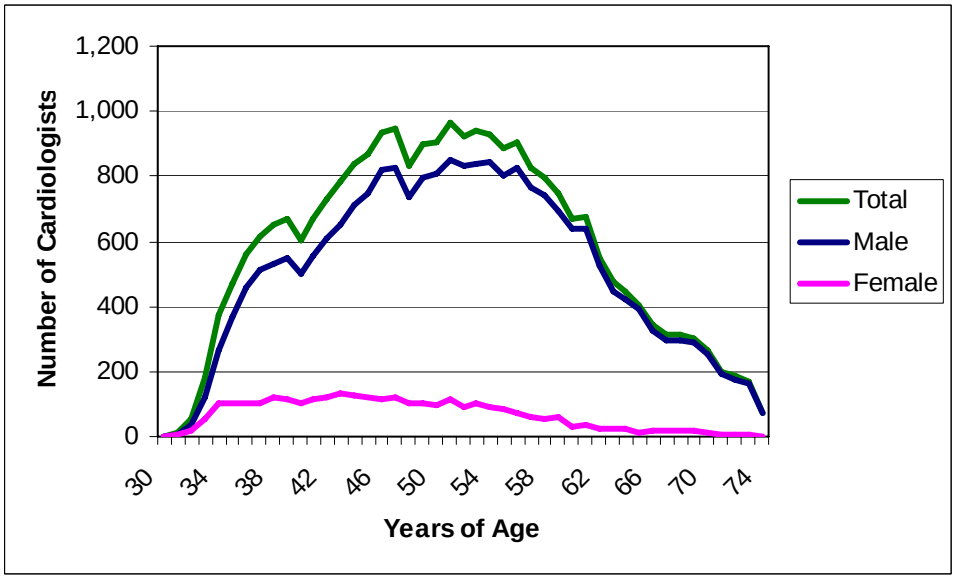


Figure E-2 presents the number of cardiologists by age and gender. While there have been increases in the number of women in cardiology, women still represent a very small percentage of cardiologists. About 12% of general cardiologists are women and less than 10% of interventional cardiologists and cardiac electrophysiologists are women. Women have greater representation in pediatric cardiology where 29% of cardiologists are women.

Figure E-2: Number of Cardiologists, 2008 by Age/Gender



A substantial percentage of cardiologists are nearing retirement age. Forty-three percent of general cardiologists and 31% of pediatric cardiologists are over age 55. The decisions these cohorts make about when to retire will have a significant influence on the supply of cardiologists over the next 20 years.

B. Current Demand

Our analysis found two strong indicators of excess demand for cardiologists. First, data from the National Residency Match program indicates very strong demand for both adult and pediatric cardiovascular disease training. Over the past five years, there have been approximately 1.8 applicants for each general cardiovascular disease training position available and 1.3 applicants for each pediatric position available. Second, data from the ACC Academic Practice, Pediatric Practice, and Private Practice surveys asked practices included in the surveys to identify the number of positions they are currently seeking to fill with cardiovascular disease specialists. The data from these surveys indicates substantial excess demand for new cardiologist which cannot be met with the current number of fellows completing training annually. Based on these surveys, the level of excess demand for each cardiology subspecialty is displayed in Table E-1.

Table E-1: Excess Demand for Cardiologists, 2008 by Subspecialty

Cardiology Subspecialty	Excess Demand
General Cardiology	1,685
Cardiac Electrophysiology	660
Interventional (Coronary+Peripheral)	1,941
Pediatric	127

C. Supply and Demand Projections, 2008-2025

The Lewin Group maintains a Physician Supply and Demand Model (PSDM), which has the capability to project supply of and demand for physician services under alternate scenarios.

Figures E-3 through E-6 display the results of the model by cardiology subspecialty. The blue curve indicates baseline supply. This baseline assumes current numbers of fellows completing training, and current productivity and retirement rates by age and gender will continue through 2025. The red curve is baseline demand. Baseline demand includes increases in demand related only to demographic changes in the U.S. population as projected by the U.S. Census Bureau.

In addition to increases related to demographics, the green demand curve includes a 1% annual increase in demand related to U.S. per capita income growth and technological advances. Recent physician workforce studies by Cooper (2002)[2] and others[3] argue that continued

[2] Cooper, Richard A., Thomas E Getzen, Heather J McKee, and Prakash Laud, (2002) "Economic and demographic trends signal an impending physician shortage," Health Affairs, Vol 21, Issue 1, 140-154.

[3] Koenig, L., Siegel, J.M., Donson, A., Hearle, K., Ho, S., and Rudowitz, R. (2003). Drivers of healthcare expenditures associated with physician services. The American Journal of Managed Care, 9 (Special Issue 1): SP34–42.

economic growth and technological advancement will induce increased demand for health care services beyond our baseline demand which is limited to current per capita consumption adjusted for demographics changes. Estimates of cardiology service expenditures from the Medicare population and United Health Group members for the past several years show increases in demand per beneficiary between 2% and 9% depending on cardiology subspecialty/age group, so we believe the 1% annual increase is conservative.

For all cardiology specialties these figures indicate current excess demand based on the estimates in Table E-1. The supply of pediatric cardiologists, interventional cardiologists and clinical cardiac electrophysiologists is projected to increase over the next 20 years. The supply of clinical cardiac electrophysiologists is projected to increase most rapidly at an annual rate of 3.6%. The supply of pediatric cardiologists and interventional cardiologists is projected to increase at about 1.5% annually. In contrast, the supply of general cardiologists will decline substantially from about 16,600 in 2008 to about 13,000 in 2025 (about a 1.4% annual decline).

Starting from current levels of excess demand, demand for pediatric cardiology is projected to increase at an average annualized rate of 0.4% based on demographic changes. Demand increases for interventional cardiology and clinical cardiac electrophysiology are expected to average about 1% annually based on demographics. While demand for general cardiology is projected to increase most rapidly in this period with an average annualized increase of 1.8% based on demographics, the average annual increase in demand for general cardiologists in this period is 1.6% for the first half of the period and increases to 1.9% for the second half of the period. In addition to these demand increases based on demographics, we believe additional increases in demand of about 1% annually related to technological advances and per capita income growth are likely.

Overall, the projections indicate that by 2025, supply and demand for clinical cardiac electrophysiology and pediatric cardiology will be near equilibrium and the shortage of interventional cardiologists will be similar to the current level. In contrast, the shortage of general cardiologists will increase from about 1,700 in 2008 to about 16,000 in 2025.

Cookson, J.P., and Reilly, P. (1994). Modeling and Forecasting Healthcare Consumption.
Chad L. Deal, Roderick Hooker, Timothy Harrington, Neal Birnbaum, Paul Hogan, Ellen Bouchery, Marisa Klein-Gitelman, and Walter Barr. (2007) "The United States Rheumatology Workforce: Supply and Demand, 2005-2025." Arthritis and Rheumatism. Vol. 56, No. 3, pp722-729.

Figure E-3: Baseline Supply and Demand for FTE Cardiologists
General Cardiology
2008-2025

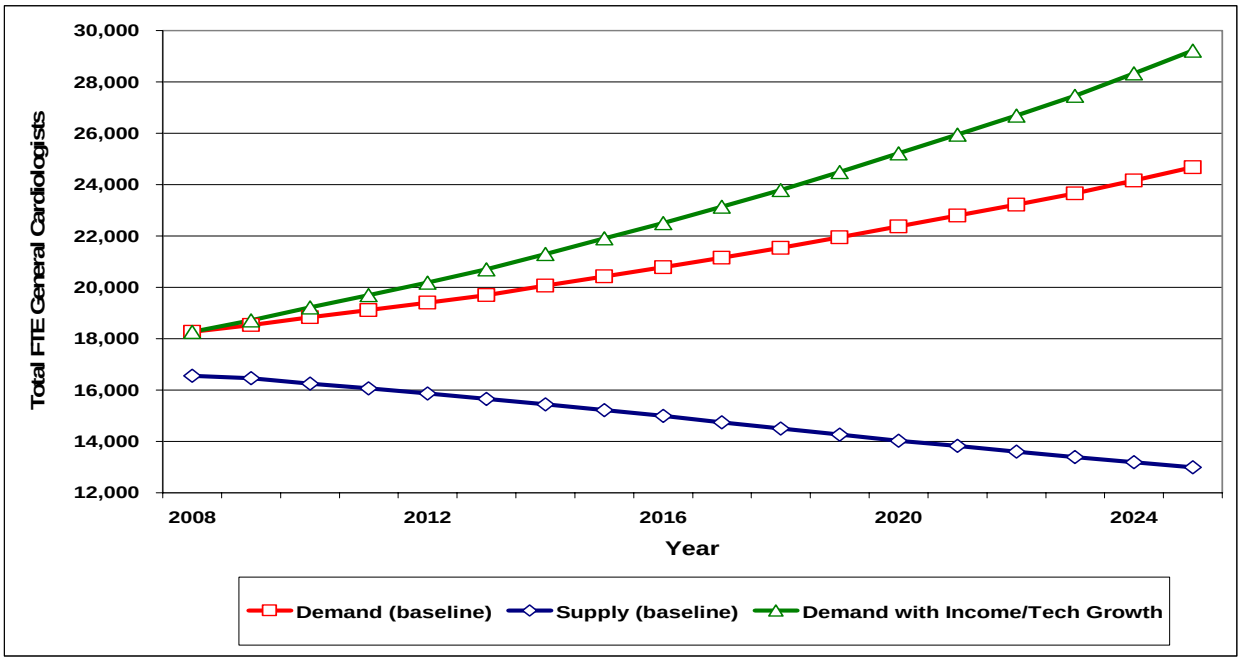


Figure E-4: Baseline Supply and Demand for FTE Cardiologists
Interventional Cardiology
2008-025

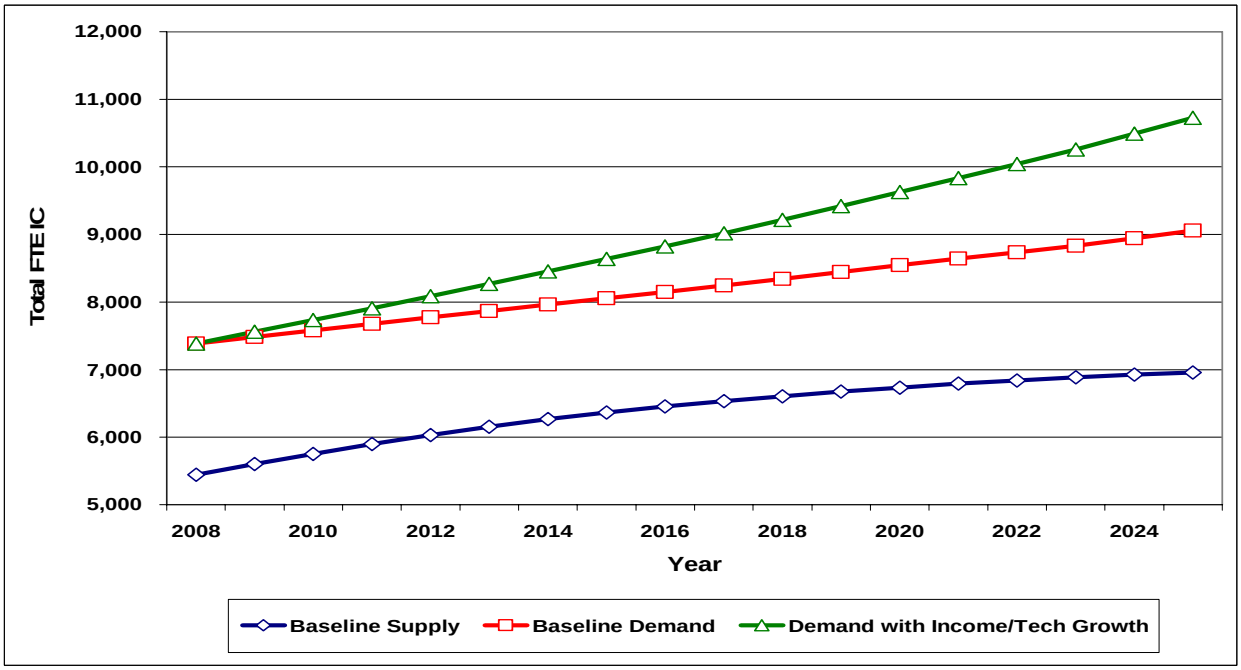


Figure E-5: Baseline Supply and Demand for FTE Cardiologists
Clinical Cardiac Electrophysiology
2008-2025

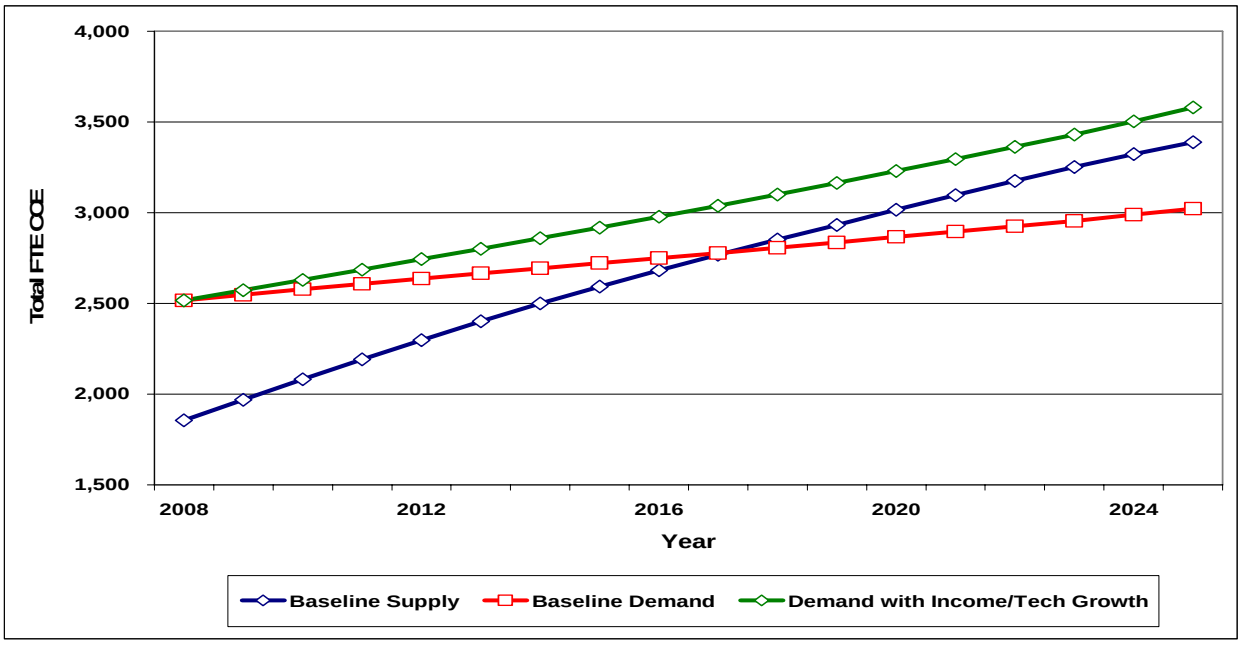
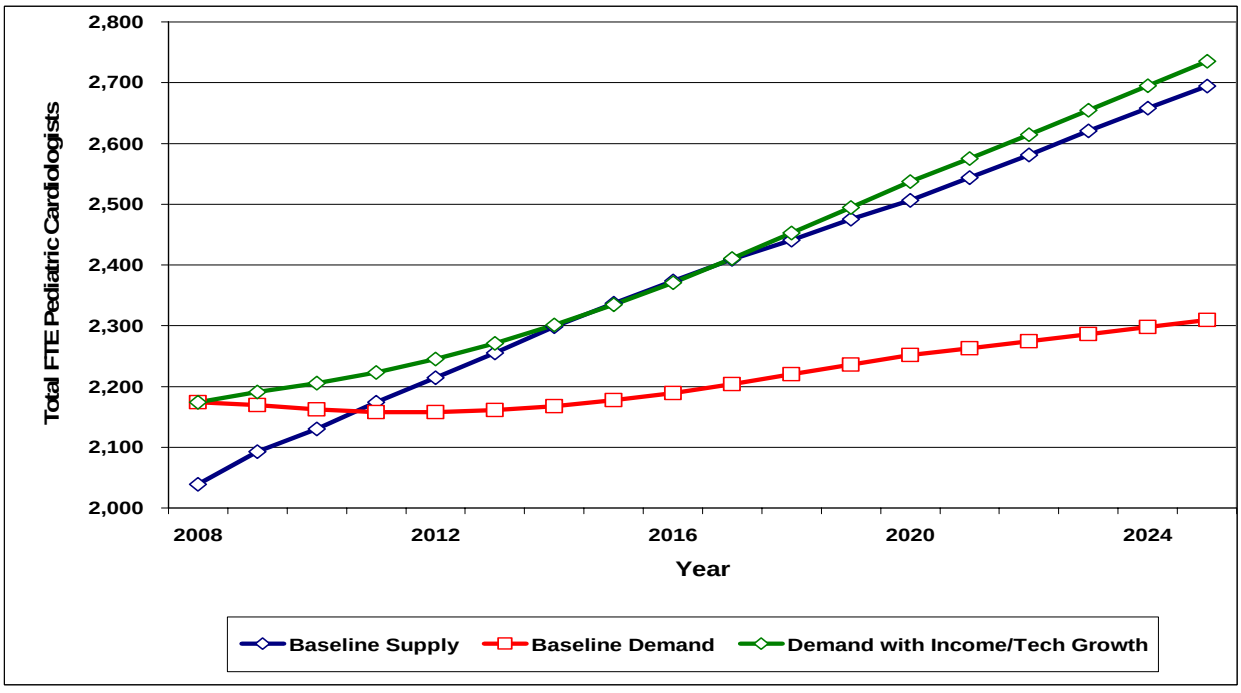


Figure E-6: Baseline Supply and Demand for FTE Cardiologists
Pediatric Cardiology
2008-2025



D. Subspecialty Choice

The Lewin Group and AAMC used two approaches to gain a better understanding of the factors affecting subspecialty choice. The first approach is a quantitative analysis of specialty choice based on observations of internal medicine program graduates in the AMA Masterfile between 1991 and 2004. The second approach is a qualitative analysis of specialty choice using focus groups with physicians completing internal medicine residencies, physicians completing cardiology fellowships, and cardiology training program directors.

Overall, the results of the quantitative model and the focus groups/interviews indicate the following:

- *Compensation* – Our quantitative model indicates that compensation has a significant positive influence on specialty choice for both men and women. The influence of compensation on specialty choice is stronger for men. Focus group participants indicated that compensation is an important factor in their choice of practice setting.
- *Length of Training* – In the quantitative model, length of training was an important factor in specialty choice particularly for graduates of Historically Black Colleges and Universities (HBCU). Length of training was less important to women than men. IMGs were more likely to choose specialties with longer training.
- *Work-life Balance* – Work-life balance is very important to both male and female fellows who participated in the focus groups/interviews. Many fellows indicated they had initially been discouraged from pursuing cardiology because of the field's long hours and on-call demands. Now, these fellows are looking for practice opportunities that afford work-life balance, such as working in a larger practice where call time is shared and practice management duties are limited.

E. Retirement and Part-time Work

Our analysis assessed the factors that influence cardiologists and other physicians to retire or reduce their work effort prior to retirement. Data from a survey of physicians over 50 conducted by AAMC in conjunction with nine physician specialty associations provide the basis for this analysis. We conduct both descriptive and multivariate analysis of these data.

The sample sizes within the AAMC survey are not sufficient to analyze cardiology subspecialties separately. Pediatric cardiologists were grouped with pediatricians in this survey, and thus are not reflected in our analysis. The cardiologist results for this analysis reflect predominant responses from general cardiologists.

Overall, we find that cardiologists have similar or slightly lower retirement rates relative to other medical specialists and surgical specialists. While age and health status are the most important factors in the retirement decision over which there is limited influence, professional satisfaction is a key factor in the retirement decision which can be targeted for improvement. Lack of professional satisfaction was second only to health status as the most commonly cited factor in early retirements listed by 31% of cardiologists who had retired earlier than planned. In contrast, 73% of active cardiologists indicated that career satisfaction was an important factor in their decision to remain active in medicine. Several factors that influence professional satisfaction that

were cited as important to retirement planning for cardiologists are: on-call responsibilities, increasing regulation in medicine, insufficient reimbursement, decreasing clinical autonomy, and stress of practice.

As part of our analysis of retirement, we assessed the availability of part-time work for cardiologists. There is a gap between cardiologists' interest in working part-time and availability of part-time opportunities for cardiologists:

- Relative to other medical specialties, cardiologists have a similar level of interest in working part-time with 66% of cardiologists and other medical specialists indicating they are currently working part-time or might choose to work part-time prior to retirement.
- However, cardiologists were less likely than other medical specialists to work part-time (12% vs. 21%).
- Cardiologists were more likely than other medical specialists to indicate that part-time work was not available in their current practice (46% vs. 34%).
- While only 12% of active cardiologists over 50 currently work part-time, an additional 54% would be interested in working part-time prior to retirement.

Addressing the gap between desire and availability of part-time work among cardiologists might result in later retirements and greater career satisfaction.

F. Practice Efficiency

Given the current shortage of cardiologists and the likelihood that this shortage will be exacerbated by demographic trends and technological advances over the next 20 years, cardiologists will be faced with increased pressure to improve practice efficiency to maintain quality of care and work-life balance. The results of our practice efficiency analysis are suggestive of ways cardiologist practice efficiency might be improved.

- *Increase use of mid-level practitioners* – The regression results indicate about $300,000 in gross revenue is earned by a practice for each additional full-time Nurse Practitioner (NP) or Physician Assistant (PA) on staff. This is about 40% of the revenue earned for each additional physician. However, many practices did not indicate any use of mid-level practitioners. Larger practices that use NPs and PAs, on average, have a lower ratio of mid-level practitioners per physician than smaller practices using NPs and PAs suggesting that there may be efficiency in increasing mid-level practitioners in larger practices.
- *Research efficient practice for serving outreach communities* – The regression results related to outreach offices suggests that these offices do not have a significant impact on practice revenue. Further research is warranted into the costs related to supporting outreach offices and the benefits to the practice. In addition, as the supply shortage of general cardiologists becomes more extreme, provision of care to individuals in rural communities or other underserved areas will need to be addressed. This presents an opportunity for the cardiology community to investigate the most efficient methods of providing quality care to these communities.

There is substantial variation in practice structure, earnings, and productivity across cardiology practices in the U.S. Research to identify efficient practice patterns will aid the cardiology community as demand for cardiology services increases.

G. IMGs, Women, and URMs

Several components of this workforce assessment addressed issues related to IMGs, women, and URMs.

1. Role of IMGs in Cardiology

IMGs represent a substantial share of the cardiology workforce in the United States (about 30%). The share of cardiologists who are IMGs appears likely to remain steady at this level with the exception of interventional cardiology where younger interventionalists are more likely to be IMGs (43.2%). The vast majority of IMGs who complete cardiology training in the United States remain in this country after completion of their training. Thus, IMGs are likely to remain a stable component of the cardiologist workforce in the U.S.

2. Underrepresentation of Women in Cardiology

As noted above, women represent a small fraction of all adult cardiologists. Meanwhile, they have nearly equal representation in internal medicine. We investigated some of the potential sources for this underrepresentation. Our findings include:

- Work-life balance is important to women in specialty choice and cardiology is perceived as a specialty with poor work-life balance; and
- In focus groups, female cardiology fellows stated that they had difficulty fitting into the cardiology community because there are few women. They also said that they believed within their cardiology training they received less respect and that their commitment to medicine was perceived as less than that of their male counterparts.

Addressing work-life balance and cultural issues within the cardiology community will encourage more women to enter the field of cardiology.

3. URMs in Cardiology

Program directors had few formal programs for attracting URMs. Comparing the share of cardiology fellows in URM groups to the representation of these groups in medical school and internal medicine residency program highlights a gap that might be targeted by program directors as an initial step in a program to increase URM representation in cardiology.

In our specialty choice analysis no indicator for race and ethnicity was available. As a proxy for Black internal medicine program graduates we used an indicator for HBCU graduates. Regression results indicated that internal medicine graduates who attended HBCU are more sensitive to compensation and length of training relative to others when they make their specialty choice decisions. This results in HBCU graduates being more likely to remain in primary care than their counterparts. These differences may be attributable to financial barriers that may make it more difficult for HBCU graduates to complete longer training programs and forces them to be more focused on compensation levels upon graduation.

H. Recommendations

Our recommendations based on this analysis focus in five areas: delaying retirement of older physicians, expanding cardiologist supply, developing efficient approaches to reach patients in underserved communities, improving cardiology practice efficiency, and encouraging women and URMs to enter the field of cardiology.

We project an increasing shortage of general cardiologists over the next 20 years. To address this shortage, a substantial increase in the number of fellows completing training in general cardiology is needed. In the near term, delaying retirement of cardiologists over 55 will assist in meeting demand. To encourage delayed retirements, we recommend:

- Education of the cardiology community on methods to support work reductions among older physicians, such as availability of part-time work and more limited call responsibilities; and
- Advocacy related to issues that are important to professional satisfaction among cardiologists (e.g., regulation in medicine, clinical autonomy, and adequate reimbursement rates).

In the longer term, increased funding for general cardiology fellowship programs is warranted. Development of a shortened training track for general clinical cardiology as proposed by Working Groups 1 and 8 of the ACC's 35th Bethesda Conference might allow for a more substantial increase in the number of cardiologists within limited training resources.

As the shortage of general cardiologists becomes more extreme over the next 20 years, low-income and rural communities are likely to be the most affected by the shortage. Research into efficient methods to serve these populations (e.g., telemedicine, outreach offices, collaboration with primary care physicians) is warranted. In addition, care in underserved communities might be improved through advocacy to encourage financial support from governmental and charitable organizations for cardiologists in service to these communities.

Our estimates indicate that even with expansion of fellowship positions and delayed retirements, excess demand for general cardiology services will be substantial. Addressing this gap between supply and demand will require substantial improvements in practice efficiency. Our findings related to practice efficiency focus in two areas:

- One method of improving practice efficiency is use of mid-level practitioners. The evidence from this study suggests that mid-level practitioners are a highly productive component of the cardiac care team and that there is substantial room for expansion of their use. More detailed research on efficient and effective use of mid-level practitioners and dissemination of this research to the cardiology community will encourage expanded use of mid-level practitioners.
- Also, we find that some practices (typically larger practices) use information technology, shared call schedules, and practice managers to allow cardiologists to have improved work-life balance and more focused time in patient care. Research and education on these methods could improve practice efficiency.

In addition to developing supply and demand projections, another component of this research addressed the underrepresentation of women and minorities in cardiology. Our two primary findings related to women in cardiology are:

- During focus group interviews, we found women had difficulty fitting-in and felt less valued than their male counterparts in the cardiology community, but that in the job market they were more heavily recruited than their male counterparts. Developing a culture within cardiology training programs that values diversity will address these issues and make it easier for women to choose cardiology.
- In addition, the perception of poor work-life balance in cardiology discourages men and women from entering the field. Improvements in work-life balance during training and in practice are likely to encourage women to enter cardiology.

Our findings related to URMs from the focus group with cardiology program directors indicate that few formal programs exist to attract URMs to cardiology. Since URMs are less likely to subspecialize, we suggest as a first step in attracting more minorities that cardiology training programs develop outreach to encourage URM medical school graduates and internal medicine program graduates to consider cardiology. Another approach to increasing URM representation in cardiology is to increase the number of residency and visa slots for foreign trained physicians.

In addition, our analysis indicates that the length of training required for cardiology discourages HBCU internal medicine program graduates from pursuing cardiology. Decreasing the length of training, offering additional financial support during training, and offering loan repayment following training are likely to encourage more Black internal medicine program graduates to enter cardiology.

Today it is more critical than ever to increase the cultural proficiency of the cardiology profession as the patient population continues to become more diverse. Individualized care is the cornerstone of quality. Regardless of the background of the cardiologist or resident, it is important that they receive cultural proficiency education in their residency and fellowship training as well as continuing education in this area.

I. INTRODUCTION

The American College of Cardiology (ACC) and the American College of Cardiology Foundation asked The Lewin Group and the Association of American Medical Colleges (AAMC) to conduct a workforce study of cardiologists to better understand the factors affecting the supply of and demand for cardiologists. In particular, the study was intended to provide answers to the following questions:

- What is the appropriate methodology for tracking cardiovascular workforce trends over time?
- What factors influence physicians to: enter the field of cardiology, subspecialize within cardiology, pursue part-time work, retire, and remain in the workforce?
- How would the cardiology community respond to the infusion of non-physician clinicians and/or additional cardiologists into the workforce?
- What role do foreign medical graduates have in the cardiology workforce?
- What impact would incremental reductions of income have on the cardiology workforce?
- What can ACC do to influence the behavior of the cardiology workforce to maximize efficiency?

This paper presents the results of this workforce study and findings related to these questions.

Following this introduction, the report consists of eleven major sections. The first five of these sections define current supply and demand, model projected supply and demand, and discuss methods for tracking supply and demand in the future. The next five sections present descriptive and economic analyses on the following topics: subspecialty choice, retirement, practice efficiency, international medical school graduates (IMGs) in cardiology and underrepresented minorities (URMs) in cardiology.

Support for this study was provided by the ACC Workforce Task Force chaired by Dr. George P. Rodgers.[4] The task force was a source of institutional and clinical information relevant to the cardiology physician workforce, as well as guidance for the study itself.

A. Timeline

The Lewin Group began this study in December 2007. Analysis of data sources was conducted between December 2007 and July 2008. Focus groups and individual interviews with cardiology fellows and cardiology program directors were held during the ACC's Annual Scientific Sessions from March 29 through April 1, 2008. Participants were invited to share their perspectives on the factors affecting specialty choice, the future supply of cardiovascular specialists, residency trends, and the changing cardiology workforce. Focus groups and individual interviews with internal medicine program residents were conducted during June 2008. Eighteen internal medicine

[4] The members of the Task Force were Dr. Jamie B. Conti, Dr. Brian P. Griffin, Dr. Jerry D. Kennett, Dr. Jeffrey A. Feinstein, Dr. Svati Shah, Dr. Mary N. Walsh, Dr. Eric S. Williams, Dr. Jeffrey L. Williams, and Workforce Initiative staff Kelly Haenlein, Pat Miyamoto, and Debjani Mukherjee.

residents at two separate residency training programs were interviewed. Residents were asked about their current specialty choice plans, the factors influencing their specialty choice decision, interest in cardiology, and thoughts regarding their future practice setting. In July 2008, a draft report was prepared to obtain discussion and feedback from the ACC Workforce Task Force. After discussion with the Task Force a final report was prepared in October 2008.

B. Overview of Workforce Studies

Interest in physician workforce issues can be traced at least to the late 1960's. At that time the main concern was ensuring that there were sufficient physicians to meet patient needs. In 1976, the Graduate Medical Education National Advisory Committee (GMENAC) was founded by the U. S. Department of Health Education and Welfare to project the need for physicians by specialty in 1990. The Committee estimated the need for various physician specialties using estimates based on the judgments of experts. While the notion of centralized planning of physician supply was implicit in GMENAC, it became somewhat more explicit with the establishment of the Council on Graduate Medical Education (COGME) in 1986.

Over time the focus of physician workforce studies shifted from concern regarding too few physicians to concern that there were too many specialists relative to generalists. Weiner's (1994)[5] projections, based on the staffing patterns of staff-model health maintenance organizations (HMOs), indicating a substantial excess supply of specialists by the year 2000 were central in this debate. Because the projected spread of staff model HMOs did not materialize, assumptions in more recent studies have been updated.

More recently, physician workforce studies by Cooper (2002)[6], BHPr (2006)[7] and COGME (2003)[8] have indicated an impending shortage of physicians—particularly specialists. More recent models have focused on demographic changes and continued economic growth as the driving forces in demand for specialty care. The focus on economic growth as the underlying force behind demand for health care services is based on the assumption that advances in technology provide for an unlimited spectrum of services, particularly specialist services. Providing health benefits and use of these services is constrained only by our ability and willingness to pay.[9]

C. The Field of Cardiology

Cardiologists specialize in finding, treating, and preventing heart and blood vessel disorders. Typically, ten years of training are required to become a cardiologist. This training includes

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[5] Weiner, J.P. (1994) "Forecasting the Effects of Health Reform on U.S. Physician Workforce Requirement. Evidence from HMO Staffing Patterns." JAMA.; 272:222-230.

[6] Cooper, Richard A., Thomas E Getzen, Heather J McKee, and Prakash Laud, (2002) "Economic and demographic trends signal an impending physician shortage," *Health Affairs*, Vol 21, Issue 1, 140-154.

[7] Bureau of Health Professions. (2006) Physicians Supply and Demand: Projections to 2020. U.S. Department of Health and Human Services. Oct. http://bhpr.hrsa.gov/healthworkforce/reports/physiciansupplydemand/default.htm.

[8] Council on Graduate Medical Education. (2003) Reassessing Physician Workforce Policy Guidelines for the U.S. 2000-2020. Washington, DC: U.S. Department of Health and Human Services.

[9] A complementary hypothesis is simply that health care is a "normal" good. As real income per capita grows, the demand for many goods and services, including health, increases. It may be the case that the demand for specialty care increases by more than the demand for primary care as real income grows.

four years of medical school, three years of training in internal medicine or pediatrics, and three to four years of training in specialized cardiology.

For this study, we divide cardiologists into four major subgroups: pediatric cardiologists, general cardiologists, interventional cardiologists, and cardiac electrophysiologists. Pediatric cardiologists specialize in the treatment of heart conditions in children, particularly congenital heart problems. The other three cardiology subspecialties treat adult patients. General cardiologists treat the spectrum of heart and blood vessel disorders, however, they may refer specific conditions or disorders to cardiology subspecialists who have advance training in these areas. Interventional cardiologists have advanced training in catheter based treatment of heart diseases including procedures such as balloon angioplasty and placement of stents. Cardiac electrophysiologists are cardiologists who have additional education and training in the diagnosis and treatment of abnormal heart rhythms.

The majority of cardiologists are primarily engaged in clinical practice. However, some are engaged in administration or research. Others are engaged in medical teaching. This study addresses the supply of all cardiologists regardless of their primary employment activity, but the demand analysis focuses on demand for clinical services as those are the activities in which most cardiologists are engaged.

D. Market-Based Analysis and Limitations

Two points should be made at the outset. First, there is no attempt in this study to determine the "right" number of cardiologists in a normative or needs-based sense. The estimates of demand presented here are based on market conditions. These include underlying epidemiological conditions or "need," but also include economic and other factors affecting demand, such as income and insurance coverage of the underlying population. Hence, no necessary normative significance should be attributed to the demand estimates nor to associated market "equilibria."[10]

Second, we provide predictions of future supply and demand through 2025. While the predictions have the appearance of precision, there are too many variables to achieve such precision over long periods, in practice. Events that can not now be anticipated will undoubtedly have a significant and unpredictable influence on the demand for cardiologists ten or fifteen years from now. Thus, our point estimates should be interpreted as representing a broad range, under the assumption that all other factors are constant. Our overall market assessment is based on the systematic analysis of a number of cases or scenarios that our research indicates are likely to affect future demand and supply. Undoubtedly, there will be factors that will affect future markets that cannot currently be anticipated. An advantage of a workforce model is that the implications of alternative assumptions or projections regarding the future can be evaluated quickly.

[10] The only additional significance of an estimated equilibrium point--a point at which demand is approximately equal to supply--is that the number and incomes of cardiologists will be stable at that point. If demand exceeds supply, one can anticipate rising incomes and increases in the numbers of cardiologists, and vice versa if supply were to exceed demand.

II. OVERVIEW OF CURRENT WORKFORCE

In this section, we provide a description of the size and distribution of the cardiology workforce in 2008. Section V uses these data as a baseline and makes projections about the number of cardiologists in the future. This section is divided into three parts. The first part explains how we define a cardiologist for the purpose of this study and provides aggregate counts of cardiologists by subspecialty. The second part describes the demographic characteristics of the current workforce. The final part provides information on the geographic distribution of the workforce.

A. Defining the Current Workforce

In this section, we describe the parameters we use to describe a cardiologist for the purposes of this analysis.

1. Baseline Count of Cardiologists

There are a number of ways to define the current supply of cardiologists which lead to different estimates. The choice is important, because this "baseline" number will permeate all subsequent analyses.

We developed our baseline count of cardiologists from the American Medical Association (AMA) Masterfile. In this file, we defined cardiologists for the purposes of the workforce study as any medical doctor (MD) or doctor of osteopathy (DO) who meets the following self-reported criteria:

1. Must **not** claim "resident" (or "fellow") as their current major professional activity. Only physicians who have completed their training and have entered the workforce are considered.
2. Must be less than 75 years of age, and working in the U.S. or Puerto Rico. We only want to consider those physicians who are actively practicing in the U.S. or its territories.
3. Must have completed graduate medical training in general cardiology, interventional cardiology, cardiac electrophysiology, or pediatric cardiology **or** be board-certified in one of these four specialties.

The implications of our criteria are shown in Table II-1.

Table II-1: Number of Board Certified or Fellowship Trained Cardiologists, 2008 by AMA Masterfile*

Training/Certification	General Cardiologists	Interventional Cardiologists	Cardiac Electrophysiologists	Pediatric Cardiologists
Fellowship Trained Only	3,587	392	301	774
Board Certified Only	2,632	4,427	1,049	170
Fellowship Trained and Board Certified	12,077	786	547	1,397
Total	**18,296**	**5,605**	**1,897**	**2,341**

* Includes physicians whose status in the AMA file is retired, semi-retired or inactive. Also, includes physicians who have training or board certification in cardiology but who are not currently practicing cardiology. Adjustment is made for activity status in the next section.

2. Number of Active Cardiologists

We make two adjustments to the total count of cardiologists in Table II-1 above to yield our estimate of the count of active cardiologists. First, we adjust the counts for physicians over 50 to address retirement and inactivity that may not be recorded in the AMA file. Then, we adjust the counts for physicians who report training and/or board certification in cardiology, but who do not report practicing cardiology as their primary or secondary specialty. We discuss each of these adjustments in turn below.

Adjustment for Retirement/Inactivity

One limitation of the AMA Masterfile for estimating current physician supply is the time lag between when a physician's work status changes and when the information in the Masterfile is updated. AMA attempts to contact approximately one-third of physicians each year to update their information in the Masterfile. Thus, if a physician retires, there can be up to a 3-year lag before his/her status is changed from active to inactive.[11] In addition, some physicians choose not to respond to AMA's request for information. These issues in updating physicians' activity status result in the Masterfile overestimating the supply of active physicians—especially for older physicians.

To collect additional information on the work status of older physicians, AAMC, in collaboration with nine specialty associations, conducted a survey of 18,000 physicians age 50 and older. We refer to this survey as the "Over 50 Survey." The Over 50 Survey was used to collect information on whether the physician was working part-time, full-time, or retired. Physicians also reported hours worked in various activities. Some physicians, listed as active[12] in the Masterfile, reported through the Over 50 Survey that they had retired. This was more common among older physicians. In addition, a portion of physicians listed as retired or

[11] AMA also analyzes sources other than the physician survey to maintain and update the Masterfile.

[12] AMA defines an active physician as one working 20 or more hours per week in medical activities. For purposes of modeling, we define an active physician as one who works at least one hour per week in medical activities. Part of the active workforce works fewer than 20 hours per week in medical activities, and thus would be counted as active for this analysis but is inactive using the AMA definition. When using the Over 50 Survey to compute average hours worked by physician age, gender and specialty, we include all physicians working at least one hour per week.

inactive in the Masterfile, reported through the Over 50 Survey that they are still working (often these were physicians working part-time).

To compare self-reported activity status from the Over 50 Survey (which we assume represents the correct activity status at the time of the survey) with the activity status in the Masterfile, we use logistic regression analysis to develop an algorithm that predicts the probability a physician is working at least one hour per week in medicine as a function of age, gender, specialty and activity status listed in the Masterfile. We then apply the predicted probability of working estimated for each physician in our cardiologist subsample to estimate total active physicians. For modeling, we assume that all physicians are retired by age 75.[13] Physicians under the age of 50 were not included in the Over 50 Survey. We assume the work status listed in the AMA file for physicians under 50 is accurate.

Adjustment for Activity in Other Specialties

In addition to the adjustment for retirement and inactivity for physicians over age 50, we made an adjustment related to physicians who were trained and/or board certified in cardiology, but who did not report cardiology as their primary or secondary specialty. Initial estimates based on the AMA Masterfile indicate 7% of those trained and/or board certified in general cardiology and 10% of those trained and/or board certified in pediatric cardiology are not practicing cardiology as their primary or secondary specialty.

Because the AMA Masterfile is updated periodically based on physician self-reports and many of these physicians indicated internal medicine or pediatrics as their primary specialty and unspecified as their secondary specialty, we hypothesized that many of these physicians had not updated their AMA Masterfile record subsequent to completing training in cardiology. We obtained name, practice location, and contact information for a sample of 50 of these general cardiologists and 50 of these pediatric cardiologists. Based on telephone contacts and internet searches to determine the practice specialty of these physicians, we find that 64% of these general cardiologists and 41% of these pediatric cardiologists are practicing cardiology. Thus, for general and pediatric cardiologists in this group, we assumed 64% and 41%, respectively, were actively practicing cardiology. More detail on this analysis is provided in Appendix A.

Estimate of Active Cardiologists

After applying these adjustments for workforce activity and practice specialty, Table II-2 displays the number of active cardiologists by subspecialty and training status. Only cardiologists with board certification or fellowship training in cardiology based on the AMA Masterfile are included in these estimates.

[13] The AMA Masterfile lists as active approximately 34,000 physicians age 75 and above. Our analysis to compare physician activity status from the AAMC over age 50 survey with the activity status in the Masterfile did not include the 75 and older population because of small sample size in the survey.

Table II-2: Number of Active Board Certified or Fellowship Trained Cardiologists, 2008 by AMA Masterfile

Training/Certification	General Cardiologists	Interventional Cardiologists	Cardiac Electrophysiologists	Pediatric Cardiologists
Fellowship Trained Only	2,957	388	299	561
Board Certified Only	2,162	4,274	1,012	146
Fellowship Trained and Board Certified	11,442	783	546	1,333
Total	**16,561**	**5,445**	**1,856**	**2,039**

B. Demographic Characteristics

Based on the AMA Masterfile with our adjustments for activity and practice specialty, as discussed above, Table II-3 displays the age/gender distribution of cardiologists by subspecialty. This table indicates the disparity between men and women in the field. About 88% of active general cardiologists, 97% of interventionalists, and 91% of electrophysiologists are male. In contrast, only about 71% of pediatric cardiologists are male.

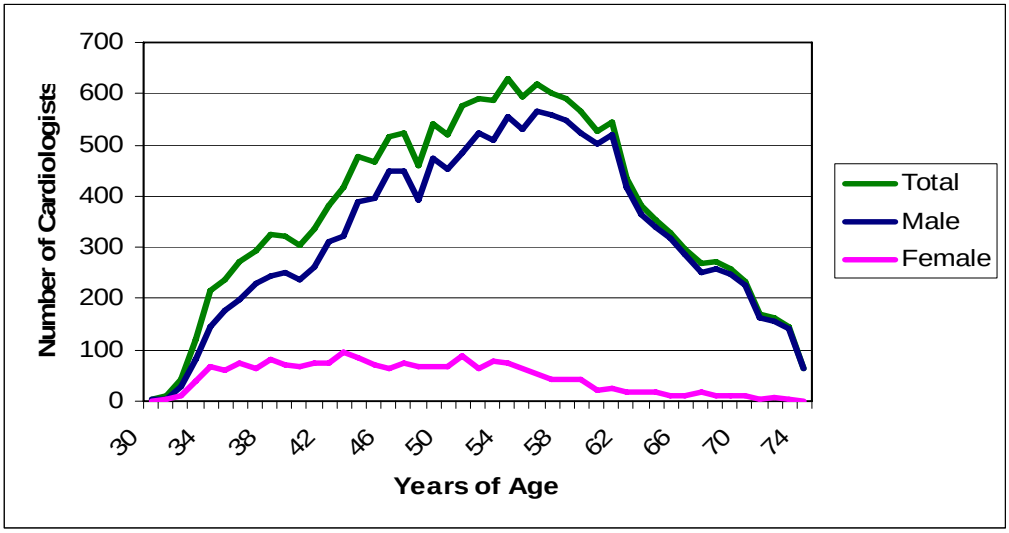
Table II-3: Age Distribution of General Cardiologists, 2008 by Gender and Age

	General Cardiologists	Interventional Cardiologists	Cardiac Electrophysiologists	Pediatric Cardiologists
Female				
<35	0.9%	0.3%	0.5%	2.7%
35-44	4.6%	1.5%	4.1%	12.1%
45-54	4.3%	1.2%	4.2%	8.4%
55-64	1.9%	0.4%	0.5%	4.2%
65-69	0.4%	0.0%	0.0%	1.1%
70-74	0.1%	0.0%	0.0%	0.5%
Total	12.2%	3.4%	9.3%	29.0%
Male				
<35	2.1%	2.5%	4.4%	2.1%
35-44	16.6%	33.2%	36.9%	20.1%
45-54	28.5%	40.6%	36.8%	23.7%
55-64	29.0%	18.4%	11.5%	16.2%
65-69	7.9%	1.5%	0.7%	5.6%
70-74	3.8%	0.3%	0.4%	3.2%
Total	87.9%	96.5%	90.7%	70.9%

In Figures II-1 to II-4, we display the number of cardiologists by gender and age. The median age for active general cardiologists is 53. Active female cardiologists tend to be younger than

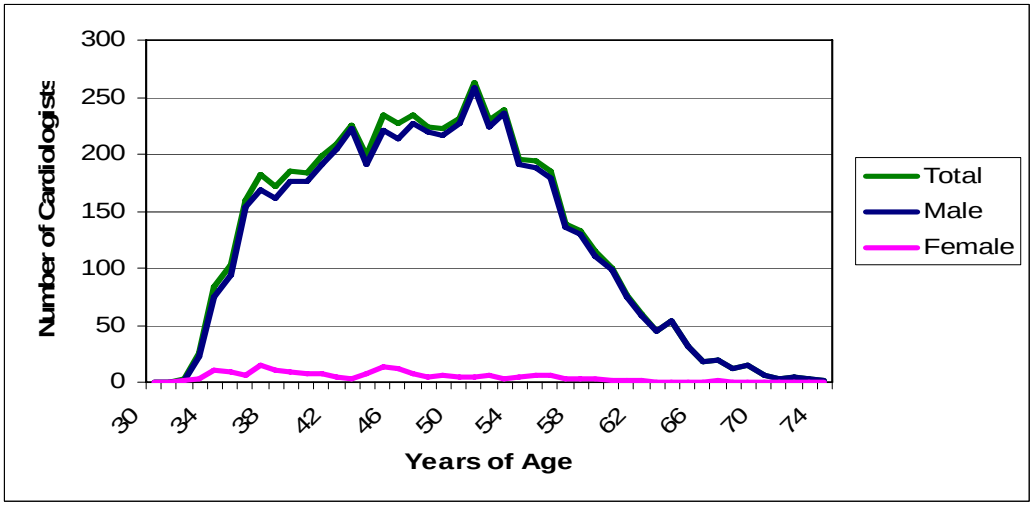
their male counterparts. The median age for active men and women, respectively, is 52 and 46. About 43%of general cardiologists are 55 or older, and thus, nearing retirement. About 12% of general cardiologists are 65 or older.

Figure II-1: Number of General Cardiologists, 2008 by Age/Gender



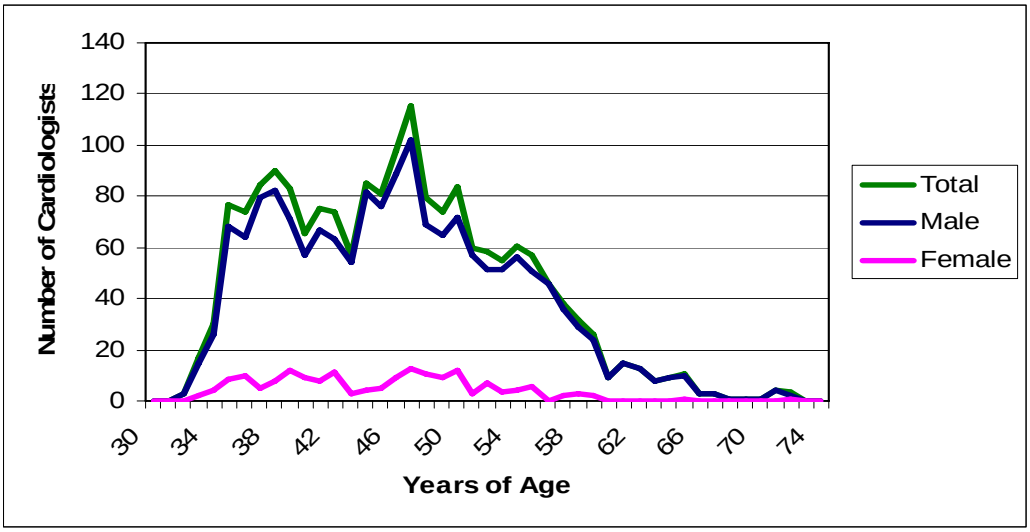
For interventionalists the median age is 48. Only about 20% of interventionalists are 55 or older. Only about 2% are 65 or older.

Figure II-2: Number of Interventional Cardiologists, 2008 by Age/Gender



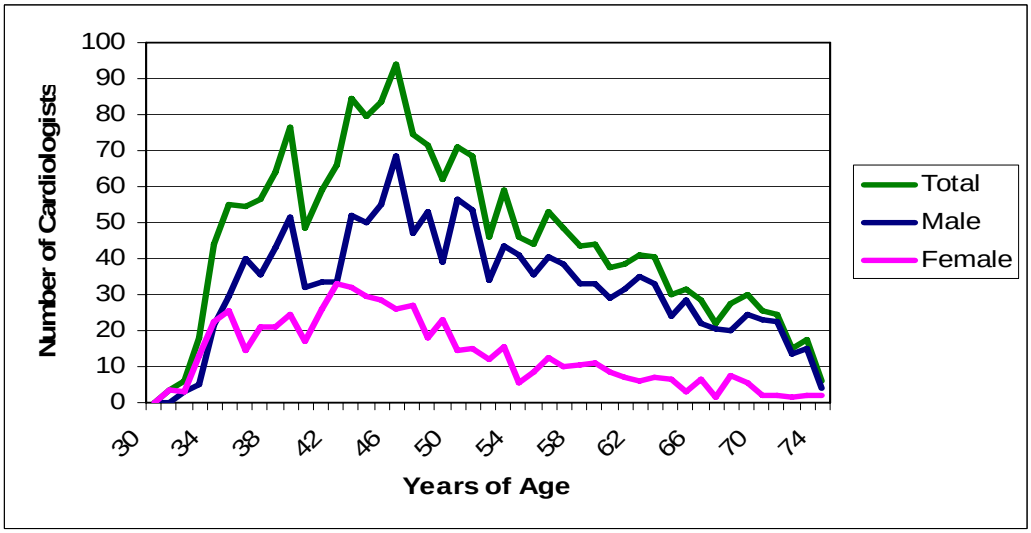
For electrophysiologists the median age is 46. Similar to interventional cardiology, only about 13% of electrophysiologists are 55 or older and only about 1% is 65 or older.

Figure II-3: Number of Cardiac Electrophysiologists, 2008 by Age/Gender



Among pediatric cardiologists the median age is 48. Thirty-one percent of pediatric cardiologists are 55 or older. About 10% are 65 or older.

Figure II-4: Number of Pediatric Cardiologists, 2008 by Age/Gender



C. Geographic Distribution of Cardiologists

Overall, there are 80.2 and 6.9 adult and pediatric cardiologists per million population in 2008, respectively. Approximately, one-quarter of the U.S. population is under the age of 18. This implies 106.9 adult cardiologists for every million adults in the U.S. and about 27 pediatric cardiologists for every million children in the U.S. If we disaggregate the adult cardiologists by subspecialty, there are 55.7 general cardiologists, 18.3 interventionalists and 6.2

electrophysiologists per million population. The counts represent all active cardiologists including those primarily engaged in patient care and those employed in teaching, research, healthcare administration or other activities.

Table II-4 presents the number of cardiologists per million population for the 15 largest core based statistical areas (CBSAs). Of the 15 largest CBSAs, Boston enjoys the highest concentration of all four cardiology subspecialties with 124 general cardiologists, 26 interventionalists, 16 electrophysiologists, and 24 pediatric cardiologists per million population. Meanwhile Riverside-San Bernardino has the lowest ratio for all four subspecialties with 30 general cardiologists, eight interventionalists, one electrophysiologist, and four pediatric cardiologists per million population.

Table II-4: Cardiologists per Million Population in the 15 Largest CBSAs, 2008

Metropolitan Area	Population	Physicians per million population			
		Gen Card	Int Card	EP Card	Ped Card
New York-Northern NJ-Long Island, NY-NJ-PA	18,709,802	102.89	21.22	7.54	10.80
Los Angeles-Long Beach-Santa Ana, CA	12,925,330	52.61	12.77	5.57	7.12
Chicago-Naperville-Joliet, IL-IN-WI	9,391,515	61.97	23.00	8.41	7.13
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	5,800,614	104.13	20.86	15.00	12.07
Dallas-Fort Worth-Arlington, TX	5,700,256	41.58	17.72	4.91	8.25
Miami-Fort Lauderdale-Miami Beach, FL	5,361,723	93.63	17.72	6.90	10.26
Houston-Sugar Land-Baytown, TX	5,180,443	53.28	25.29	5.21	8.69
Washington-Arlington-Alexandria, DC-VA-MD-WV	5,139,549	79.58	19.26	8.95	11.09
Atlanta-Sandy Springs-Marietta, GA	4,708,297	49.27	15.50	4.67	8.71
Detroit-Warren-Livonia, MI	4,493,165	48.96	22.48	5.34	5.56
Boston-Cambridge-Quincy, MA-NH	4,424,649	124.30	26.22	15.59	23.50
San Francisco-Oakland-Fremont, CA	4,153,870	66.93	19.26	6.74	11.80
Riverside-San Bernardino-Ontario, CA	3,793,081	29.53	7.91	1.32	3.69
Phoenix-Mesa-Scottsdale, AZ	3,715,360	44.95	22.61	7.27	7.27
Seattle-Tacoma-Bellevue, WA	3,166,828	47.37	18.63	7.58	8.84

Tables II-5 and II-6 present the number of general cardiologists per million population for the 10 CBSAs with the lowest concentrations and for those CBSAs with more than 150,000 people and no cardiologist, respectively. These CBSAs may present opportunity for establishing a new practice or expanding an existing practice. However, it should be noted that these statistics are generated based on the primary practice location listed for the active physicians in the AMA Masterfile. Where these CBSA are near or adjacent to another CBSA, they may be served by an outreach office or secondary practice location of a cardiologist in the nearby or adjacent CBSA.

Table II-5: CBSA with the Lowest Concentration of Adult Cardiologists, 2008

Metropolitan Area	Population	Count	Per Million Population
Holland-Grand Haven, MI	252,351	3	11.89
Aguadilla-Isabela-San Sebastian, PR	324,960	4	12.31
Jacksonville, NC	154,297	2	12.96
Merced, CA	237,005	4	16.88
Clarksville, TN-KY	238,897	6	25.12
Thomasville-Lexington, NC	153,775	4	26.01
Visalia-Porterville, CA	401,502	11	27.40
Kingston, NY	181,779	5	27.51
Provo-Orem, UT	412,361	12	29.10
Salem, OR	369,406	11	29.78

Table II-6: CBSA with More Than 150,000 Population and No Cardiologists, 2008

Metropolitan Area	Population
Ottawa-Streator, IL Micro SA	153,601
Eau Claire, WI Metro SA	153,150
Monroe, MI Metro SA	152,552
El Centro, CA Metro SA	152,448
Yuba City, CA Metro SA	151,391
Columbia, MO Metro SA	151,307
Vineland-Millville-Bridgeton, NJ Metro SA	151,183
Blacksburg-Christiansburg-Radford, VA Metro SA	150,870
Pueblo, CO Metro SA	150,171

The next several tables display the CBSAs with highest concentration of each cardiology subspecialty. Rochester, MN has the highest concentration of all three adult specialties and ranks second behind Ann Arbor, MI for the highest concentration of pediatric cardiologists. Figures II-5 through II-8 display the distribution of cardiologists in each of the four subspecialties across the United States.

Table II-7: CBSA with the Highest Concentration of General Cardiologists, 2008

Metropolitan Area	Population	Count	Per Million Population
Rochester, MN	174,853	102	583.35
Durham, NC	451,212	88	195.03
Charlottesville, VA	180,901	30	165.84
Ann Arbor, MI	339,191	50	147.41
Lebanon, NH-VT	171,381	22	128.37
Boston-Cambridge-Quincy, MA-NH	4,424,649	550	124.30
Trenton-Ewing, NJ	365,271	43	117.72
Gainesville, FL	239,114	26	108.73
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	5,800,614	604	104.13
New York-Northern NJ-Long Island, NY-NJ-PA	18,709,802	1925	102.89
Barnstable Town, MA	228,683	23	100.58
New Haven-Milford, CT	845,694	85	100.51
Sarasota-Bradenton-Venice, FL	651,862	65	99.71
Greenville, NC	160,806	16	99.50
Seaford, DE	172,216	17	98.71

Figure II-5: Concentration of General Cardiologists Across CBSAs in the United States, 2008

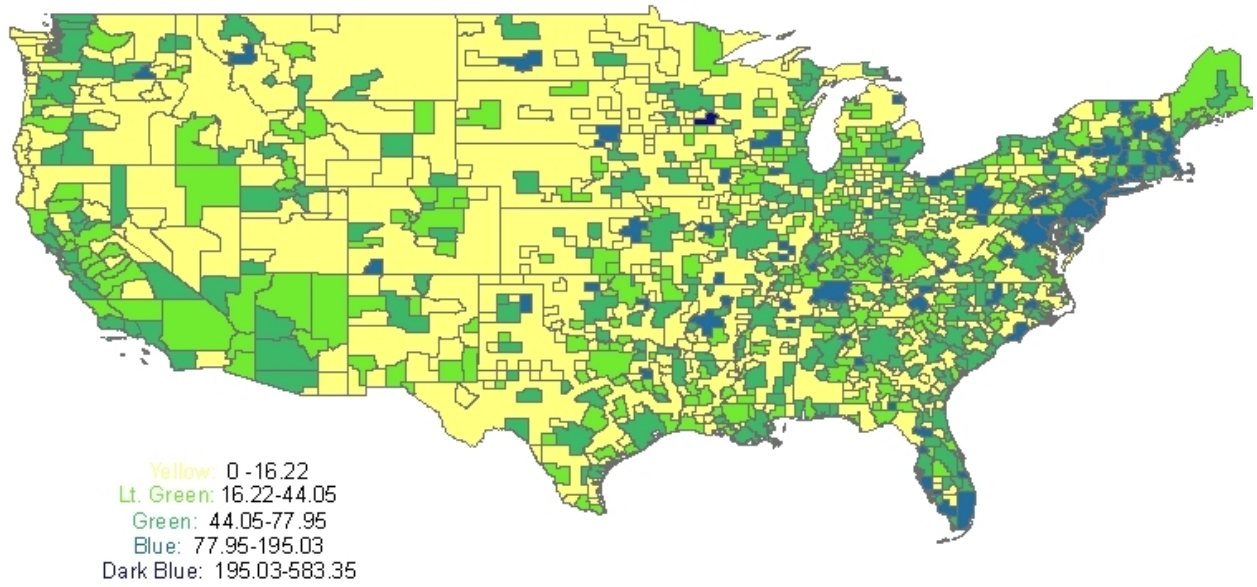


Table II-8: CBSAs with the Highest Concentration of Interventionalist Cardiologists, 2008

Metropolitan Area	Population	Count	Per Million Population
Rochester, MN	174,853	18	102.94
Springfield, IL	204,745	19	92.80
Lubbock, TX	257,663	18	69.86
Greenville, NC	160,806	10	62.19
Tyler, TX	186,414	11	59.01
Ann Arbor, MI	339,191	20	58.96
Lexington-Fayette, KY	424,661	24	56.52
Joplin, MO	164,235	9	54.80
Gainesville, FL	239,114	13	54.37
Sioux Falls, SD	203,324	11	54.10
Lebanon, NH-VT	171,381	9	52.51
Shreveport-Bossier City, LA	381,817	20	52.38
Durham, NC	451,212	22	48.76
Macon, GA	228,170	11	48.21
Terre Haute, IN	168,767	8	47.40

Figure II-6: Concentration of Interventional Cardiologists Across CBSAs in the United States, 2008

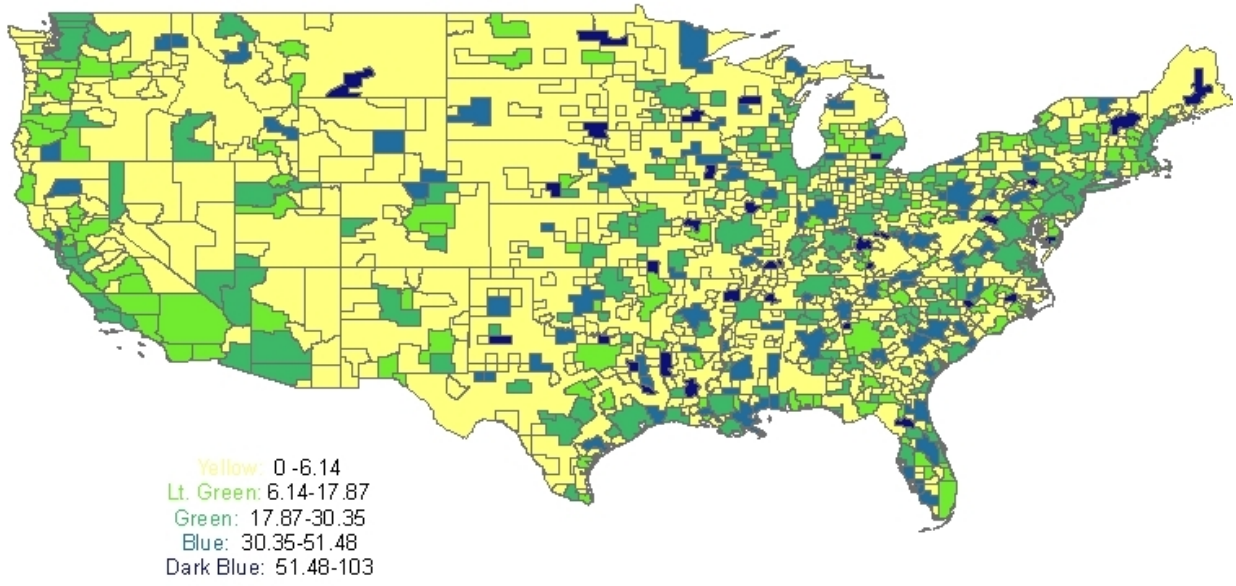


Table II-9: CBSAs with the Highest Concentration of Cardiac Electrophysiologists, 2008

Metropolitan Area	Population	Count	Per Million Population
Rochester, MN	174,853	14	80.07
Ann Arbor, MI	339,191	18	53.07
Burlington-South Burlington, VT	204,485	7	34.23
Lebanon, NH-VT	171,381	5	29.17
Durham, NC	451,212	12	26.60
Gainesville, FL	239,114	6	25.09
Charlottesville, VA	180,901	4	22.11
Wilmington, NC	303,246	6	19.79
Springfield, IL	204,745	4	19.54
Harrisburg-Carlisle, PA	519,331	10	19.26
Saginaw-Saginaw Township North, MI	209,062	4	19.13
Greenville, NC	160,806	3	18.66
Indianapolis, IN	1,621,613	30	18.50
Spokane, WA	435,644	8	18.36
Erie, PA	282,355	5	17.71

Figure II-7: Concentration of Clinical Cardiac Electrophysiologists Across CBSAs in the United States, 2008

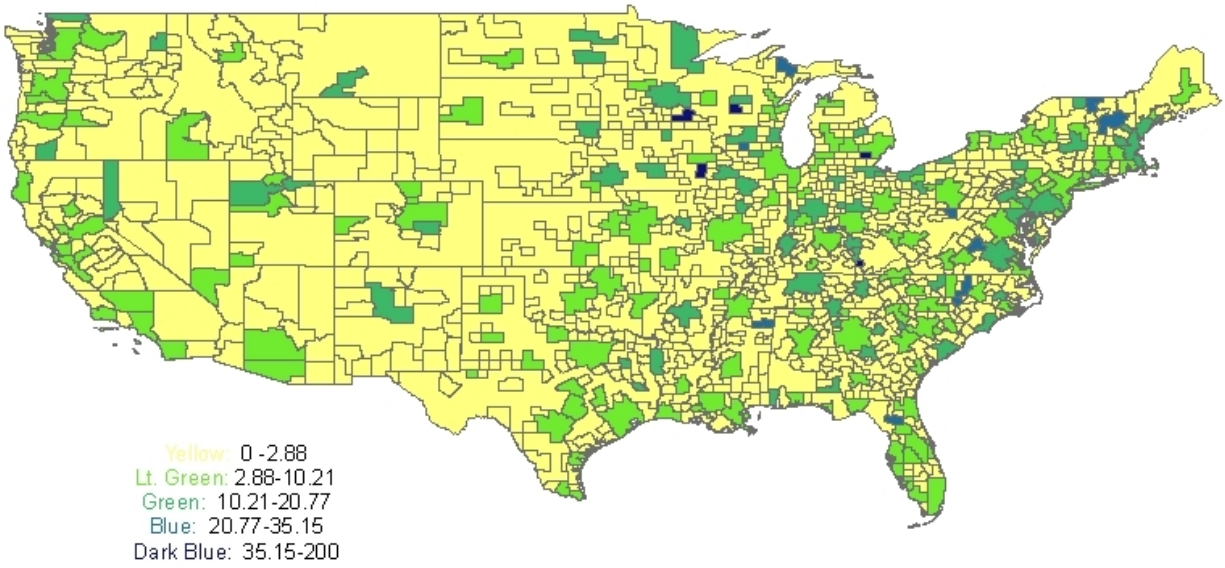
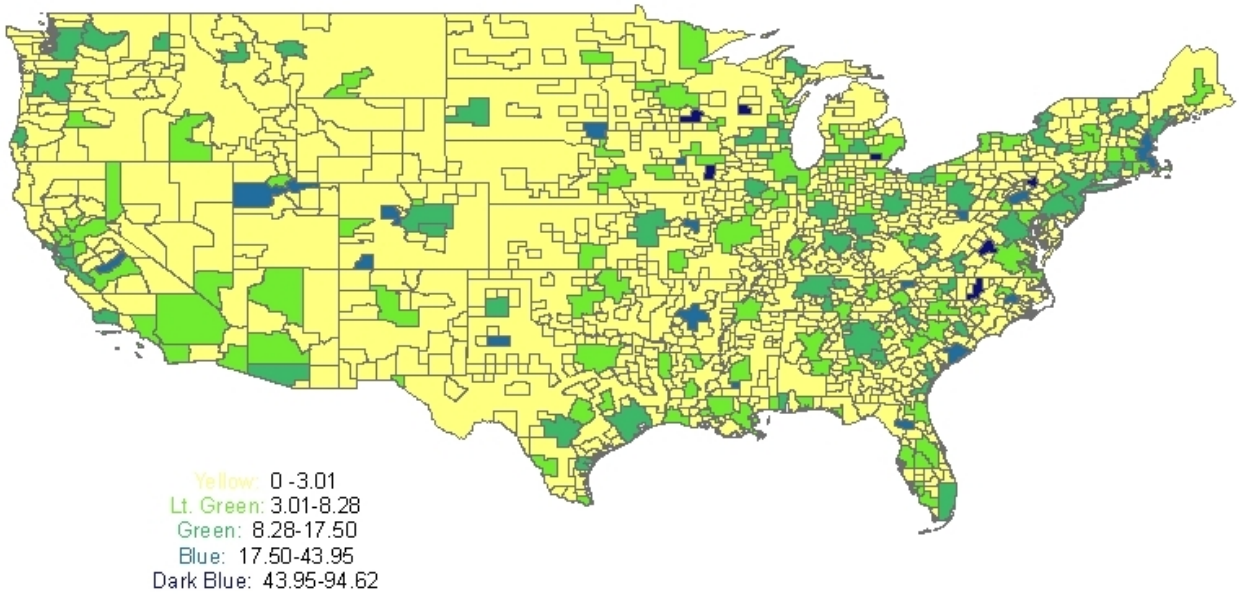


Table II-10: CBSAs with the Highest Concentration of Pediatric Cardiologists, 2008

Metropolitan Area	Population	Count	Per Million Population
Ann Arbor, MI Metro SA	339,191	24	70.76
Rochester, MN Metro SA	174,853	12	68.63
Durham, NC Metro SA	451,212	25	55.41
Charlottesville, VA Metro SA	180,901	10	55.28
Gainesville, FL Metro SA	239,114	8	33.46
Charleston-North Charleston, SC Metro SA	583,434	16	27.42
Little Rock-North Little Rock, AR Metro SA	636,636	16	25.13
Greenville, NC Metro SA	160,806	4	24.87
Boston-Cambridge-Quincy, MA-NH Metro SA	4,424,649	104	23.50
Johnson City, TN Metro SA	187,321	4	21.35
Harrisburg-Carlisle, PA Metro SA	519,331	11	21.18
Sioux Falls, SD Metro SA	203,324	4	19.67
Salt Lake City, UT Metro SA	1,018,826	20	19.63
Lubbock, TX Metro SA	257,663	5	19.41
Lebanon, NH-VT Micro SA	171,381	3	17.50

Figure II-8: Concentration of Pediatric Cardiologists Across CBSAs in the United States, 2008



III. OVERVIEW OF CURRENT DEMAND

In this section, we examine the distribution of services currently being provided by cardiologists. First, we provide a brief description of our data sources. Then, we provide an overview of services provided by cardiologists, identify competitors, and assess demand for the four cardiology subspecialties.

A. Data Sources

We use multiple sources of data for these statistics. For services provided under the Medicare program, we use the BMAD file. This file includes provider specialty, CPT code, payment amount, and number of units for claims billed under Medicare Part-B in a given fiscal year. For services provided to the population under age 65, we use an extract from the United Health Group (UHG) commercial claims database known as the Research Data Mart (RDM) which includes information on beneficiary age, type of insurance coverage, CPT code, units of service and UHG paid amount (i.e., allowed amount less beneficiary coinsurance and payments made by other insurers) for approximately 16 million covered beneficiaries. Finally, for information on patient diagnosis and cardiologist competitors, we use the National Ambulatory Medical Care Survey (NAMCS), which includes observations for a national sample of physician office visits. Each visit observation includes information on provider specialty, diagnosis, and reason for visit. We use the National Ambulatory Medical Care Survey to analyze patterns of health care use in the outpatient setting.

B. Overview of Cardiologists Services

In this section, we look at the types of services provided by cardiologists and assess trends in demand for various service types.

1. Services to Those Less than Age 65

In Table III-1 we present cardiologist services provided to a privately insured population. Insurer payments have been divided into those for Evaluation and Management Services (E&M) and those for procedural services (Non-E&M). Beneficiary coinsurances and deductibles, as well as payments from secondary insurers are not included in the total payment amounts listed.

Table III-1: Private Insurer Payments to Cardiologists Per Million Member Months

Service	2003	2006	Annual % Change
E&M			
0-17	$198,057	$229,738	5%
18-39	$199,985	$232,502	5%
40-64	$996,294	$1,080,728	3%
Non-E&M			
0-17	$496,423	$664,452	10%
18-39	$923,205	$1,130,891	7%
40-64	$5,224,889	$6,018,227	5%

The trends listed in Table III-1 suggest that Non-E&M services have been growing at a faster rate than E&M services for all age groups. Non-E&M services have been growing particularly rapidly for the pediatric population with a 10% annual growth rate between 2003 and 2006.

Table III-2 displays the top 20 procedural services by total payments in 2003 and shows the annualized growth in payments for these services between 2003 and 2006. Only one service that was in the top 20 in 2003 was not in the top 20 in 2006. This is injection for coronary x-rays. This service was replaced in the top 20 for 2006 by J0152 – injection of adenosine for diagnostic use.

Table III-2: Top 20 Procedural Services in 2003
Private Insurance Payments to Cardiologists
(Per Million Member Months)

CPT Code	Description	Payments per Million Member Months		
		2003	2006	Annualized % Change
78465	Heart image (3d), multiple	$392,423	$497,107	8.2%
93307	Echo exam of heart	$256,776	$314,956	7.0%
93015	Cardiovascular stress test	$163,791	$173,844	2.0%
93325	Doppler color flow add-on	$157,985	$210,675	10.1%
93320	Doppler echo exam, heart	$142,435	$173,057	6.7%
92980	Insert intracoronary stent	$131,796	$141,739	2.5%
93510	Left heart catheterization	$117,464	$120,273	0.8%
78480	Heart function add-on	$70,967	$91,824	9.0%
78478	Heart wall motion add-on	$70,761	$91,406	8.9%
A9500	Technetium Tc-99m sestamibi	$66,310	$101,691	15.3%
93350	Echo transthoracic	$62,400	$65,787	1.8%
93000	Electrocardiogram, complete	$47,990	$57,265	6.1%
A9502	Technetium Tc-99m tetrofosmin	$43,298	$72,608	18.8%
A9505	Thallium Tl-201 thallous chloride	$41,038	$45,185	3.3%
93010	Electrocardiogram report	$36,606	$43,748	6.1%
93556	Imaging, cardiac cath	$29,887	$28,950	-1.1%
93303	Echo transthoracic	$26,636	$34,373	8.9%
93651	Ablate heart dysrhythm focus	$26,209	$30,826	5.6%
93545	Inject for coronary x-rays	$26,078	$17,674	-12.2%
93620	Comp electrophysiological eval	$24,455	$27,461	3.9%

2. Services to the Medicare Population

Table III-3 displays total Medicare payments to cardiologists in 2001 and 2006. During this period, overall cardiologists' payments increased by 8% annually. At the same time, the Medicare enrollment in the Part B program increased only 1.5% annually. Thus, payments per enrollee increased substantially in this period. Payments for non-E&M services increased more rapidly than payments for E&M services. In 2001, E&M services represented 35% of payments to cardiologists. By 2006, this share had declined to 29%.

Table III-3: Medicare Payments to Cardiologists (in Millions of Dollars)

Service	2001	2006	Annualized % Change
Total	$4,268	$6,408	8%
E&M	$1,502	$1,847	4%
Non-E&M	$2,766	$4,561	11%

Table III-4 displays trends in E&M services. Office visits and consultations were the fastest growing visit categories. Hospital visits were growing at less than one-percent annually.

Table III-4: Evaluation and Management Services Medicare Payments to Cardiologists (in Millions of Dollars)

Service	2001	2006	Annualized % Change
Total E&M	$1,502	$1,847	4.2%
Office Visits	$556	$790	7.3%
Hospital Visits	$565	$576	0.4%
Consults	$324	$441	6.4%
Other	$57	$39	-7.3%

Table III-5 displays the 20 procedures representing the greatest share of cardiologist payments in 2001. The services in the top 20 are fairly consistent between 2001 and 2006. However, in 2006, two services moved into the top 20: injection adenosine (J0151 and J0152) and electrode insertion of pacemaker or pacing cardioverter defibrillator (33249). Injection of adenosine increased from $26 million in 2001 to $86 million in 2006. Electrode insertion of pacemaker or pacing cardioverter defibrillator increased from $16 million in 2001 to $45 million in 2006.

Table III-5: Top 20 Procedural Services in 2001 Medicare Payments to Cardiologists (in Millions of Dollars)

CPT Code	Service	2001	2006	Annualized % Change
78465	Heart image (3d), multiple	$367	$756	16%
93307	Echo exam of heart	$336	$514	9%
92980	Insert intracoronary stent	$184	$237	5%
93510	Left heart catheterization	$154	$192	4%
93320	Doppler echo exam, heart	$149	$235	10%
93325	Doppler color flow add-on	$141	$257	13%
93015	Cardiovascular stress test	$107	$161	9%
93000	Electrocardiogram, complete	$85	$105	4%
93010	Electrocardiogram report	$77	$84	2%
78478	Heart wall motion add-on	$61	$140	18%
78480	Heart function add-on	$59	$137	19%
A9500	Technetium Tc-99m sestamibi	$58	$163	23%
93526	Rt & Lt heart catheters	$45	$41	-2%
93556	Imaging, cardiac cath	$39	$50	5%
93880	Extracranial study	$37	$106	23%
33208	Insertion of heart pacemaker	$37	$37	0%
A9502	Technetium Tc-99m tetrofosmin	$34	$92	22%
93555	Imaging, cardiac cath	$33	$39	4%
A9505	Thallium Tl-201 thallous chloride	$31	$41	6%
92982	Coronary artery dilation	$27	$12	-14%

3. Summary

Payments to cardiologists have increased substantially over the last several years. Annualized increases in the privately insured population, as represented by the UHG data, by age group ranged from 4 to 9%. Annual increases in the Medicare population were about 8%. Non-E&M services are increasing more rapidly than E&M services suggesting that in the future E&M services will represent a smaller share of cardiology practice revenue than they do currently.

C. Competitors

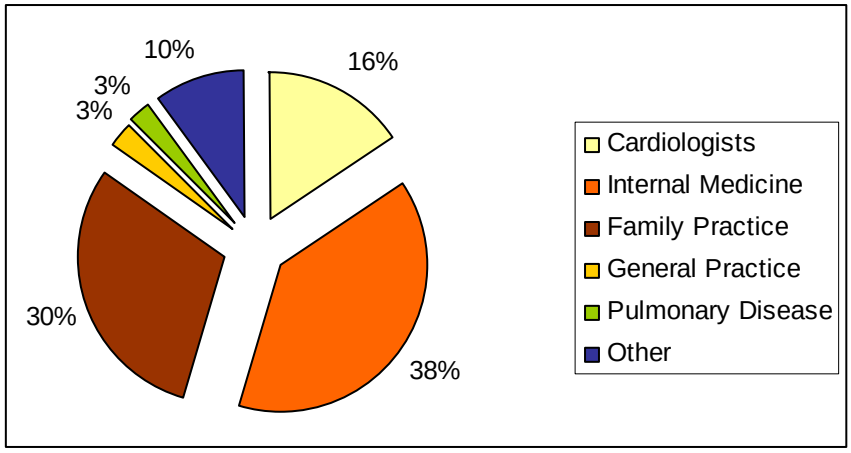
Table III-6 displays the top diagnoses in terms of the number of cardiologist visits in the 2005 NAMCS. These diagnoses represent 61% of all cardiologist office visits in 2005. The final column of the table indicates the percentage of office visits for the given diagnosis that were provided by cardiologists. Among this set of top diagnoses only 16% of visits with the same diagnosis were provided by a cardiologist. Cardiologists provided less than 10% of the visits for hypertension, hyperlipidemia, chronic airway obstruction, and diabetes.

Table III-6: Top Diagnoses in the 2005 NAMCS for Cardiologists (Excludes Follow-up Exam and Other Specified Aftercare)

ICD-9 Code	Diagnosis Label	Visits		Cardiologist Share
		Cardiologist	Non-Cardiologist	
	Total	**16,070,116**	**84,946,819**	**16%**
-4019	HYPERTENSION NOS	3,432,100	39,216,902	8%
41400	COR ATH UNSP VSL NTV/GFT	3,255,413	3,934,707	45%
78650	CHEST PAIN NOS	1,514,994	2,337,470	39%
42731	ATRIAL FIBRILLATION	1,126,715	1,490,397	43%
-4139	ANGINA PECTORIS NEC/NOS	783,608	415,554	65%
-4280	CHF NOS	728,110	1,670,618	30%
-4254	PRIM CARDIOMYOPATHY NEC	632,013	322,130	66%
-4241	AORTIC VALVE DISORDER	578,412	315,338	65%
78609	RESPIRATORY ABNORM NEC	574,909	1,376,818	29%
-7851	PALPITATIONS	553,169	858,368	39%
-2724	HYPERLIPIDEMIA NEC/NOS	519,086	6,904,722	7%
V717-	OBS-SUSP CARDIOVASC DIS	398,049	192,227	67%
4260-	ATRIOVENT BLOCK COMPLETE	384,739	0	100%
496--	CHRONIC AIRWAY OBSTRUCTION NEC	383,053	6,676,539	5%
78659	CHEST PAIN NEC	342,964	748,163	31%
-7802	SYNCOPE AND COLLAPSE	331,483	727,362	31%
25000	DMII WO CMP NT ST UNCNTR	268,248	17,759,504	1%
-4240	MITRAL VALVE DISORDER	263,051	77,878	77%

Figure III-1 displays the share of visits for these top diagnoses by the provider specialty in the NAMCS. Internal medicine and family practice specialties provide the greatest share of these visits. Given the important role primary care physicians play in the treatment of many top cardiology diagnoses, as demand for cardiology care increases, collaboration with primary care physicians may be one source of increased efficiency. Increased efficiency may be possible by assuring appropriate referrals and cooperation in managing chronic conditions.

Figure III-1: Share of Top Cardiologist Diagnoses by Specialty



D. Demand for Subspecialists

In this section, we disaggregate demand by cardiology subspecialty. Services provided to patients under 18 are assigned to pediatric cardiologists. Adult services are disaggregated by CPT code. We identified CPT codes which require specialized training in interventional cardiology or cardiac electrophysiology. These services are listed in Appendix B.

1. Services to Those Less than 65

In this section, we display trends in utilization and payment for a privately insured population based on the UHG RDM files.

Table III-7 displays trends in services and payments to cardiologists by subspecialty for this privately insured population. Annualized increases in payments have been greatest for pediatric cardiology. General cardiology and cardiac electrophysiology payments increased at similar rates (6.3% and 5.9%, respectively). Payment increases for interventional cardiology lagged behind the other subspecialties.

Table III-7: Number of Services and Insurer Payments Per Million Member Months 2003 and 2006

	2003		2006		Annualized Trend	
	Services	Payments	Services	Payments	Services	Payments
Pediatric Cardiology	6,114	$694,479	7,211	$894,190	5.7%	8.8%
General Cardiology	26,934	$2,771,573	32,531	$3,328,397	6.5%	6.3%
Interventional Cardiology	520	$301,821	600	$326,492	4.9%	2.7%
Cardiac Electrophysiology	187	$115,691	234	$137,592	7.8%	5.9%

The next two tables display more detail on services provided by interventionalists and electrophysiologists. Table III-8 displays detail on services provided by interventionalists. In 2006, 61% of the payments for services we have identified as interventional cardiology are for intracoronary stents. These services were only growing at only 2.4% annually. Angioplasty and atherectomy represent a much smaller share of interventional payments; however, these services were growing more rapidly.

Table III-8: Number of Services and Insurer Payments Per Million Member Months, 2003 and 2006
Interventional Cardiologists

	2003		2006		Annualized Trend	
	Services	Payments	Services	Payments	Services	Payments
Total	**514**	**$298,532**	**591**	**$322,032**	**4.8%**	**2.6%**
Insert Intracoronary Stent (92980-92981)	173	$183,255	203	$196,541	5.6%	2.4%
Transluminal Balloon Angioplasty (35450-35476)	33	$18,158	35	$25,115	2.1%	11.4%
Atherectomy (92995-92996, 35480-35495)	2	$1,775	7	$2,742	44.0%	15.6%
Transcatheter Placement of Stents (37205-37208, 37215-37216)	8	$3,798	12	$4,985	11.5%	9.5%

Table III-9 displays detail on services provided by cardiac electrophysiologists. In 2006, 46% of the payments for the services we have identified as cardiac electrophysiology are for electrophysiology evaluations. These services were growing rapidly.

Table III-9: Number of Services and Insurer Payments Per Million Member Months, 2003 and 2006
Cardiac Electrophysiology

	2003		2006		Annualized Trend	
	Services	Payments	Services	Payments	Services	Payments
Total	**187**	**$115,691**	**234**	**$137,592**	**7.8%**	**5.9%**
EP Evaluation (93641-93642)	18	$8,966	26	$11,769	12.6%	9.5%
Comprehensive EP Evaluation (93619-93622)	59	$45,160	71	$51,769	6.1%	4.7%
Ablate Heart Dysrhythm Focus (93650-93652)	26	$36,214	33	$41,301	8.1%	4.5%
Map tachycardia, add-on (93609)	14	$7,630	13	$4,906	-2.4%	-13.7%
Intracardiac electrophysiologic 3-dim mapping (93613)	7	$4,070	14	$7,479	27.6%	22.5%

2. Services to the Medicare Population

In this section, we present utilization and payment information for the Medicare population based on data included in the Medicare BMAD files.

Table III-10 shows Medicare services per beneficiary by cardiology subspecialty. The growth rates displayed here for the Medicare population for general cardiology and interventional cardiology are somewhat higher than those observed for the privately insured population. Growth rates for cardiac electrophysiology are somewhat slower than for the privately insured population. Similar to the privately insured population, general cardiology is growing most

rapidly. Electrophysiology and interventional cardiology are growing at similar rates in the Medicare population.

Table III-10: Number of Services and Insurer Payments Per Million Beneficiaries 2001 and 2006

	2001		2006		Annualized Trend	
	Services	Payments	Services	Payments	Services	Payments
General Cardiology	2,265,828	$104,514,788	3,082,066	$147,222,491	6.3%	7.1%
Interventional Cardiology	15,646	$7,032,436	22,474	$8,683,174	7.5%	4.3%
Cardiac Electro-physiology	4,490	$1,709,165	7,242	$2,132,286	10.0%	4.5%

Table III-11 provides an overview of service counts and Medicare payments for cardiac electrophysiology procedures in 2001 and 2006. The number of services and total payments for cardiac electrophysiology has grown rapidly over this five year period at 12% and 6% annually.

Table III-11: Electrophysiology Services Provided to the Medicare Population Number of Services (in Thousands) and Total Payments (in Millions) 2001 and 2006

	2001		2006		Annualized Trend	
Service	Number of Services	Total Payments	Number of Services	Total Payments	Number of Services	Total Payments
Total	169	$64	294	$86	12%	6%
EP Evaluation (93641-93642)	35	$10	92	$23	21%	19%
Comprehensive EP Evaluation (93619-93622)	48	$28	71	$27	8%	-1%
Ablate Heart Dysrhythm Focus (93650-93652)	20	$14	34	$22	11%	9%
Map tachycardia, add-on (93609)	12	$5	13	$3	3%	-11%
Intracardiac electrophysiologic 3-dim mapping (93613)	0	$0	11	$4	NA	NA

Interventional cardiology services and payments for Medicare patients in 2001 and 2006 are displayed in Table III-12. Payments for interventional services grew at the same rate of 6% annually as electrophysiology services. Transluminal balloon angioplasty and transcatheter placement of stents saw the most substantial annual growth in payments.

Table III-12: Interventional Cardiology Services Provided to the Medicare Population Number of Services (in Thousands) and Total Payments (in Millions) 2001 and 2006

Service	2001		2006		Annualized Trend	
	Number of Services	Total Payments	Number of Services	Total Payments	Services	Total Payments
Total	**590**	**$265**	**911**	**$352**	**9%**	**6%**
Insert Intracoronary Stent (92980-92981)	283	$191	414	$246	8%	5%
Transluminal Balloon Angioplasty (35450-35476)	25	$9	51	$15	15%	12%
Atherectomy (92995-92996, 35480-35495)	8	$4	19	$6	18%	8%
Transcatheter Placement of Stents (37205-37208, 37215-37216)	22	$6	57	$19	21%	25%

3. Distribution of Payments Across Cardiology Subspecialties

In this section, we estimate the share of demand attributable to the four cardiologist subspecialties of interest to this study. Demand is disaggregated between adult and pediatric cardiology based on patient age. Demand for adult cardiology services is disaggregated between the adult subspecialties based on procedures designated as electrophysiology or interventional as displayed in Appendix B. The distribution of procedure expenditures by subspecialty is displayed in Table III-13. The shares for the population less than 65 are based on the UHG RDM files. The shares for the population 65 and older are based on Medicare BMAD files. The BMAD data cannot be disaggregated by gender. Thus, the shares are the same for males and females 65 and older.

Table III-13: Distribution of Procedure Payments Across Cardiology Subspecialties

		Pediatric	Generalist	Interventional	Electrophysiology
0-5	Female	100%	0%	0%	0%
	Male	100%	0%	0%	0%
6-17	Female	100%	0%	0%	0%
	Male	100%	0%	0%	0%
18-20	Female	0%	84.8%	3.2%	12.0%
	Male	0%	85.2%	4.5%	10.4%
21-44	Female	0%	89.4%	4.4%	6.3%
	Male	0%	89.5%	5.2%	5.2%
45-64	Female	0%	90.7%	6.5%	2.8%
	Male	0%	85.2%	11.2%	3.6%
65+	Female	0%	90.4%	7.7%	1.9%
	Male	0%	90.4%	7.7%	1.9%

The distribution of visit expenditures by subspecialty is displayed in Table III-14. Each procedure for interventionalists and electrophysiologists is assigned a new patient visit and an established patient follow-up visit to estimate visit expenditures for these subspecialties.

Table III-14: Distribution of Visit Payments Across Cardiology Subspecialties

		Pediatric	Generalist	Interventional	Electrophysiology
0-5	Female	100%	0%	0%	0%
	Male	100%	0%	0%	0%
6-17	Female	100%	0%	0%	0%
	Male	100%	0%	0%	0%
18-20	Female	0%	73.5%	8.7%	17.8%
	Male	0%	75.5%	10.8%	13.7%
21-44	Female	0%	77.7%	11.5%	10.8%
	Male	0%	81.2%	11.1%	7.8%
45-64	Female	0%	81.0%	14.0%	5.1%
	Male	0%	76.0%	18.2%	5.8%
65+	Female	0%	89.8%	7.7%	2.5%
	Male	0%	89.8%	7.7%	2.5%

4. Summary

By subspecialty, these results suggest the most rapid increases in demand over the last several years has been for pediatric cardiology followed by general cardiology. Demand for electrophysiology and interventional cardiology are increasing, but not as rapidly as that for general cardiology and pediatric cardiology.

IV. FACTORS AFFECTING SUPPLY AND DEMAND

In this section, we discuss the primary factors affecting the supply of and demand for cardiologists. The data presented here will provide the basis for our baseline projections of supply and demand and for simulated scenarios of how sensitive these projections are to our assumptions.

We will project the active supply of cardiologists from 2008 through 2025. We measure the count of cardiologist in two ways. First, we present the "active supply." This count is simply the number of active physicians in each year. The second measure is full-time equivalent supply or "FTE supply." This measure normalizes the count of physicians in each year by average hours worked per physician in that year relative to the average hours worked by physicians in 2008. Thus, if physicians are projected to work fewer (more) hours per week in future years "FTE supply" will be lower (higher) than "active supply." Here, we first discuss estimates of "active supply." Then, we adjust these estimates to the "FTE supply. "

Mathematically, active supply in the next year (T+1) is a function of supply in the current year (T) plus new entrants minus attrition:

$$\text{Active Supply}_{T+1} = \text{Active Supply}_{T} + \text{New Entrants}_{T} - \text{Attrition}_{T}$$

New entrants are physicians completing fellowship training. Attrition is physicians who have retired or died.

Below, we first discuss supply related factors. Then, we discuss demand related factors.

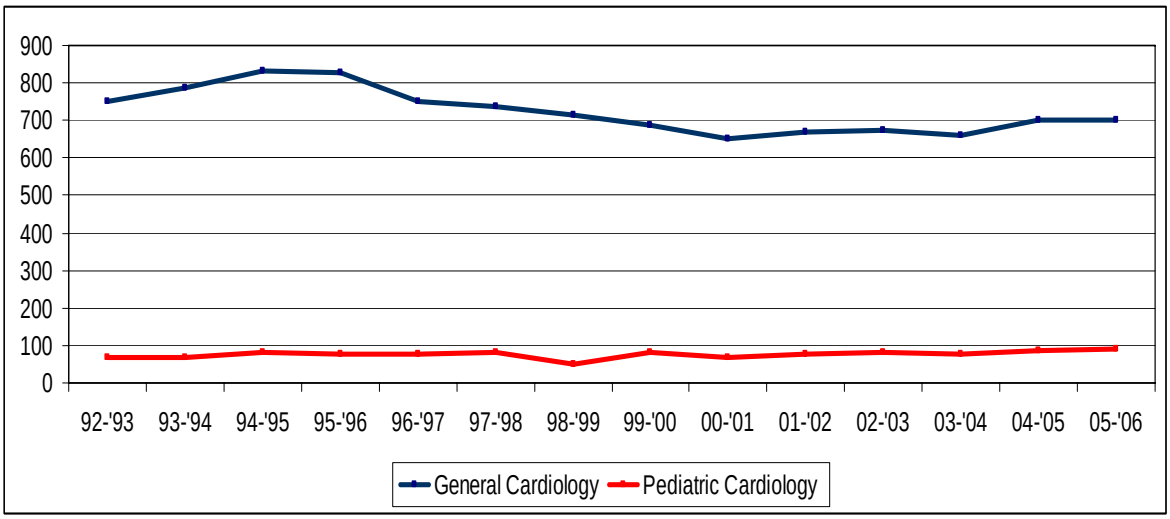
A. Factors Affecting Supply

The primary factors affecting the supply of cardiologists are the number of cardiologists completing fellowship training, the number of hours worked by active cardiologists, the mortality rate and the number of cardiologists who retire. We discuss each of these supply factors in turn in the next several sections.

1. Trends in Fellowships

Figure IV-1 displays the number of adult and pediatric cardiologists completing fellowship training between 1993 and 2006. The number completing adult cardiology training annually has decreased over this period. Between 1993 and 1997, the average number of fellows completing training in cardiovascular disease was 790. By the period 2002-2006, this number had dropped 14% to an average of 681 fellows completing training annually. In contrast, the number of fellows completing training in pediatric cardiology increased 12% from an average of 74 between 1993 and 1997 to an average of 82 between 2002 and 2006.

Figure IV-1: Number of Adult and Pediatric Cardiologists Completing Fellowship Training 1993-2006



This decline in fellows completing adult cardiovascular disease training does not appear to be related to a lack of interest in cardiology among those completing internal medicine residencies. Match program statistics for both adult and pediatric cardiology fellowships indicate strong demand for training in both subspecialties. There are about 1.8 applicants for each adult cardiovascular disease fellowship position. There are about 1.2 to 1.6 applicants for each pediatric cardiovascular disease fellowship position.[14]

Figure IV-2 displays the number of interventionalist cardiology and cardiac electrophysiology fellows completing training in each year since these programs began. Interest in these programs rose steadily after their inception; however, in the most recent period of observed data, these increases appear to be leveling off.

[14] See Table IV-5 in Section IV.C.2.

Figure IV-2: Number of Cardiac Electrophysiologists and Interventionalists Completing Fellowship Training 1993-2006

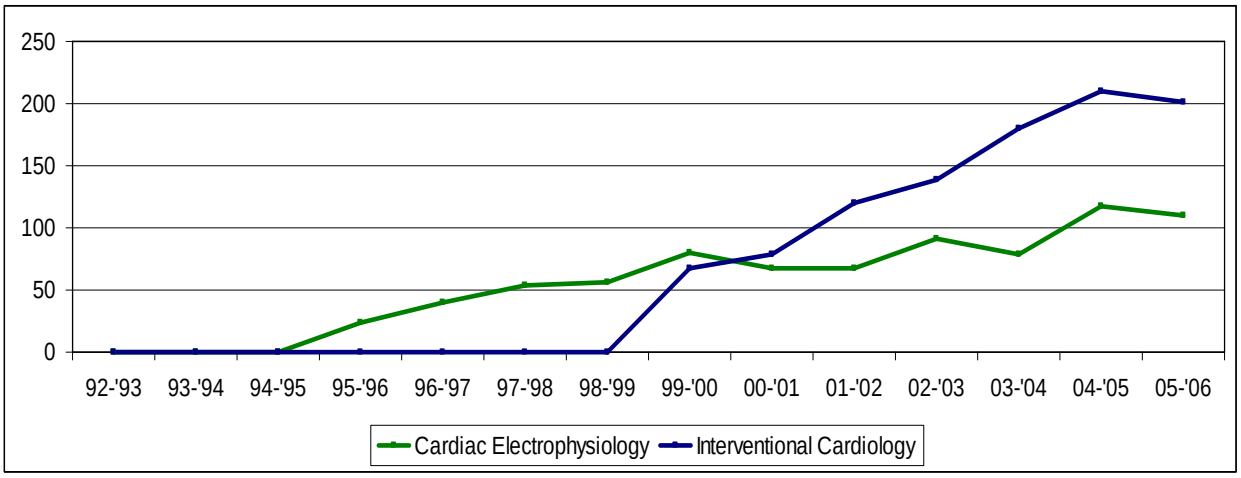


Table IV-1 shows counts of fellows completing training in each subspecialty in the most recent four years. The final column of the table shows our baseline projections for the number of fellows completing training in each year from 2008 through 2035.

Table IV-1: Baseline Projections for the Number of Cardiologists Completing Fellowship Training

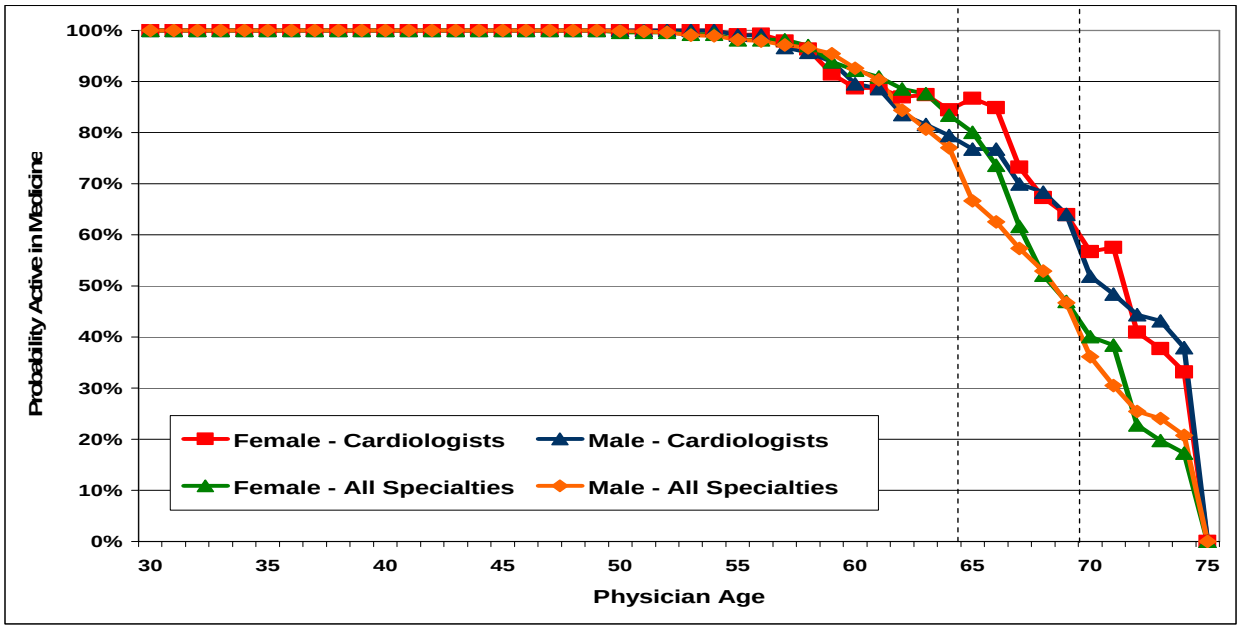
Specialty	2003-2004	2004-2005	2005-2006	2006-2007	Projected 2008-2035
General Cardiology	660	701	703	678	720
Clinical Cardiac Electrophysiology	79	117	110	124	133
Interventional Cardiology	180	210	201	225	234
Pediatric Cardiology	78	84	92	99	98

2. Retirement Rates

Baseline estimates of retirement rates for cardiologists by age are based on data from the Over 50 Survey. Retirement rates were calculated using the reported age at retirement based on survey responses. For active cardiologists age 70 and older, the expected age of retirement was used. All physicians were assumed to retire by age 75.

Figure IV-3 displays these results. The results indicate that male and female cardiologists tend to retire later than their counterparts in other specialties. The majority of cardiologists are still active at age 65 and 50-60% remain active at age 70.

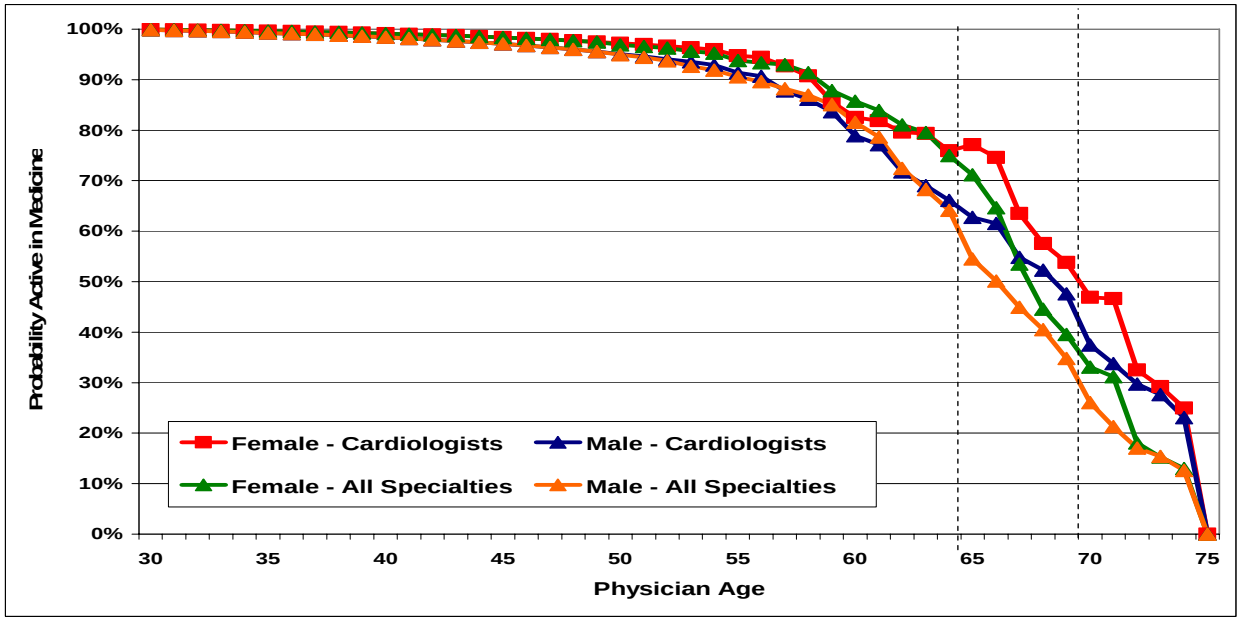
Figure IV-3: Proportion of Physicians Still Active by Age and Gender*



* Lewin analysis of AAMC/Specialty Physician Association Survey of Physicians Over 50.

The estimated retirement patterns based on physician responses to the Over 50 Survey are conditional upon the physician still being alive. Thus, we combine mortality risks with retirement probabilities to produce overall rates of attrition from the workforce as shown in Figure IV-4.

Figure IV-4: Proportion of Physicians Still Active After Adjusting for Mortality by Age and Gender*



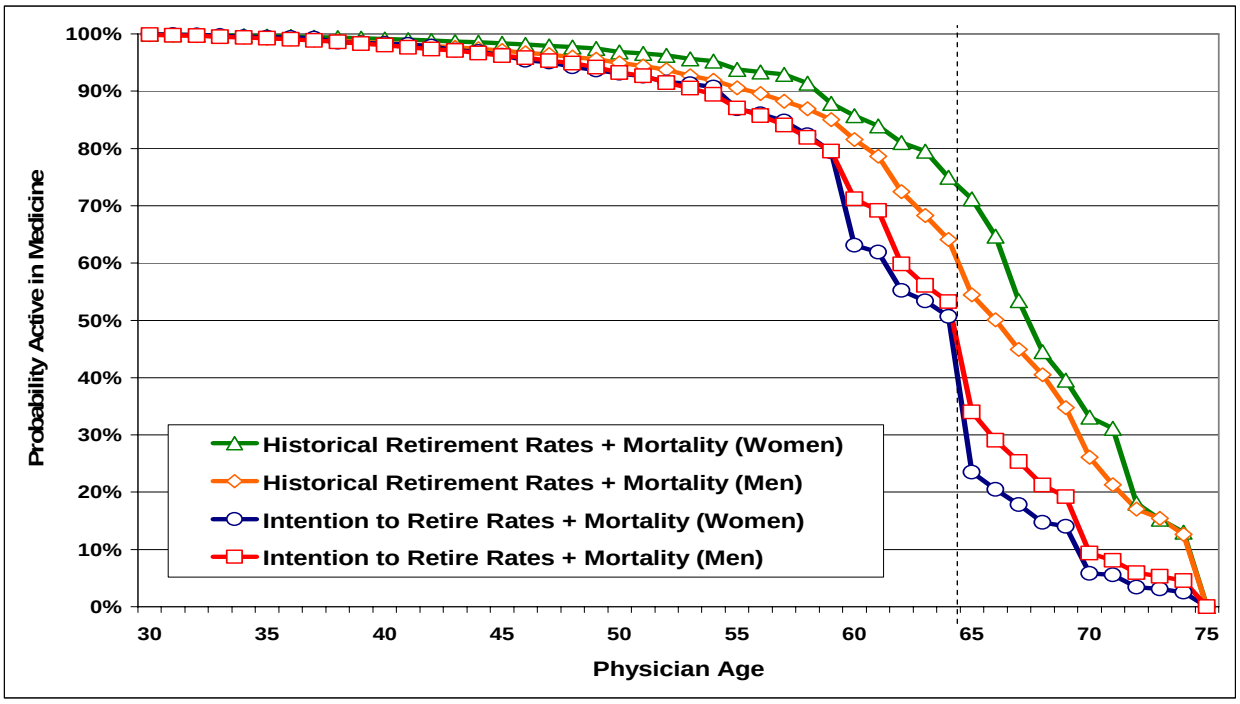
* Lewin analysis of AAMC/Specialty Physician Association Survey of Physicians Over 50 combined with CDC estimates of mortality adjusted to reflect physician's lower occupational mortality and greater access to quality healthcare.

Mortality rates are estimated based on CDC estimates for men and women. To adjust for lower occupational risk of mortality for physicians, their greater access to quality healthcare services, and their generally better health associated with affluence, we adjust the mortality rates to 80% of the national average for each age group. This adjustment is based on work by Johnson et al. (1999) who find that mortality rates among people age 25 to 64 are lower for physicians and other professional and technical occupations compared to mortality rates in most non-professional occupations.[15] For white males, age-adjusted mortality rates for professional and technical occupations are approximately 75% as high as the rates across all occupations. For white females, the mortality rates for professional and technical occupations are about 85% as high as rates across all occupations. Mortality rates for women are lower than those for men.

We use historical retirement rates in our baseline estimates; however, we also analyzed data from the Over 50 Survey on age intending to retire. These data indicate that a significant number of physicians expect to retire at milestone and eligibility ages—e.g., age 60 (milestone), age 62 (early eligibility for Social Security), age 65 (Medicare eligibility and eligibility for full Social Security benefits), and age 70 (milestone). There are numerous factors that go into retirement decisions, with some decisions not completely within the physician's control (e.g., poor health, stock market surge/crash, selling of medical practice). Active physicians who are nearing retirement can more accurately predict their age at retirement than physicians who are still years away from retirement (e.g., physicians in their 50s). Overall, we find that physicians intend to retire earlier than predicted by historical observed retirement rates. A comparison of expected and historical retirement rates is displayed in Figure IV-5.

[15] Johnson NJ, Sorlie PD, and Backlund E. 1999. The Impact of Specific Occupation on Mortality in the U.S. National Longitudinal Mortality Study. *Demography*, 36(3): 355-367.

Figure IV-5: Comparison of Historical Retirement Rates with Intention to Retire by Age and Gender*



* Lewin analysis of the Over 50 Survey.

3. *Hours of Work*

We translate the estimates of the active supply of cardiologists into estimates of FTE supply. For this study, we define an FTE as the average patient care hours per week worked across all physicians within each specialty. FTE supply in future years (T) is calculated by multiplying active supply times the adjustment for changes in average patient care hours worked.

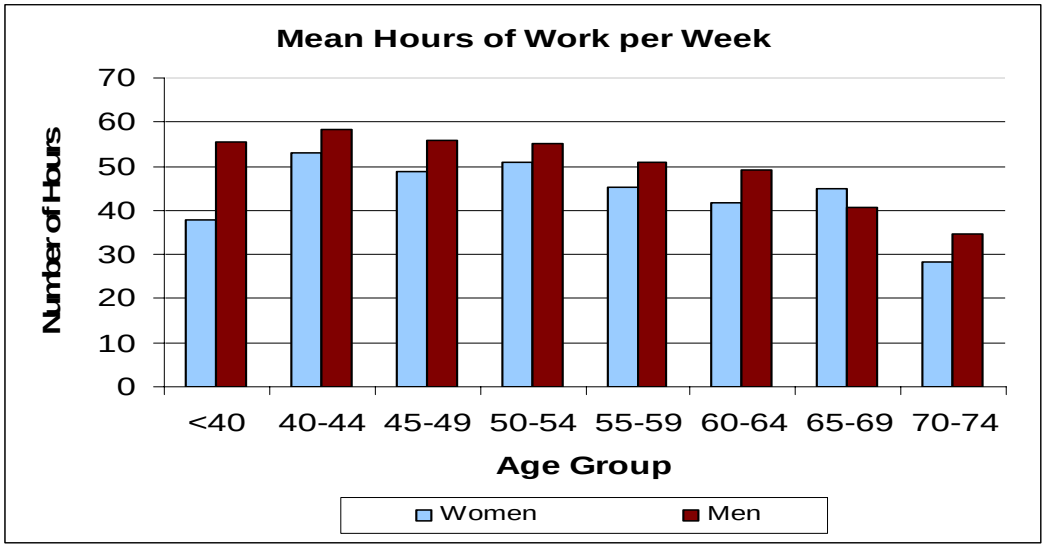
$$\text{FTE Supply}_T = \frac{\text{Ave Patient Care Hours}_T}{\text{Ave Patient Care Hours}_{T=2008}} \times \left(\text{Active Supply}_T\right)$$

For cardiologists 50 and over, we obtained estimates of average hours worked per week from the Over 50 Survey. The sample of cardiologists in the Over 50 survey who are actively engaged in cardiology is small, particularly when divided into age/gender groups. Therefore, in our modeling, we gave equal weight to the cardiologists specific mean hours worked for each age/gender cell and the overall average mean hours worked across all physicians in the over 50 survey. Because of the small sample sizes, this weighting created more stable trends in hours as physicians age than the cardiologist specific results. For cardiologists under 50, we obtained estimates of average hours worked from a survey sponsored by the Bureau of Health Professions during 2002 and 2003 that collected information on patient care hours worked.

The mean hours worked per week by age and gender assumed in the model are displayed in Figure IV-6. With the exception of the 65-69 year old age group, women tend to work fewer hours per week than men. Thus, as women represent a larger share of cardiologists, FTE

supply will decline. In addition, men tend to work fewer hours per week as they get older. Therefore, as the share of cardiologists who are older men increases, FTE supply will decline.

Figure IV-6: Mean Hours Worked per Week by Cardiologists in Patient Care*



* Hours for cardiologists under 50 are based on cardiologist specific responses to BHP 2002-2003 hours worked survey. Because the sample of cardiologists in each age/gender cell in the Over 50 Survey was small, hours for those 50 and over represent the average of mean cardiologist specific hours and mean hours across all physician specialties for the given age/gender cell based on date from the AAMC Over 50 Survey.

The means for both age groups include hours for all active physicians (i.e., both full-time and part-time). Average total work hours per week for full-time physicians would be higher than the averages reflected in Figure IV-6. The measure of total hours in the Over 50 Survey includes call time during which physicians are "actively engaged in patient care or coordination." The mean total hours for full-time cardiologists 50-59 as recorded in the Over 50 Survey is 66 hours per week. This is substantially higher than the means for both full and part-time cardiologists in this age group reflected in Figure IV-6. It is also interesting to note that a substantial portion of full-time cardiologists 50-59 (24%), report working 75 or more hours per week in the Over 50 Survey. [16] Eleven percent of full-time cardiologists 50-59 reported working more than 85 hours per week.

A less detailed source for hours worked data for cardiologists is the AMA Socioeconomics Statistics. The most recent version of the AMA survey which includes data on hours worked is the 1999 survey. Data from this survey on internal medicine specialties is reported in Table IV-2. For cardiologists, these data indicate 63 hours per week in professional activities and 58 hours per week in patient care activities. The mean hours in patient care activities from the AMA survey are similar to those in the HRSA survey.

[16] In contrast, among full-time physicians 50-59, only 10% of gastroenterologists and 15% of internal medicine specialists reported working more than 75 hours per week.

Table IV-2: Comparison of Weeks and Hours Worked in Internal Medicine Specialties AMA Socioeconomic Statistics, 1999*

Specialty	Mean	25th Percentile	Median	75th Percentile
Weeks in Practice per Year				
General Internal Medicine	47.7	47.0	48.0	50.0
Cardiovascular Disease	47.5	46.0	48.0	49.0
Gastroenterology	48.5	48.0	48.0	50.0
Other Internal Medicine	47.5	46.0	48.0	50.0
Hours in Professional Activities				
General Internal Medicine	58.1	46.0	57.0	68.0
Cardiovascular Disease	62.5	54.0	61.0	72.0
Gastroenterology	60.9	50.0	60.0	65.0
Other Internal Medicine	62.6	50.0	60.0	72.0
Hours in Patient Care Activities				
General Internal Medicine	52.9	42.0	52.0	63.0
Cardiovascular Disease	57.8	49.0	58.0	70.0
Gastroenterology	56.7	46.0	52.0	63.0
Other Internal Medicine	57.0	42.0	53.0	70.0

*AMA Socioeconomic Statistics, 2000-2002 page 131.

4. Physician Productivity

Given the growing demand for cardiologist services and the limited supply of training positions, it is likely that cardiologists in the future will look for ways to increase their productivity. Methods for increasing productivity might include:

- Use of electronic medical records;
- Increased use of mid-level practitioners;
- Increased use of efficient scheduling techniques;
- Delegation of administrative/business management duties; and
- Increased practice sizes and sharing of call responsibilities.

Responses from focus group/interviews conducted with cardiology fellows suggest that many fellows are looking for practices that will allow them to be most efficient in their work hours. Some of the increased demand for cardiology services will likely be absorbed through these and other methods of improving efficiency.

B. Factors Affecting Demand

Change in many areas will influence demand for cardiology over the next 20 years. These areas include demographic trends, lifestyle changes, economic growth, policy changes related to health insurance, and technological innovation.

- *Demographic Trends*—The U.S. population is projected to increase in all age groups over the next 20 years; however, growth in the number of people between age 65 and 84 and

over age 84 is expected to be most rapid. Between 2000 and 2010, growth in the population 65 to 84 is about one percent annually. Between 2010 and 2020, this jumps to 3.3% annually as the Baby Boomers begin to turn 65. Since age is a significant factor in the risk for cardiovascular disease, as the population ages the population's need for cardiovascular disease care will rise substantially.

- *Lifestyle Trends*—Recent trends in prevalence of obesity and type 2 diabetes in the U.S. population are likely to lead to increased demand for cardiovascular disease care. Attention to preventative care such as cholesterol reduction, reduced exposure to secondhand smoke, and increased physical activity may result in some reduction in demand for cardiology care.
- *Economic Growth*—Continued income growth in the U.S. will result in increased demand for cardiovascular disease care. In general, as income increases demand for goods and services that individuals value rises. As long as individuals see the efficacy of cardiovascular disease care, their demand will increase as incomes rise.
- *Insurance Status*—Policymakers continually express concern about the uninsured population in the U.S. and proposals for expanding coverage have been discussed by the presidential nominees. Expansion of insurance coverage would result in increased demand for services.
- *Technological Advances*—As new procedures are developed and prove efficacious, demand for care will increase above the projected increases related to demographic trends.

Of the demand-related factors listed here, only increases in preventative care, including education related to improved lifestyle choices and use of preventative therapies may shift demand downward. Overall, the factors affecting demand listed here suggest that demand will increase above the projected increases related to demographic trends. Trends in lifestyle, income, insurance status, and technological advances will likely have a substantial positive influence on demand over the next 20 years.

C. Indicators of Excess Demand

Several measures can be used to assess whether there is excess demand for cardiologist services. These measures include: changes in compensation levels, demand for training, open positions for cardiologists, and wait time for an appointment. We assess these measures here.

1. Growth in Cardiovascular Disease Specialist Compensation

Cardiologist compensation levels are not a factor affecting the demand for cardiologists. Rather, they are the outcome of the demand for and supply of cardiologists. When demand exceeds supply, we would expect compensation to rise. Conversely when supply exceeds demand, we would anticipate that earnings would begin to fall, or at least not rise as fast as they otherwise might.

In general, there is a scarcity of data on compensation of physician specialists. There are two primary sources for these data. The first is the American Medical Association's Socioeconomic Monitoring System, a survey of non-federal physicians. The last year compensation data are available from this survey is 1998. Thus, data on recent trends is not available. The second

source is Medical Group Management Association (MGMA) Physician Compensation and Productivity Survey. Data from this survey are displayed in Table IV-3, which shows earnings for cardiologists and other select internal medicine specialties for 2001 and 2006.

Table IV-3: Trends in Median Compensation Among Internal Medicine Specialties (In 2006 Dollars) MGMA*

Specialty	2001	2006	Annualized Change
Internal Medicine	$170,432	$181,187	1.2%
Cardiology: Invasive	$467,061	$457,563	-0.4%
Cardiology: Noninvasive	$364,395	$367,704	0.2%
Gastroenterology	$355,246	$406,345	2.7%
Nephrology	$267,916	$291,977	1.7%
Infectious Disease	$201,019	$201,667	0.1%
Hematology/Oncology	$312,212	$359,140	2.8%
Endocrinology	$193,892	$189,506	-0.5%
Pulmonary Disease	$245,540	$255,807	0.8%
Geriatrics	$172,966	$161,888	-1.3%
Rheumatology	$210,891	$199,810	-1.1%

* MGMA Physician Compensation and Production Survey reports for 2002 and 2007 reporting on the previous year's data. 2001 compensation adjusted to 2006 dollars based on CPI U.S. City Average for All Urban Consumers.

The compensation of both invasive and noninvasive cardiologists' exceeds the compensation of all other medical specialties in 2001. In 2006, median cardiologist compensation exceeds that of all other internal medicine subspecialties with the exception of gastroenterology which exceeds the compensation of noninvasive cardiologists. Real growth in compensation for cardiologists was low in this period with invasive cardiologists showing slightly negative real compensation change and non-invasive cardiologists showing only a 0.2% increase in compensation. During this period increasing supply of interventional cardiologists and cardiac electrophysiologists increased the share of cardiologists classified as invasive. The increasing supply of invasive cardiologists may have held compensation for invasive specialists flat.

Earnings comparisons can be very treacherous. Physicians in private practice typically earn more than those in academic practice or salaried positions. Those in large group practices earn more than those in solo practice, other things being equal. Further, physicians who work longer hours will typically earn more than those who work shorter hours, other factors held constant. Moreover, physicians who are more experienced—in the age range of 45-60—typically earn more than others. These simple comparisons of median responses from a survey of physicians' earnings do not adjust for these factors. For these reasons, as well as issues regarding the collection of earnings data in surveys, the estimates should be interpreted cautiously.

2. Demand for Training in Cardiovascular Disease Specialties

Demand for training in the field of cardiovascular disease indicates that medical school graduates believe the cost of training in monetary terms and in terms of their own time and

effort is outweighed by the potential increase in their compensation related to this training. Thus, strong demand for training positions in cardiovascular disease indicates a strong market for new cardiovascular disease graduates.

Data from the National Residency Match program indicate very strong demand for both adult and pediatric cardiovascular disease training. Table IV-4 indicates that over the past 5 years there have been approximately 1.8 applicants for each cardiovascular disease training position available. Over 99% of training positions have been filled through the match process in the last 5 years.

Table IV-4: Specialty Match Program Statistics Cardiovascular Disease, 2004-2008*

	2004	2005	2006	2007	2008
Total Applicants	1110	1192	1215	1233	1264
Positions Available	615	630	660	670	699
Applicants per Available Position	1.80	1.89	1.84	1.84	1.81
Number Matched	611	626	657	669	693
Number of Programs	156	157	163	163	164
Unfilled Programs	4	3	2	1	5

*Data drawn from National Residency Match Program Publication from Feb. 2008: *Results and Data: Specialties Matching Service 2008 Appointment Year* page 18.

Table IV-5 indicates that over the past 5 years there has been an average of 1.3 applicants for each pediatric cardiovascular disease training position available. Over 91% of training positions have been filled through the match process in the last 5 years.

Table IV-5: Specialty Match Program Statistics Pediatric Cardiology, 2004-2008*

	2004	2005	2006	2007	2008
Total Applicants	116	113	135	132	170
Positions Available	89	94	100	112	108
Applicants per Available Position	1.30	1.20	1.35	1.18	1.57
Number Matched	81	84	97	96	101
Number of Programs	45	43	45	46	45
Unfilled Programs	7	8	2	13	5

*Data drawn from National Residency Match Program Publication from Feb. 2008: *Results and Data: Specialties Matching Service 2008 Appointment Year* page 25.

These statistics suggests that if the number of fellowship training positions available in cardiology were increased, many applicants would be available to fill the positions.

3. Openings for Cardiovascular Specialists in Practices

The ACC Academic Practice, Pediatric Practice, and Private Practice Surveys asked practices included in the surveys to identify the number of positions they had available for cardiovascular disease specialists. The average number of cardiovascular specialist positions open per practice in

responding private and academic practices is listed by subspecialty in the first section of Table IV-6A. The second section indicates the total number of known private or academic practices relative to the number of responding practices and the percentage of open positions attributable to growth in demand or retirement. The number of open positions among responding practices is multiplied by these factors to yield the estimates of national demand in the third section. The number of fellows completing training in 2008, listed in the fourth section, is subtracted from the national estimates of open positions to yield the estimates of excess demand in the fifth section for each cardiology subspecialty.

Table IV-6A: Estimated Number of Open Positions for Cardiologists, 2007*

	Private	Academic	Total
Number of Open Positions in Responding Practices			
General Cardiology	213	35	248
Cardiac Electrophysiology	81	19	100
Interventional (Coronary+Peripheral)	232	24	256
Other	131	51	182
Adjustments to Yield National Demand for New Cardiologists			
Universe/Respondents	10.9	4.1	
% of Demand Related to Growth or Retirement	83.0%	77.0%	
National Estimate of New Cardiologists Demanded			
General Cardiology	1,928	110	2,038
Cardiac Electrophysiology	733	60	793
Interventional (Coronary+Peripheral)	2,100	75	2,175
Other	1,186	160	1,346
Estimated Fellows Completing Training 2008			
General Cardiology			353
Cardiac Electrophysiology			133
Interventional (Coronary+Peripheral)			234
Excess Demand 2008			
General Cardiology			1,685
Cardiac Electrophysiology			660
Interventional (Coronary+Peripheral)			1,941
Other			

*Lewin analysis of survey results as presented in ACC Presentation: Pediatric Work Force Survey Results. Slides 15 and 29 Estimating Open Positions Option 1.

Table IV-6B displays a similar excess demand calculation for pediatric cardiology.

Table IV-6B: Estimated Number of Open Positions for Cardiologists, 2007*

	Pediatric
Number of Open Positions in Responding Practices	
General Cardiology	40
Cardiac Electrophysiology	7
Interventional (Coronary+Peripheral)	8
Other	76
Adjustments to Yield National Demand for New Cardiologists	
Universe/Respondents	1.8
% of Demand Related to Growth or Retirement	93.0%
National Estimate of New Cardiologists Demanded	
General Cardiology	69
Cardiac Electrophysiology	12
Interventional (Coronary+Peripheral)	14
Other	130
Total	225
Estimated Fellows Completing Training 2008	98
Excess Demand 2008	127

*Lewin analysis of survey results as presented in ACC Presentation: Pediatric Work Force Survey Results. Slides 15 and 29 Estimating Open Positions Option 1.

The specific point estimates reported in Table IV-6A and Table IV-6B should be used with caution since detail on practice size (including number of cardiologists and patient volume) are not available for the cardiologist practices that did not respond to the survey. Larger practices and practices that were interested in hiring may have taken more interest and been more likely to respond to the survey.

In the ACC practice surveys, 74% of private practices indicated they were recruiting for an additional cardiologist(s) and 65% of openings in private practices were attributed to increased demand rather than replacement of retiring or resigning staff. Ninety-six percent of academic practices indicated they were seeking to hire a cardiologist. Fifty-seven percent of these openings were attributed to new practice opportunities.

Responding academic practices indicated it was most difficult to fill openings for adult congenital, cardiac electrophysiology, and interventional coronary cardiologists. Private practices reported that it was most difficult to fill openings for pediatric cardiology, cardiac electrophysiology, and interventional peripheral cardiologists.

Cardiology practices are recruiting for mid-level practitioners as well as physicians. Seventy-four percent of private practices and 56% of academic practices indicated they had openings for mid-level practitioners.

4. Wait time for Appointments to See Cardiovascular Specialists

Recent data on wait times for cardiovascular disease specialists are not available. The most recent data available are from the AMA Physician Socioeconomics Statistics 2000-2003. Table IV-7 below displays these data and compares wait times for cardiologists to mean wait times for other internal medicine specialists in 1999 and 2001. Wait times for an appointment increased substantially for both cardiologists and other internal medicine specialties in this period, suggesting increasing demand for services.

Table IV-7: Mean Days Waiting for an Appointment for New Patients*

Specialty	1999	2001
Overall Internal Medicine	12.0	18.0
General Internal Medicine	12.4	18.3
Cardiovascular Disease	11.8	17.2
Gastroenterology	12.1	18.3
Other	9.1	16.0

*AMA Physician Socioeconomic Statistics, 2000-2002 and 2003.

Since appointment wait times increased substantially between 1999 and 2001 and no recent data is available on wait times for appointments, we recommend obtaining data on appointment wait times in any future efforts to survey the cardiology workforce as discussed more fully in Section VI below.

5. Summary

Overall, the indicators discussed in this section suggest substantial excess demand for cardiologist services which will not be met within the current capacity for training.

V. PROJECTIONS OF SUPPLY AND DEMAND

In this section, we present estimates of the supply of cardiologists and the demand for their services from 2008 through 2025. First, we present a baseline set of assumptions and projections based on these assumptions. After discussion of this baseline, we present alternative scenarios, varying the baseline assumptions to test the sensitivity of our estimates to the assumptions.

We recognize that (at least) two major factors affect the forecast accuracy of projections. The model must be able to reflect, accurately, the effect on demand and/or supply of anticipated changes in the health care marketplace. That is, the model must be able to reflect the effects of changes in growth in insurance coverage and household incomes, the effects of an aging population on demand, and so forth. Second, the "scenarios" considered must capture the future path of variables or factors affecting demand and supply. That is, we must correctly anticipate the changes in insurance coverage and income growth, changes in "competing" providers, and disease incidence, and so forth.

The second aspect of forecast accuracy is as much a matter of judgment and, to an extent, serendipity, as it is of science. We draw on an eclectic source of information and judgment, including our Advisory Group members and our own judgment, in formulating some of the scenarios. The first aspect of forecast accuracy depends on the richness of the available data and the appropriateness of methods for applying it to capture the relationship between demand and/or supply and factors. It also rests on the assumption that relations measured in the past will be preserved in the future—that is, the measured effects are stable over time.

A. Overview of Model

The Lewin Group maintains a Physician Supply and Demand Model (PSDM), which has the capability to project the supply of and demand for physician services under alternate scenarios. The supply component of the PSDM is an inventory model that starts with the supply of cardiologists in 2008 as discussed above. The model can make annual supply projections along the dimensions of physician age, gender, education type (US medical school graduate [USMD], US graduate of osteopathic medicine [DO], and international medical graduate [IMG]) through 2025. Projections include the number of active physicians, as well as the number of FTE physicians that take into account the impact of physician demographics (age and gender) and user-defined scenarios (e.g., changes in work-life balance) with implications for the average number of hours that physicians work.

Supply scenarios that can be modeled include the implications of changes in (1) number of physicians graduating from cardiology fellowships, (2) average hours worked patterns, and (3) retirement patterns. The demand component of the PSDM projects future demand on an annual basis through 2025 taking into account changing demographics (population growth, aging, and race/ethnicity mix), economic growth, and user-defined scenarios regarding changes in physician productivity and use of non-physician clinicians (NPCs). For demand, data from national surveys (e.g., National Ambulatory Care Survey), administrative claims data (e.g., Nationwide Inpatient Sample), and specialty surveys are used to create detailed physician-to-population ratios for each specialty and healthcare delivery setting by population demographics (age group, gender, race/ethnicity) and insurance status (insured, uninsured).

B. Baseline Assumptions

Our Baseline projection makes the following assumptions:

Supply-Side

- *Baseline Counts* – The number of cardiologists is estimated to be the number of FTE physicians in the AMA Masterfile for 2008 who are board certified or fellowship trained in cardiology adjusted for activity status based on modeling in the Over 50 Survey.
- *New Entrants* – Because the number of fellows completing training in clinical cardiac electrophysiology and interventional cardiology has been increasing in recent years the number of fellows completing these programs is projected to continue to increase before leveling off. The number of fellows completing training in general and pediatric cardiology are expected to remain at the 2008 level. These assumptions are displayed in the last column of Table IV-1.
- *Attrition Rates* – Attrition rates are estimated based on observed retirement patterns for those under 70 and retirement expectations for those over 70 based on responses to the Over 50 Survey. Mortality rates are based on CDC estimates adjusted to account for the fact that mortality rates for professional and technical occupations are approximately 75% as high as the rates across all occupations.

Demand-Side

- *Supply/Demand* – In 2008 there is excess demand for cardiologists. The level of excess demand for each subspecialty is based on the calculations in Table IV-6A and IV-6B.
- *Demographics* – Population demographics will change as projected by the U.S. Census Bureau. Most prominently, the Census' estimates project about an 80% increase in the population over 65 and about a 50% increase in the Hispanic population over the next twenty years.
- *Technology and Utilization Patterns* – The model assumes that within demographic groups, current patterns of health care use and delivery continue into the future.
- *Subspecialty Demand* – Demand is disaggregated by subspecialty within age group and type of service based on the shares estimated in Section III.D.3 Tables III-13 and III-14. These shares reflect current patterns of care. As current technologies are disseminated, as practice patterns evolve, and as new procedures and technologies are introduced significant shifts in these shares are likely. Demand projections by subspecialty should be reassessed as new technologies are introduced and shifts in care patterns across subspecialties are observed.

C. Baseline Scenario

Figures V-1 through V-5 display the baseline results of the model by cardiology subspecialty. The blue curve in each figure indicates baseline supply. This baseline assumes current numbers of fellows completing training, current levels of productivity per active physician, and current retirement rates by age/gender will continue through 2025. The red curve in each figure is baseline demand. Baseline demand includes increases in demand related only to demographic changes in the U.S. population as projected by the U.S. Census Bureau.

In addition to increases related to demographics, the green demand curve includes a 1% annual increase in demand related to U.S. per capita income growth and technological advances. Recent physician workforce studies by Cooper (2002)[17] and others[18] argue that continued economic growth and technological advancement will induce increased demand for health care services beyond our baseline demand which is limited to current per capita consumption adjusted for demographics changes. Estimates of cardiology service expenditures from the Medicare population and United Health Group members for the past several years show increases in demand per beneficiary between 2% and 9% depending on cardiology subspecialty/age group, so we believe the 1% annual increase is conservative.

For all cardiology specialties these figures indicate current excess demand based on the estimates in Table IV-6A and IV-6B. The supply of pediatric cardiologists, interventional cardiologists and clinical cardiac electrophysiologists is projected to increase over the next 20 years. The supply of clinical cardiac electrophysiologists is projected to increase most rapidly at an average annual rate of 3.6%. The supply of pediatric cardiologists and interventional cardiologists is projected to increase at an average of about 1.5% annually. In contrast, the supply of general cardiologists will decline substantially from about 16,600 in 2008 to about 13,000 in 2025 (about an average 1.4% annual decline).

Demand for pediatric cardiology is projected to increase at an average of 0.4% annually based on demographic changes. Baseline demand increases for interventional cardiology and clinical cardiac electrophysiology are expected to average 1% annually based on demographics. Demand for general cardiology is projected to increase most rapidly in this period with an average 1.8% annual increase based on demographics. The average annual increase in demand for general cardiologists in this period is 1.6% for the first half of the period and increases to 1.9% for the second half of the period.

These annual rates of increase in demand for cardiovascular disease care attributable to demographic shifts are similar to projections by Foot et al. (2000)[19] and Steinwachs et al. (2000).[20] Foot et al. (2000) projected a 66% and 96% increase in heart disease prevalence and heart disease related deaths, respectively, based on demographic changes between 2000 and 2030. This would translate to an increase of between 1.7% and 2.3% annually. Steinwachs et al. (2000) estimated a 46% increase in treatment costs for heart disease between 2000 and 2025 or a 1.5% annual increase over the period based on demographics.

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[17] Cooper, Richard A., Thomas E Getzen, Heather J McKee, and Prakash Laud, (2002) "Economic and demographic trends signal an impending physician shortage," Health Affairs, Vol 21, Issue 1, 140-154.

[18] Koenig, L., Siegel, J.M., Donson, A., Hearle, K., Ho, S., and Rudowitz, R. (2003). Drivers of healthcare expenditures associated with physician services. The American Journal of Managed Care, 9 (Special Issue 1): SP34–42.
Cookson, J.P., and Reilly, P. (1994). Modeling and Forecasting Healthcare Consumption.
Chad L. Deal, Roderick Hooker, Timothy Harrington, Neal Birnbaum, Paul Hogan, Ellen Bouchery, Marisa Klein-Gitelman, and Walter Barr. (2007) "The United States Rheumatology Workforce: Supply and Demand, 2005-2025." Arthritis and Rheumatism. Vol. 56, No. 3, pp722-729.

[19] Foot et al. (2000) "Demographics and Cardiology." Journal of the American College of Cardiology, Vol. 35, No. 4, pp. 1067-1081.

[20] Steinwachs et al. (2000) "The Future of Cardiology." Journal of the American College of Cardiology. Vol. 35, No. 4, pp. 1092-1099.

Overall, assuming the 1% annual increase in demand for income growth and technological change, the projections indicate that by 2025, supply and demand for clinical cardiac electrophysiology and pediatric cardiology will be near equilibrium and the shortage of interventional cardiologists will be similar to the current level. In contrast, the shortage of general cardiologists will increase from about 1,700 in 2008 to about 16,000 in 2025.

Figure V-1: Baseline Supply and Demand for FTE Cardiologists
Total Adult Cardiologists
2008-2025

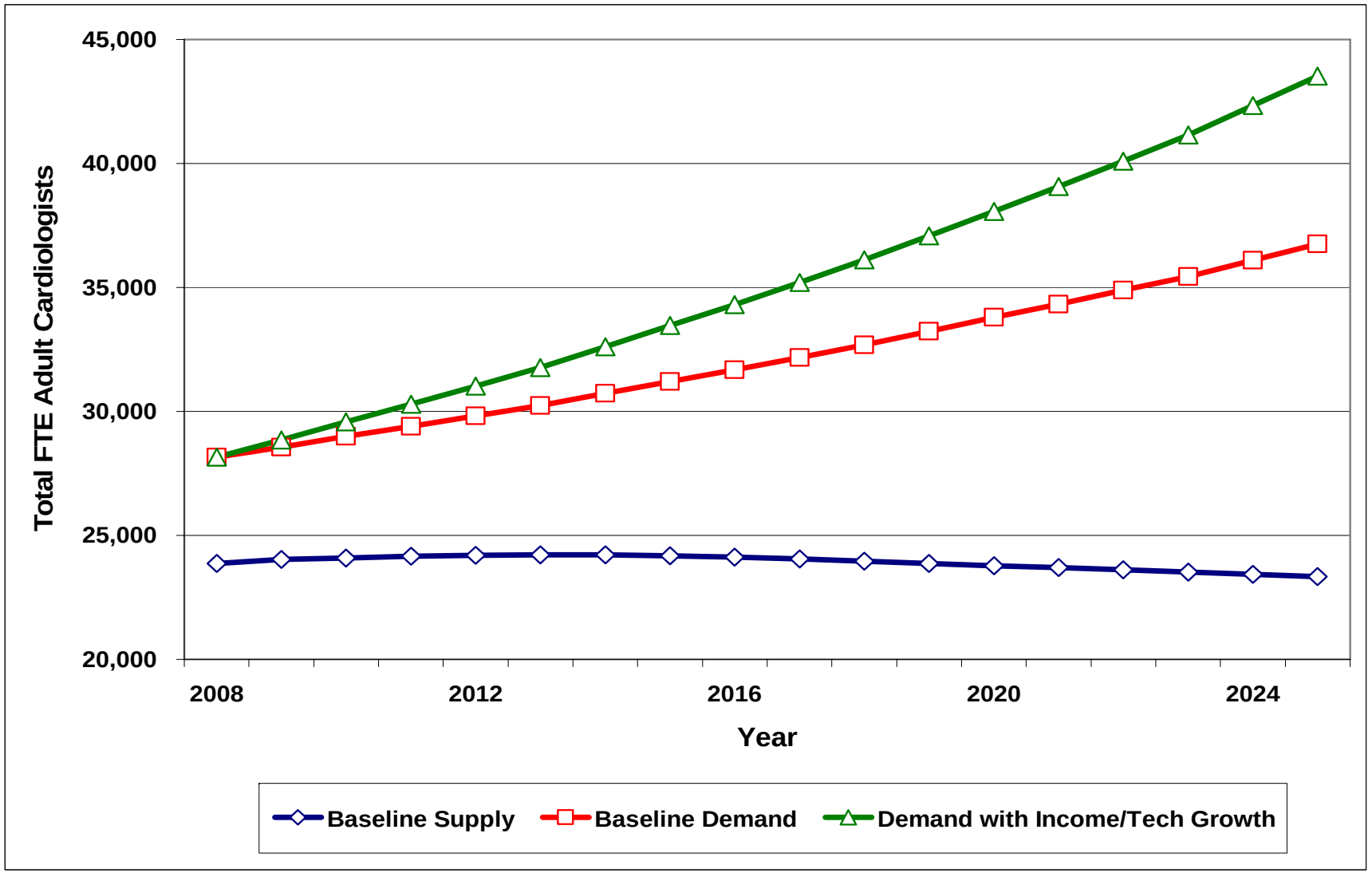


Figure V-2: Baseline Supply and Demand for FTE Cardiologists
General Cardiology
2008-2025

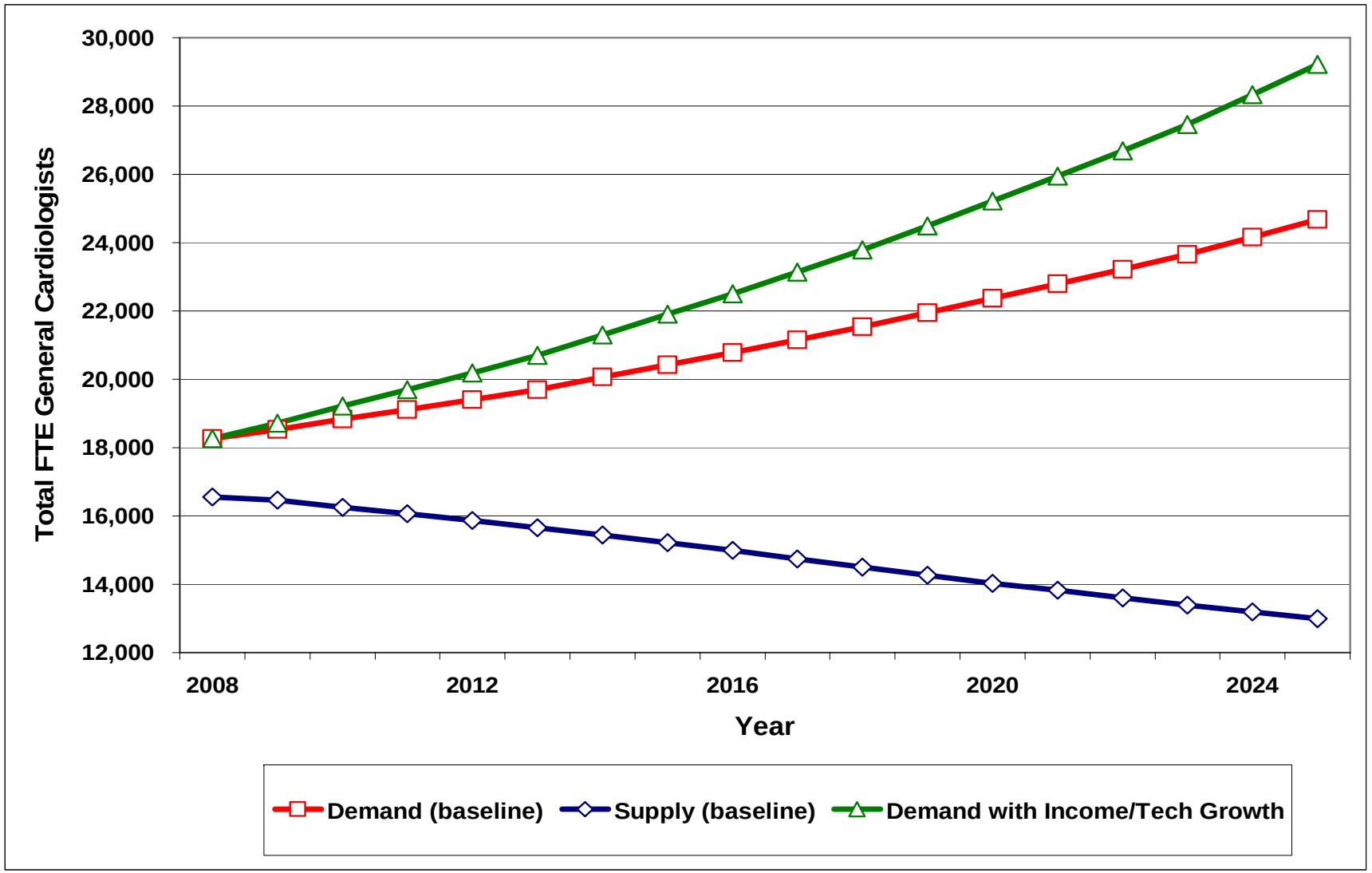


Figure V-3: Baseline Supply and Demand for FTE Cardiologists
Interventional Cardiology
2008-2025

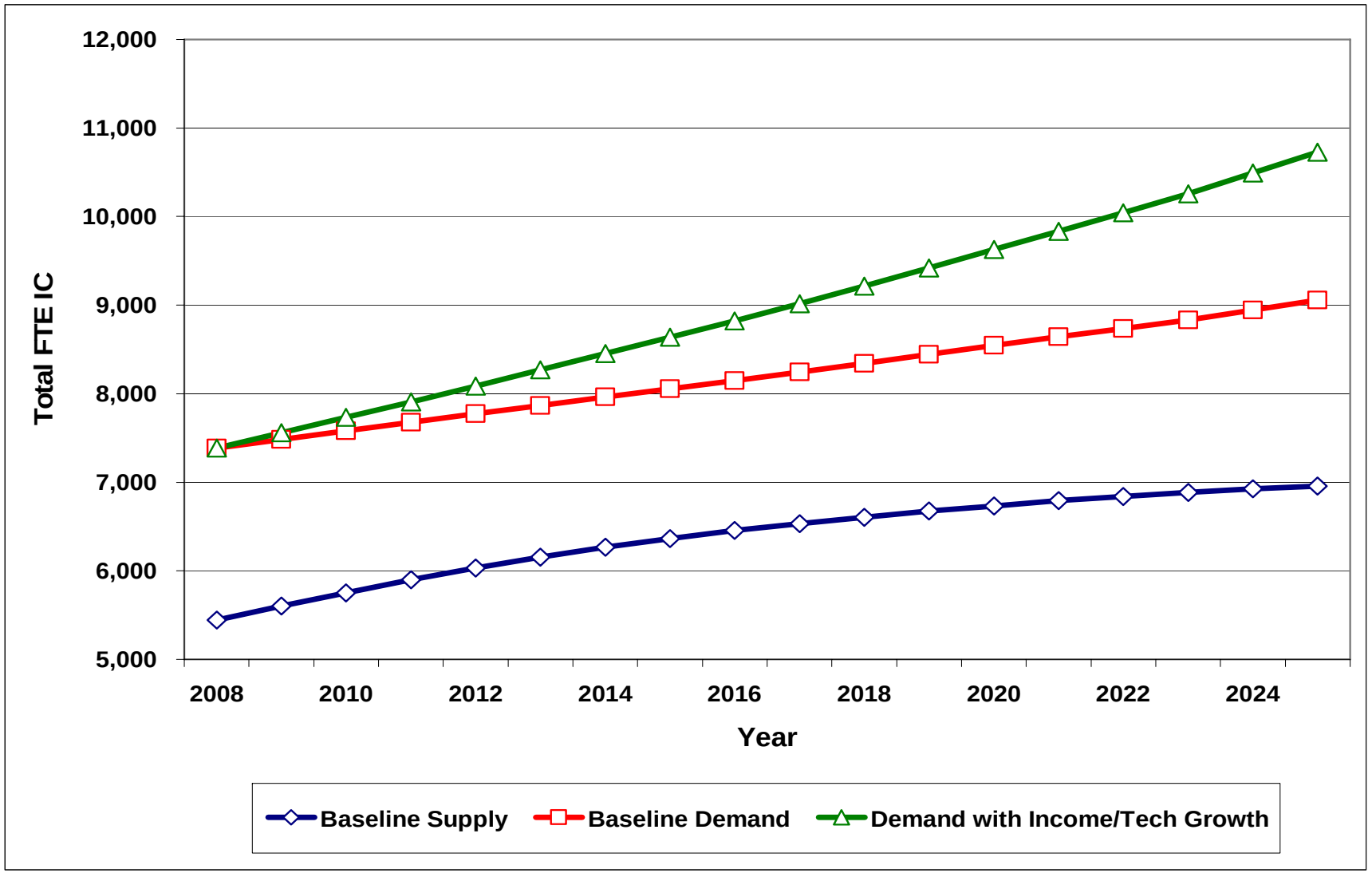


Figure V-4: Baseline Supply and Demand for FTE Cardiologists
Clinical Cardiac Electrophysiology
2008-2025

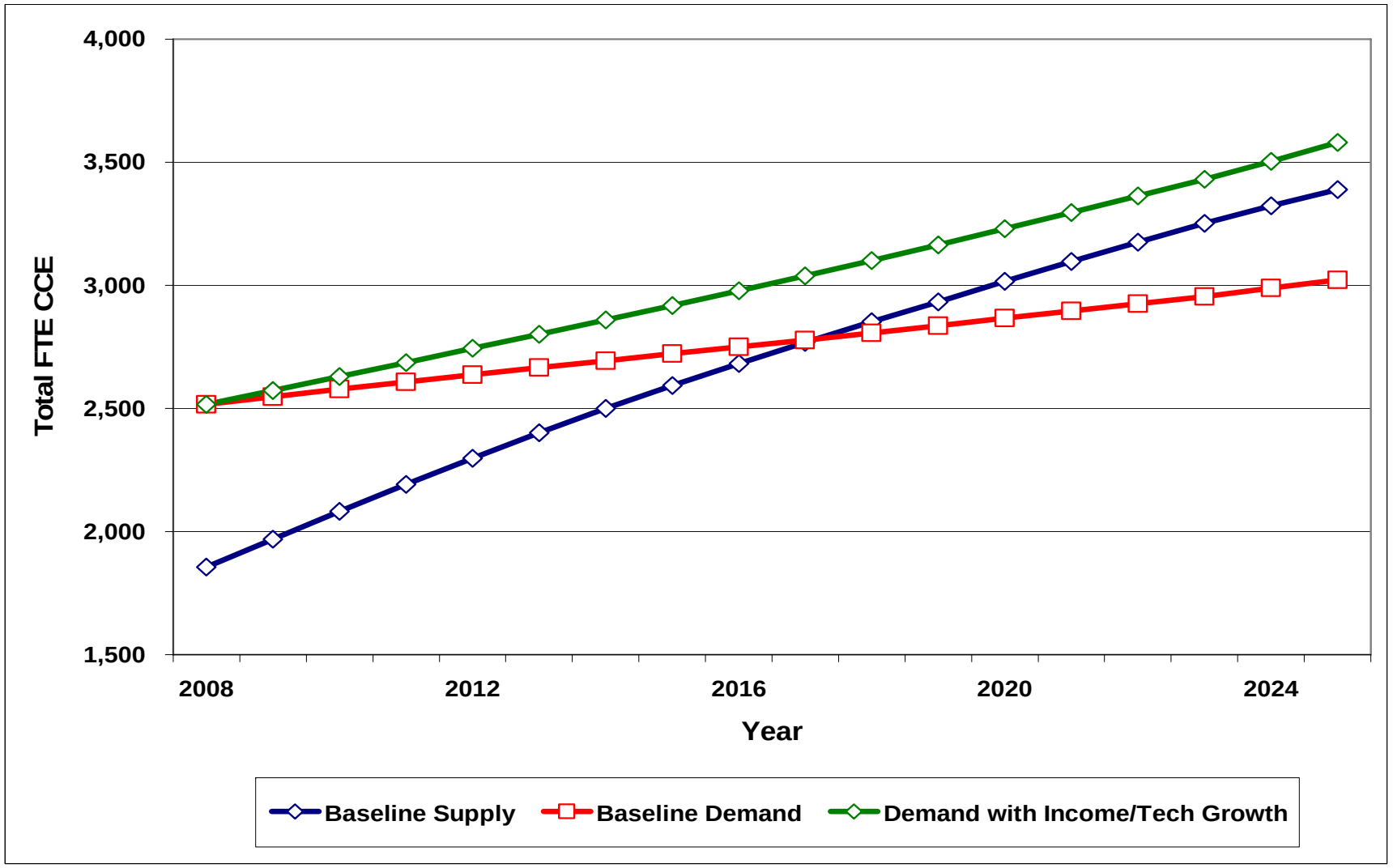
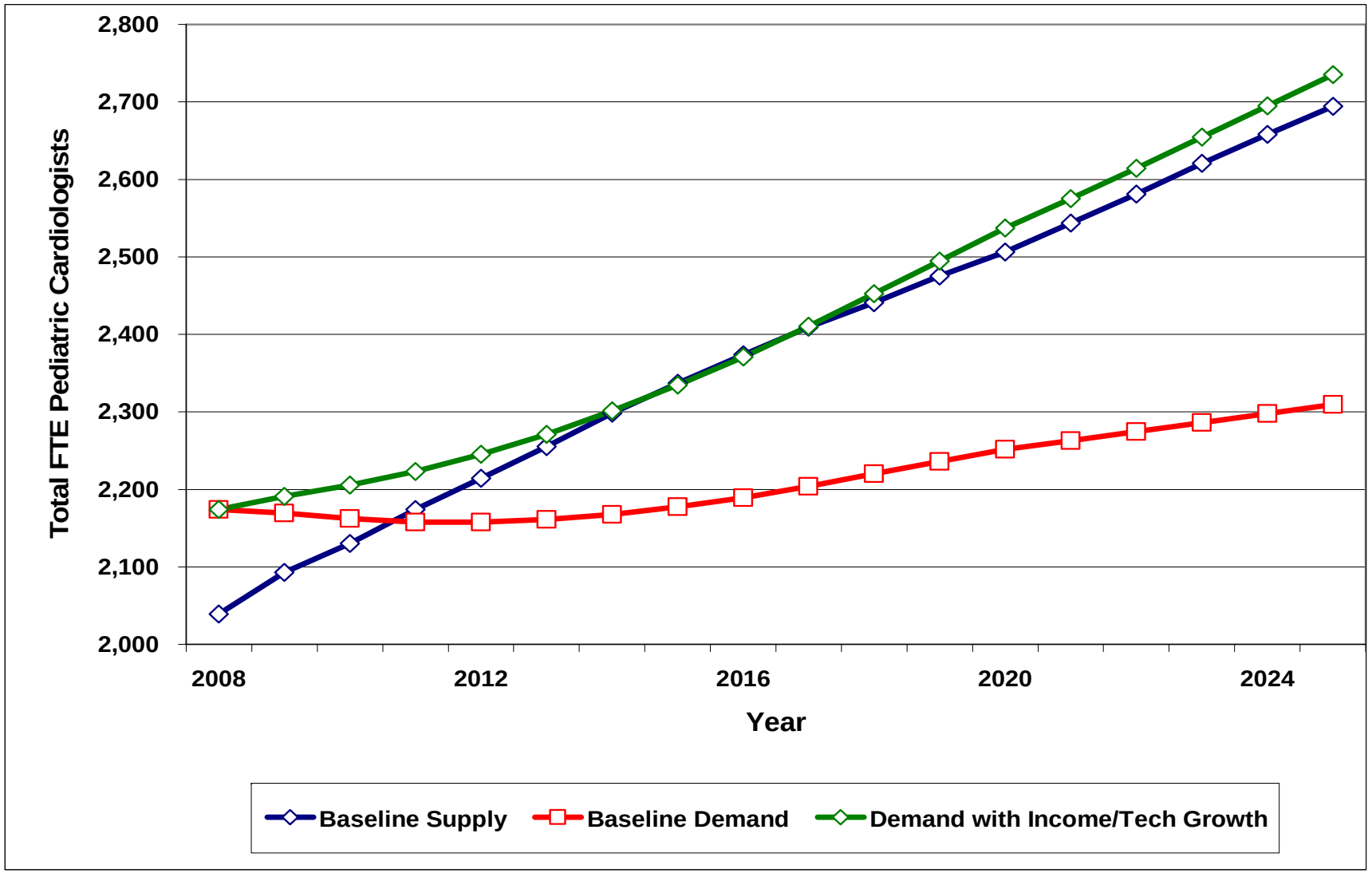


Figure V-5: Supply and Demand for FTE Cardiologists
Pediatric Cardiology
2008-2025



D. Alternative Scenarios

In this section, we present alternative scenarios to test the sensitivity of the baseline to some of the assumptions above.

Supply-Side Shifts

These scenarios address how changes in cardiologist training and productivity would influence the supply of cardiologist services over the next 20 years.

- *Reduce Training Length* – Working Groups 1 and 8 of the ACC's 35th Bethesda Conference recommended shortening the training for general clinical cardiologists by introducing a five year combined internal medicine/general cardiology training program. Currently, to become a general cardiologist three years of internal medicine and three years of cardiology training are required. Thus, the combined program would reduce training by one year. We model the impact of this change on supply by assuming the number of years of cardiology funding required for each fellow will be reduced from three years to two years,[21] but that the same total number of years of training will be available overall, so that reducing the number of years of training per graduate will result in a 50% increase in the number of fellows completing general cardiology training annually.[22]
- *Increase Fellowship Positions* – Working Group 1 of the ACC's 35th Bethesda Conference recommended advocating to ACGME and its internal medicine RRC for an increase in the number of approved cardiology fellowship positions. This working group also recommended identifying other sources of public and private support for increasing the number of fellowship positions. This scenario assumes this advocacy results in a 10% increase in the number of fellows completing general cardiology training.
- *New Cohorts Work Less* – Our focus group findings indicate that cardiology fellows are attracted to practices that offer work-life balance. Selection of practices that offer shared call and flexible work schedules may allow them to work fewer hours than previous generations of cardiologists while maintaining high quality care for their patients. We model this by assuming that cardiologists who complete training after 2008 will work 10% less than the current average.
- *Delayed Retirement* – Given the current shortage of cardiologists and the large number of cardiologists who are nearing retirement, delaying retirement of older cardiologist is likely to have a significant impact on supply. We model this potential shift in supply, by assuming retirement is delayed by one year relative to the baseline.

[21] The assumed increases in cardiology fellows resulting from this scenario are optimistic, because we assume the resources saved as a result of the training time reductions can be fully captured to expand cardiology training as opposed to allowing some expansion of internal medicine as well.

[22] For example, about 700 fellows currently complete training in general cardiology annually, implying about 2,100 training years currently available. A shift from three to two years of training per fellow would imply about 1,050 fellows (or a 50% increase in fellows) completing training annually within the same number of training years currently available. This shift would imply a substantial increase in the number of internal medicine training years allocated to residents planning to become cardiologists. Because there are currently 1.8 applicants for each cardiologist training position, we believe attracting a larger share of internal medicine graduates into cardiology is feasible; however, the implications of this shift for the supply of general internists warrants further research.

Demand-Side Shifts

On the demand side, we simulate how improvements in productivity will influence the supply of cardiologist services over the next 20 years.

- *Improve Practice Efficiency* – The shortage of cardiologist will encourage changes in practice that will reduce demand for cardiologists. These changes might include use of mid-level providers, technologists, case managers, and primary care physicians to substitute for some care cardiologists previously provided. Changes might also include more efficient practices in appointment scheduling and patient follow-up. We model these changes as a 10% decrease in the amount of time cardiologists spend per patient.

Figure V-6 through V-9 display the alternative supply-side and demand-side scenarios for each of the four cardiology subspecialties. Figure V-6 displays baseline supply and demand as well as the five alternative scenarios for general cardiologists. Of the scenarios, reducing the length of training from six to five years has the most substantial impact on supply, because we have modeled it as resulting in a 50% increase in fellowships. Even with this substantial increase in the production of new cardiologists an additional 8,000 general cardiologists would be needed to meet the anticipated level of demand in 2025. Delaying retirements and increasing fellowship positions by 10% result in very small shifts in supply.

Figure V-6: Alternative Scenarios
FTE General Cardiologists
2008-2025

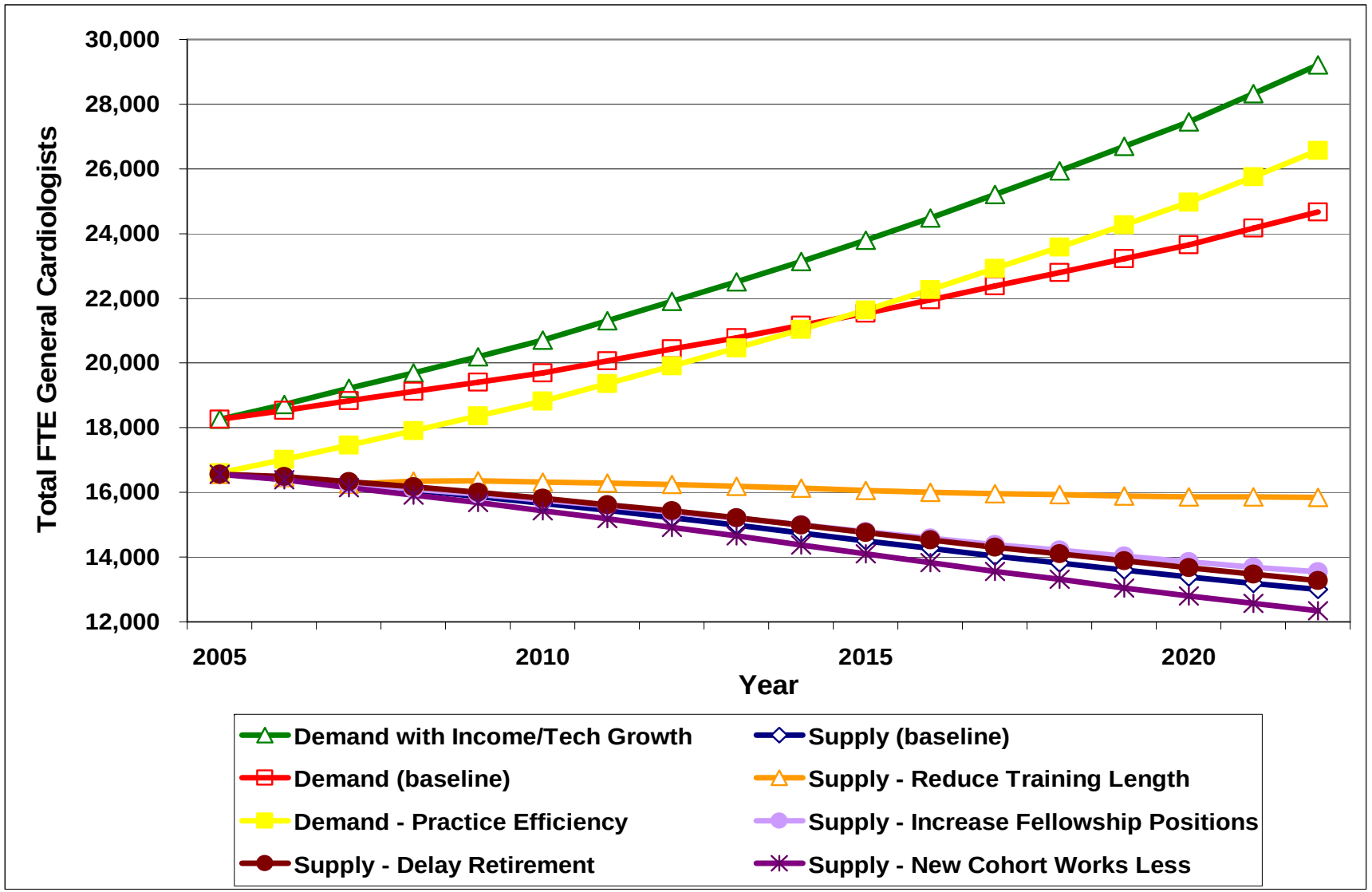


Figure V-7: Alternative Scenarios
FTE Interventional Cardiologists
2008-2025

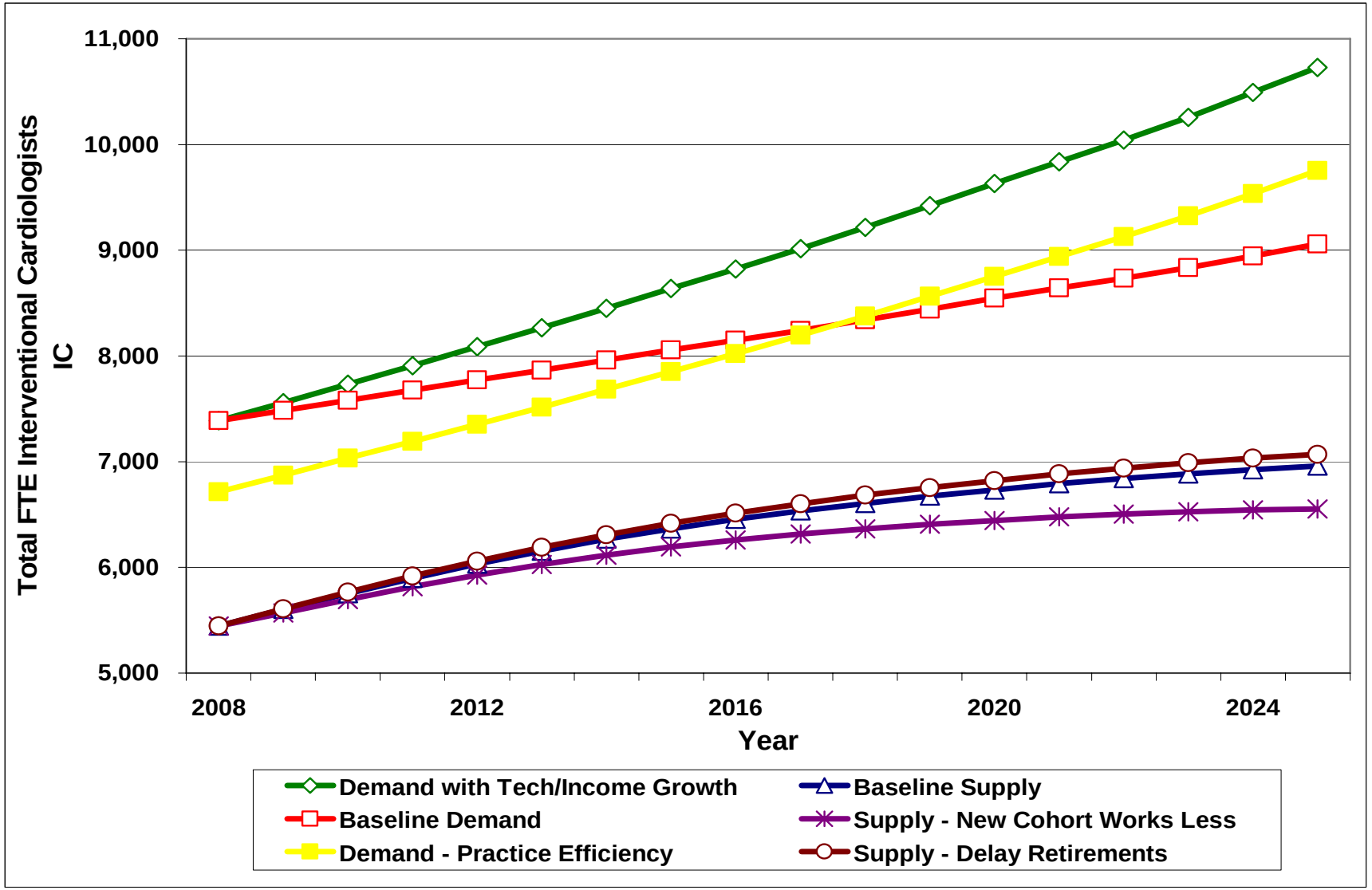


Figure V-8: Alternative Scenarios
FTE Clinical Cardiac Electrophysiologists
2008-2025

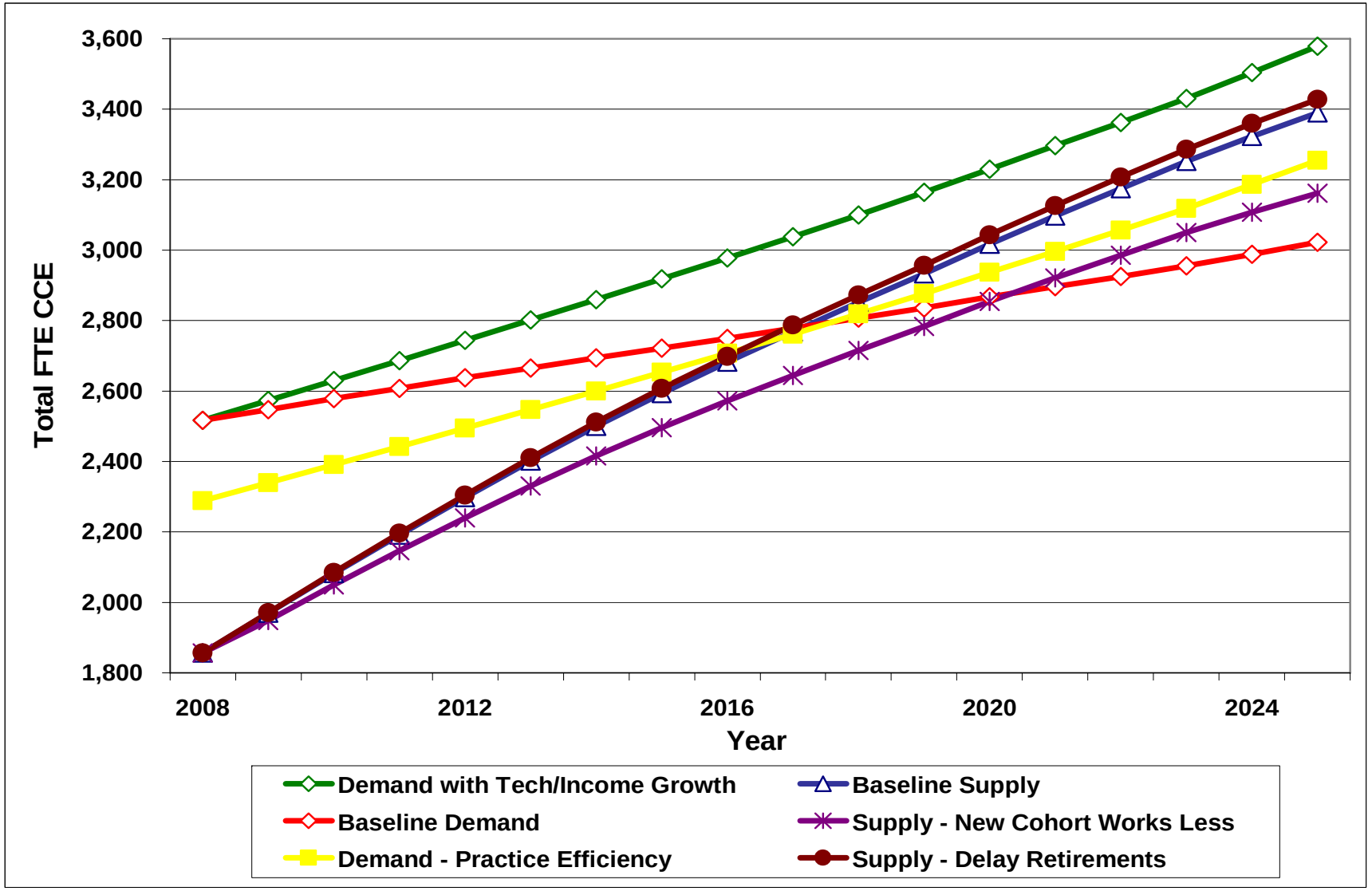
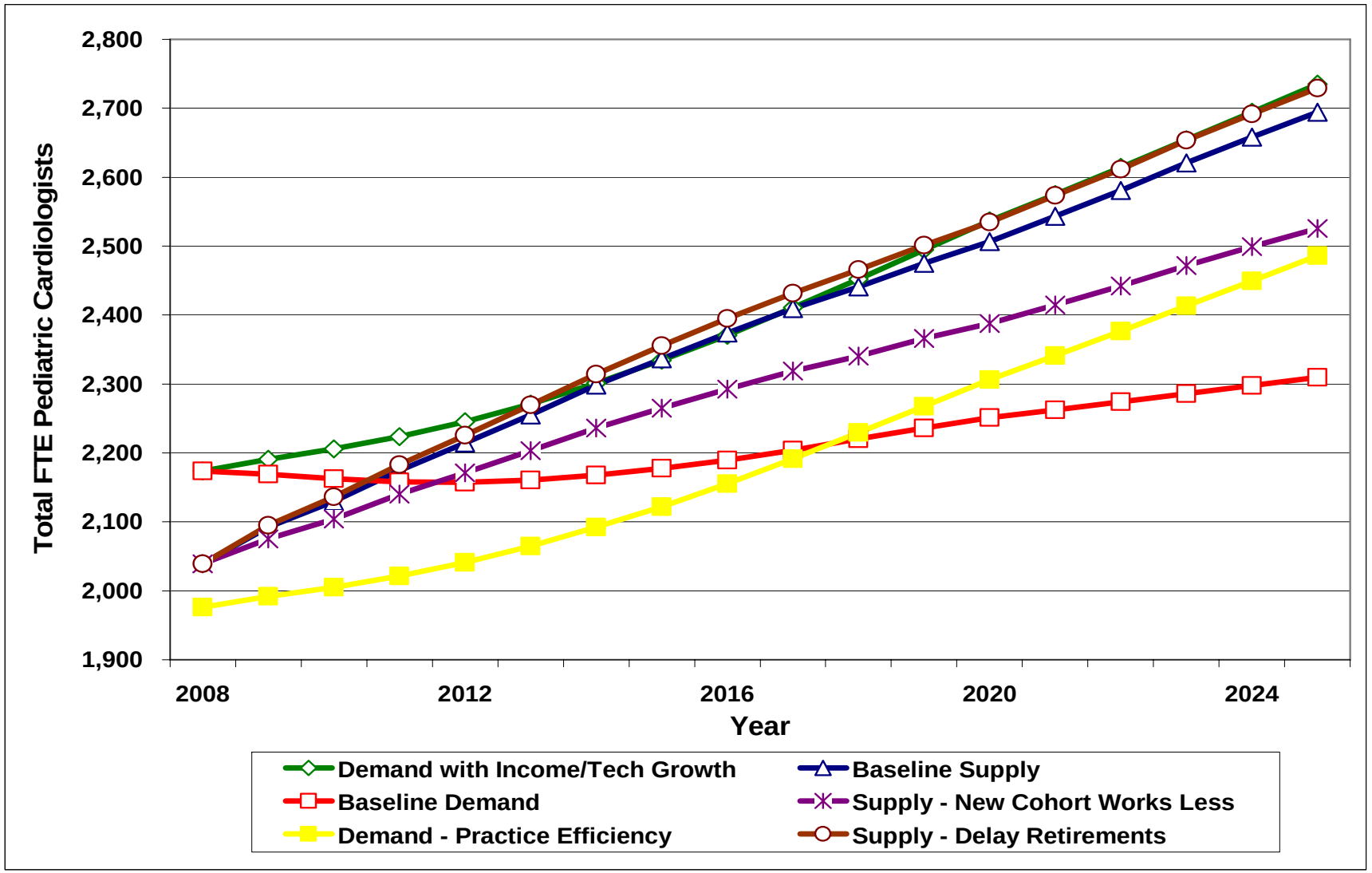


Figure V-9: Alternative Scenarios
FTE Pediatric Cardiologists
2008-2025



VI. RECOMMENDATIONS REGARDING TRACKING OF CARDIOVASCULAR WORKFORCE TRENDS

We recommend tracking cardiovascular workforce trends by updating the components of the PSDM approximately every three to five years. The three to five year period was selected because there are important factors affecting both the supply of and demand for cardiologist services where substantial uncertainty exists. For example, about 40% of general cardiologists are over the age of 55. As these physicians age, their decisions about retirement and reductions in work effort will have a substantial impact on the supply of cardiology services. Also, as this older cohort of physicians retires and the younger cohorts, who are more likely to have subspecialty training, represent a larger share of the cardiology workforce, practice and treatment patterns may shift. Technological advances over the next several years may also result in substantial changes in the demand for cardiology services.

As part of updating the model, we recommend conducting a survey of cardiologists to collect data on the following topics:

- Basic demographics of physician (e.g., age, sex, race, marital status, number of children, IMG status, subspecialty)
- Practice descriptives (e.g., number of offices, type of practice, practice setting, number of physicians on staff, financial structure, availability of part-time work, open positions)
- Productivity measures (e.g., hours worked, # of visits, # of procedures, mean wait time for an appointment)
- Retirement expectations (e.g., anticipated retirement age, anticipated work reduction prior to retirement, factors influencing retirement)
- Share of time in various activities (e.g., practice administration, patient care)
- Share of time providing various types of cardiology care (e.g., electrophysiology, interventional, general)
- Measures of practice efficiency (e.g., on-call practices, use of NP/PAs, methods of patient screening)
- Patient characteristics (e.g., share of patients by age, sex, insurance coverage)
- Cultural proficiency (e.g., has the physician or practice staff had training related to cultural proficiency, does the practice have bilingual staff)
- Income

The survey could be conducted at the physician level using the AMA Masterfile as the sampling frame or at the practice level with a list developed by ACC/MedAxiom.

VII. SUBSPECIALTY CHOICE

In this section, we discuss our analysis of factors affecting subspecialty choice. This analysis is primary based on quantitative analysis of specialty choice among internal medicine program graduates in the AMA Masterfile between 1991 and 2004. The AMA Masterfile includes the universe of physicians completing internal medicine residencies in a given year, so this approach is representative of all internal medicine graduates. These findings are supplemented by discussions with focus group including physicians completing internal medicine residencies, physicians completing cardiology fellowships, and cardiology training program directors. The focus groups are not a representative sample of physicians in each group; however, they can provide context and insights into trends that are observed in the quantitative analysis. They can also provide information related to issues where quantitative data is unavailable. A detailed description of the focus groups is provided in Appendix D.

Below, we first discuss subspecialty choice for internal medicine graduates. Then, we provide statistics related to subspecialization within cardiology.

A. Analysis of Subspecialty Choice Post Internal Medicine Residency

In this section, we present a quantitative analysis of subspecialty choice for internal medicine graduates between 1991 and 2004. We estimate a multinomial logit model allowing internal medicine graduates completing their residency in this period to choose to practice primary care in internal medicine or to choose to pursue fellowship training in one of nine internal medicine subspecialties.

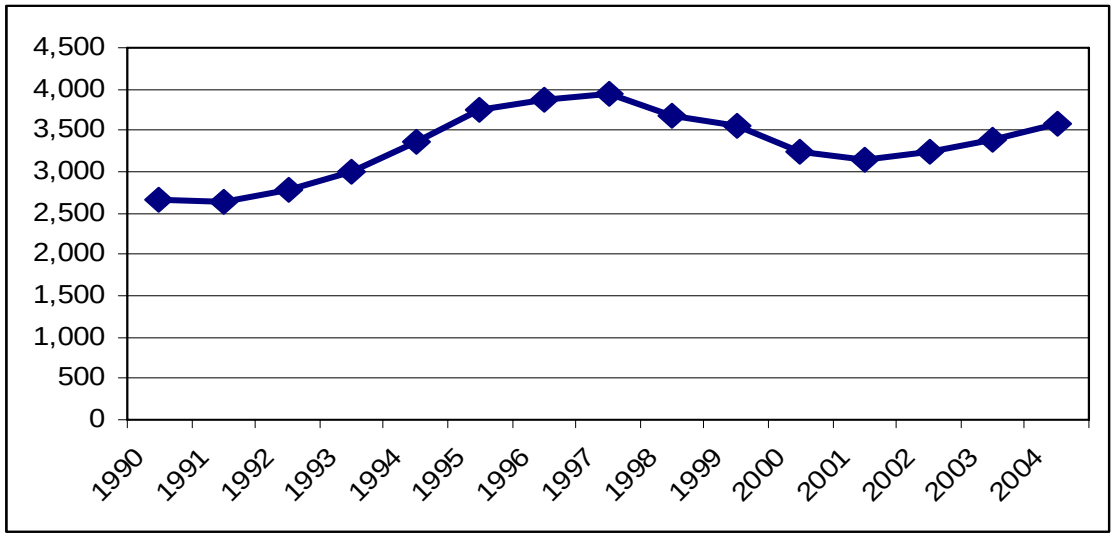
In the next section, we describe the methods and data for this analysis. Then, we present the model results. In the final section, we use simulation techniques to highlight the implications of the analysis.

1. Data and Methods

We estimate a multinomial logit model allowing internal medicine graduates completing their residency in this period to choose to practice primary care in internal medicine or to pursue fellowship training one of the following internal medicine subspecialties: cardiology, nephrology, geriatrics, gastroenterology, infectious disease, endocrinology/metabolism, obstetrics/gynecology, pulmonary disease/pulmonary critical care, hematology/oncology or rheumatology. The model allows us to estimate the impact of specific factors on specialty choice holding other factors constant and controlling for changes in the environment such as predictions that the growth of managed care would result in increased demand for primary care physicians.

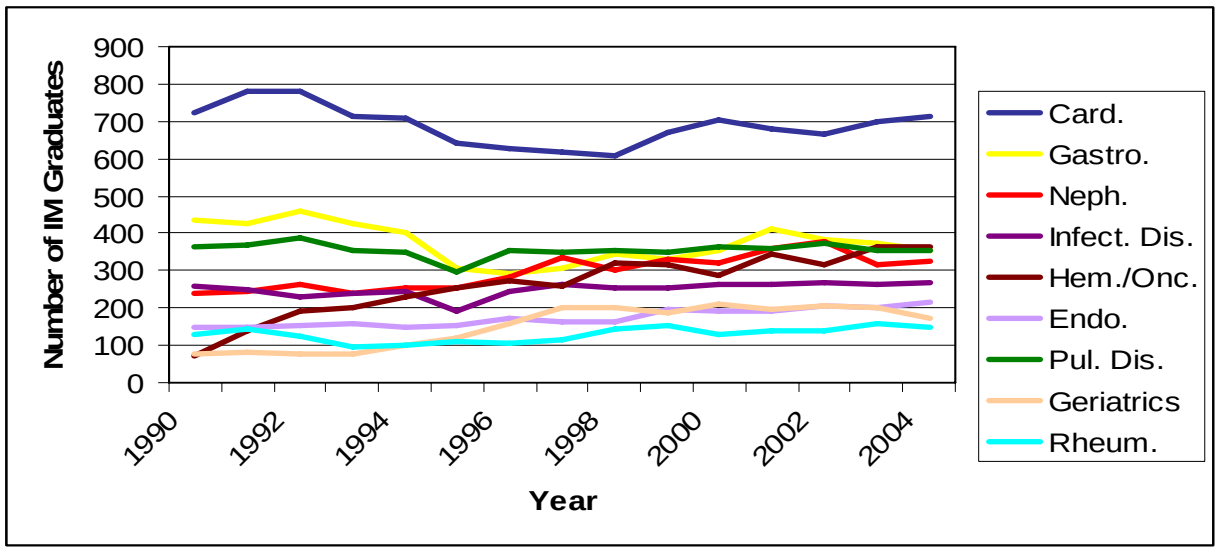
Figure VII-1 displays the number of internal medicine graduates pursuing primary care.

Figure VII-1: Number of Graduates Pursuing Primary Care



The number of graduates pursuing primary care increased between 1994 and 1998. After 1998 the number of graduates remaining in primary care began to decline. Figure VII-2 displays the number of internal medicine graduates pursuing subspecialties.

Figure VII-2: Number of Graduates Pursuing Internal Medicine Subspecialties



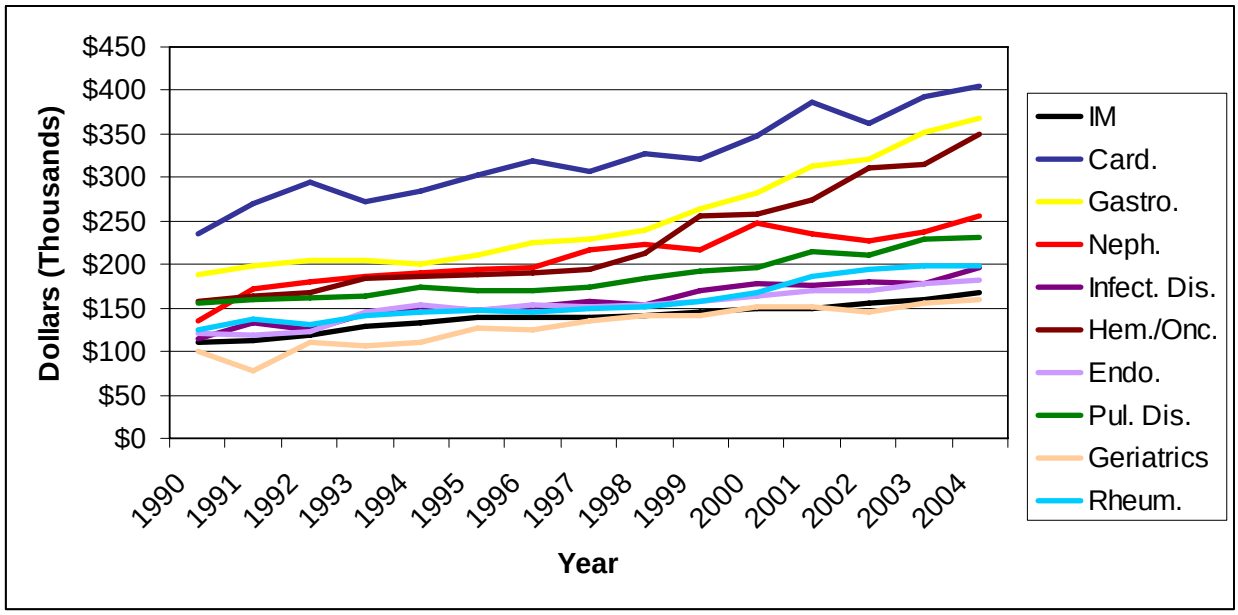
The number of graduates pursuing subspecialization tends to decline in the early 1990s and then flatten out.

The multinomial logit model estimates the impact of characteristics of each choice as well as the impact of personal characteristics of the individual on this choice.

The characteristics of each choice included as explanatory variables in the model are:

- Expected compensation – This is the median compensation for each subspecialty in the year of graduation in 1994 dollars relative to median compensation in internal medicine in 1994 as reported in the MGMA survey for that year. [23] Figure VII-3 displays median compensation for these subspecialty from 1990-2004. Cardiology consistently had the highest compensation levels, followed by gastroenterology.

Figure VII-3: Median Compensation Based on MGMA Survey, 1990-2004



- Number of years of training required beyond IM – This is the number of years of training require by the American Board of Internal Medicine (ABIM) to be eligible to sit for the Board in each subspecialty as displayed in Table VII-1.

Table VII-1: Number of Years of Training Required to Qualify for Boards*

Subspecialty	Number of Years of Training Beyond IM
Internal Medicine	0
Geriatrics	1
Nephrology, Hematology/Oncology, Endocrinology, Rheumatology, Pulmonary Disease, Infectious Disease	2
Cardiology	3
Gastroenterology	2 for graduates prior to 1998, 3 for graduates after 1998

* Reported by ABIM.

[23] MGMA reports differentiate between invasive and non-invasive cardiologists when calculating median income. We weight these estimates based on the survey population to estimate median income for cardiologists overall.

- Number of training positions available in subspecialty/number of internal medicine graduates in year – From 1998-2004, based on statistics published by JAMA in their medical education issue for each year. Prior to 1998 based on data provided by AAMC.
- Indicator of whether the decision year was prior to 1994 or between 1994 and 2001 when workforce projections projected a primary care shortage (1994-2001). These impacts for these periods would be relative to the period 2002-2004 when a specialist shortage was projected.

The characteristics of the internal medicine graduates that are included as explanatory variables in the model are:

- Location of internal medicine program (i.e., region, urban/rural[24])

Table VII-2: Specialty Choice by Geographic Location of Internal Medicine Program

Specialty	Midwest	NE	South	West	Large Metro Area	Small Metro Area	Other
Internal Medicine	55%	53%	54%	66%	54%	59%	56%
Cardiology	12%	12%	13%	9%	12%	11%	13%
Gastroenterology	6%	7%	7%	5%	6%	6%	7%
Pulmonary Disease	6%	6%	6%	4%	6%	6%	5%
Nephrology	5%	5%	5%	3%	5%	5%	4%
Infectious Disease	4%	5%	4%	3%	4%	3%	3%
Hematology/Oncology	4%	4%	4%	3%	4%	4%	5%
Endocrinology	3%	3%	3%	2%	3%	3%	3%
Geriatrics	2%	3%	2%	2%	3%	2%	2%

- Gender—Based on AMA Masterfile indicator.
- Black—Race/ethnicity is not available from the AMA Masterfile. As a proxy, we created an indicator variable for individuals who graduated from medical school at Historically Black Colleges and Universities (HBCU). These schools are Howard University, Meharry Medical College, and Morehouse School of Medicine.
- International Medical School Graduate—Based on AMA Masterfile indicator.
- Doctor of Osteopathy—Based on AMA Masterfile indicator.

Table VII-3 shows the specialty choice distribution of internal medicine graduates by personal characteristics. Women, doctors of osteopathy, and graduates of HBCU are more likely to pursue primary care. Men are more likely to specialize. Graduates of U.S. and foreign medical schools are equally likely to specialize. However, relative to IMGs, U.S. trained physicians are more likely to pursue cardiology and gastroenterology. IMGs are more likely to pursue specialties such as pulmonary disease, nephrology, and geriatrics relative to U.S. trained physicians.

[24] http://www.ers.usda.gov/briefing/rurality/RuralUrbCon/

Table VII-3: Specialty Choice by Personal Characteristics of Internal Medicine Program

Specialty	Female	Male	MD	DO	IMGs	US Trained	Non-HBCU	HBCU
Internal Medicine	65%	50%	55%	66%	54%	56%	55%	70%
Cardiology	5%	15%	12%	9%	10%	13%	12%	8%
Gastroenterology	3%	8%	6%	5%	5%	7%	6%	6%
Pulmonary Disease	4%	7%	6%	5%	7%	6%	6%	2%
Nephrology	4%	5%	5%	4%	6%	4%	5%	4%
Infectious Disease	5%	4%	4%	2%	4%	4%	4%	4%
Hematology/Oncology	4%	4%	4%	3%	4%	4%	4%	1%
Endocrinology	4%	2%	3%	1%	3%	2%	3%	1%
Geriatrics	3%	2%	3%	1%	4%	2%	2%	2%
Rheumatology	3%	2%	2%	3%	2%	2%	2%	0%

In the next section, we discuss the model results including presentation of the coefficient estimates and estimation of their implications.

2. Results

Table VII-4 displays the coefficients for relative compensation and years of training.

Table VII-4: Multinomial Logit Model Results

Variable	Coefficient Estimate	Standard Error
Compensation	0.127 **	0.056
Male * Compensation	1.110 *	0.034
IMG * Compensation	-0.560 **	0.027
HBCU * Compensation	0.209 **	0.213
Years of Training	-0.042	0.039
Male * Years of Training	-0.033 **	0.012
IMG * Years of Training	0.106 **	0.011
HBCU * Years of Training	-0.365 **	0.082

** Significantly different from zero at the 99% confidence level.
* Significantly different from zero at the 95% confidence level.

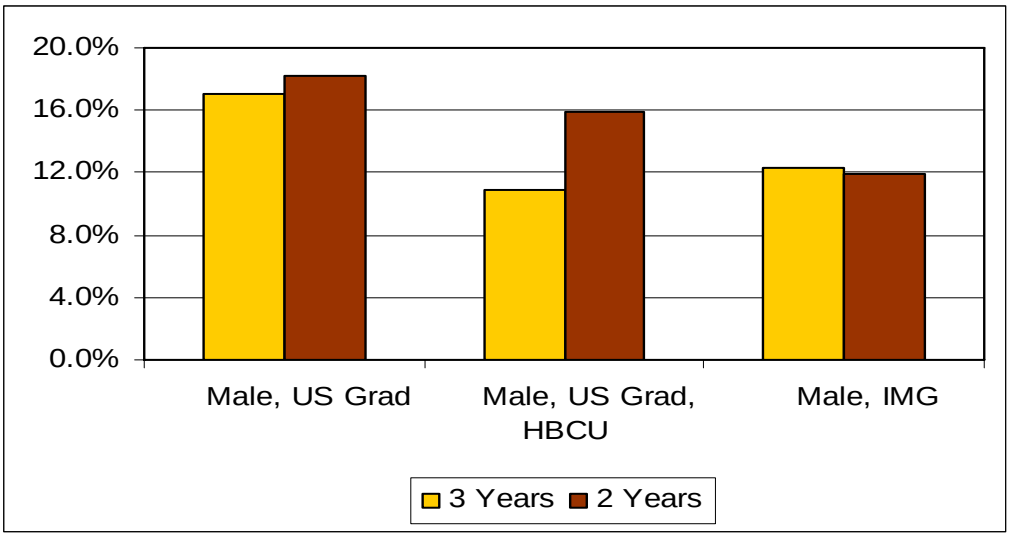
These coefficients were estimated holding characteristics such as region and urban setting of school constant. In Table VII-5, we translate these coefficients into elasticities. The elasticities are the percentage change expected in cardiology enrollment for a one percent change in compensation or years of training required. Thus, a one-percent increase in cardiology compensation relative to internal medicine will yield a 2.5% increase in the percentage of male U.S. medical school graduates choosing cardiology.

Table VII-5: Estimated Compensation Elasticities

Demographic	Elasticity
Male, U.S. Grad	2.53
Female, U.S. Grad	0.29
Male, IMG	1.46
Male, U.S. Grad, HBCU	3.19

To understand the implications of the estimated coefficients in the model for number of years of training required, we simulate the impact of decreasing cardiology training requirements from three years to two as was proposed by the ACC Cardiology Workforce Task force in the 35th Bethesda Conference Report. As displayed in Figure VII-4, this one-year decrease in training requirements would increase the percentage of male, U.S. medical school graduates choosing cardiology from 17.1% to 18.2%. The increase for graduates of HBCU is more substantial, increasing from 10.8% to 15.9%.

Figure VII-4: Change in Percentage of Internal Medicine Graduates Choosing Cardiology Resulting from Decreasing Training Requirements By One Year



In order to test the predictive power of this model, we re-estimated the model using only a random 80% of the sample. Then, we used the resulting coefficient estimates to predict the specialty choice distribution for the remaining 20%. These results are displayed in detail in Appendix C. Overall, the coefficient estimates for the 80% sample are very similar to those for the full sample in Table VII-4 and the predicted specialty choice distributions were generally very similar to the observed choices for the excluded 20%.

B. Analysis of Subspecialization within Cardiology

In this section, we analyze data available on subspecialization within adult cardiology. In 1992, ABIM began certification in clinical cardiac electrophysiology. Certification in interventional cardiology began in 1999. Table VII-6 lists the number of cardiologists certified in these subspecialties in each year since 1992.

Between 1992 and 1998 substantial numbers of practicing cardiologists obtained certification in cardiac electrophysiology. After this initial group, certifications appear to reflect fellows completing training.

Between 1999 and 2003 substantial numbers of practicing cardiologists obtained certification in interventional cardiology. After 2003, the number of cardiologists certifying in interventional cardiology leveled-off, but is still greater than the approximately 200 fellows who complete training in interventional cardiology each year.

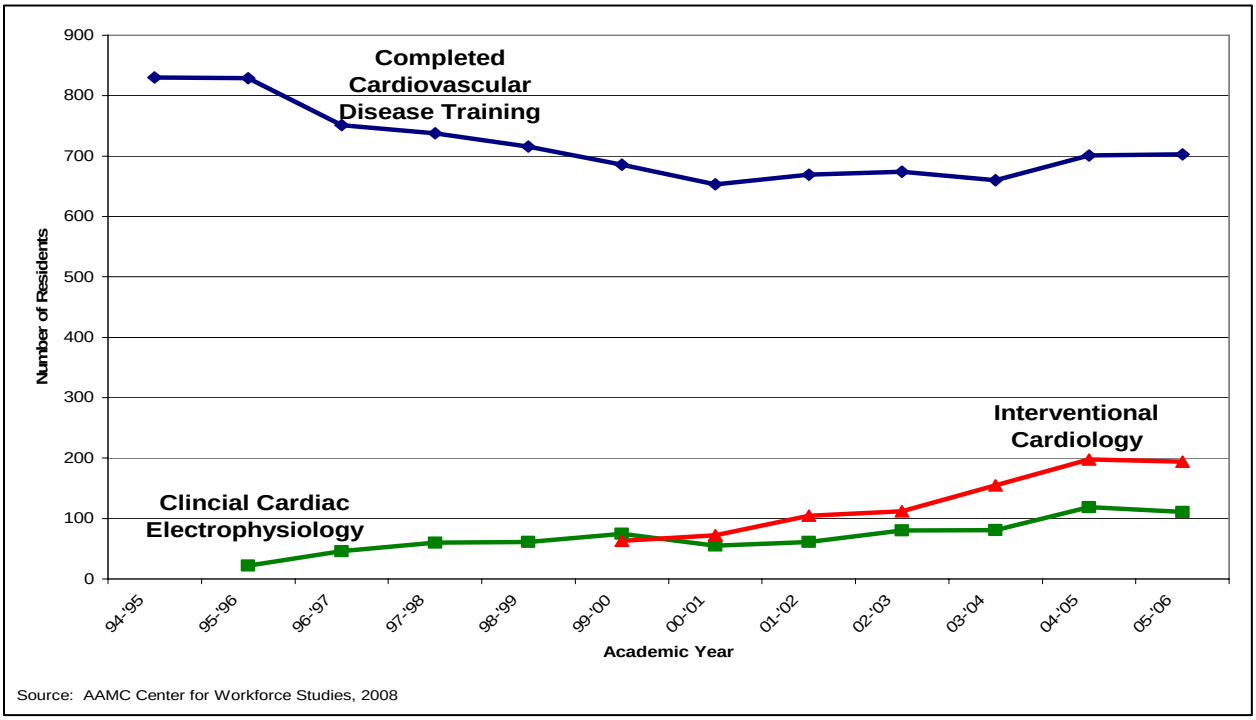
Table VII-6: Number of Cardiologist Certified by ABIM[25]

Year	Clinical Cardiac Electrophysiology	Interventional Cardiology
1992	386	NA
1993	NA	NA
1994	225	NA
1995	NA	NA
1996	187	NA
1997	NA	NA
1998	122	NA
1999	67	2,115
2000	77	753
2001	75	521
2002	90	489
2003	102	636
2004	91	287
2005	125	225
2006	120	288

Figure VII-5 displays the number of fellows in clinical cardiac electrophysiology and interventional cardiology training programs between 1994-1995 and 2005-2006. It appears the number of fellows participating in these training programs may have peaked in 2004-2005 and have begun leveling off. Additional years of data should be added to verify this trend.

[25] Downloaded from http://www.abim.org/pdf/data-candidates-certified/Number-Certified-Annually.pdf on 2/10/08.

Figure VII-5: Cardiovascular Disease Subspecialization Training Trends



Source: AAMC Center for Workforce Studies, 2008

C. Summary

Overall, the results of the quantitative model and comments made in the focus groups/interviews indicate the following:

- *Compensation* – In the focus groups/interviews fellows rarely cited compensation as a factor in their choice of specialty. However, the quantitative analysis of specialty choice finds that compensation is a very important factor in specialty choice and many fellows indicated compensation was an important factor in their choice of practice setting.
- *Length of Training* – In the quantitative model, length of training was an important factor in specialty choice particularly for graduates of HBCU. Length of training was less of a hinderance to women than men. IMGs were more likely to choose specialties with longer training. During the interviews/focus groups, while fellows noted the length of training as a downside to cardiology and some suggested shortening training, many indicated additional topics such as private practice could be added to the training or indicated that they thought reducing the length of training would jeopardize quality.
- *Work-life Balance* – Work-life balance is very important to both male and female fellows who participated in the focus groups/interviews. Many fellows indicated they had initially been discouraged from pursuing cardiology because of the field's long hours and on-call demands. Now, these fellows are looking for practice opportunities that afford work-life balance, such as working in a larger practice where call time is shared and practice management duties are limited.

- *Practice Culture* – In addition to work-life balance fellows indicate they are looking for practice cultures that agree with their personality, practice style, and personal values. Many fellows expressed concern about pressures to perform procedures in order to produce revenue and indicated they sought practice cultures where quality of care was paramount to revenue production.
- *HBCU Graduates in Cardiology* – Internal medicine graduates who attended HBCU are more sensitive to compensation and length of training relative to others when they make their specialty choice decisions. This results in HBCU graduates being more likely to remain in primary care than their counterparts. Financial barriers may exist for graduates of HBCU which make it more difficult for them to remain in training and more important for them to have high earnings upon completion of training. Fellowship program directors had few formal programs for attracting URMs. Targeted financial assistance might be a means to address this issue.
- *IMGs in Cardiology* – Based on the quantitative model, IMGs are less sensitive to duration of training than U.S. trained physicians. However, they are also less motivated by compensation levels.

Strong demand for cardiology fellows is giving the fellows choice among practice settings allowing issues such as work-life balance and practice culture to play an important role in the fellows' employment decisions.

VIII. RETIREMENT AND WORK REDUCTION PRIOR TO RETIREMENT

In this section, we analyze the factors that influence cardiologists and other physicians to retire or reduce their work effort prior to retirement. Data from the Over 50 Survey provide the basis for this analysis. In the next section, we describe these data. Then, in Section B below, we provide a descriptive analysis of survey responses related to retirement and part-time work choices. In Section C, we present the results of two models of retirement choice. The first model allows a choice between continuing to work and retirement. The second model allows a third choice, part-time work. The final section below summarizes the implications of these results for the cardiovascular workforce.

A. Data and Methods

To collect information on physicians' retirement choices, AAMC, in collaboration with nine specialty associations, conducted a survey of about 18,000 physicians age 50 and older between December 2005 and July 2006. The survey was administered by the Center for Health Workforce Studies, University at Albany, State University of New York except for Pediatrics, Anesthesiology and Orthopedic Surgery, which were administered by their respective specialty membership association. Each questionnaire included the same core set of items, with some specialties being asked additional questions specific to their specialty. Samples sizes and response rates varied by specialty. The response rate for cardiologists was 45.4%. Response rates for other specialties varied between 33% and 73%. Weights were developed to correct for non-response and sampling rates to produce nationally representative estimates. The total number of responses was 12,167.

The questionnaire addressed work status/retirement decisions including the following areas:

- Activity status (full-time work, part-time work, fully retired, temporarily inactive, never practiced medicine);
- For active physicians, description of current practice (e.g., hours, setting, location, activities);
- For retired physicians (date of retirement, reasons for retirement);
- For retired and active physicians, factors affecting retirement decisions; and
- Background information (e.g., age, gender, race/ethnicity, health status, financial status, primary/secondary specialty).

Pediatricians, pediatric subspecialists, and anesthesiologists were included in the survey, but excluded from our analysis because certain data elements were unavailable for these specialties because the specialty society administered their surveys rather than the Center for Health Workforce Studies. Thus, pediatric cardiologists are not included in this analysis. Similarly, surgical specialties are included in our descriptive analysis, but not in the regression analysis, because location information was not available for retired surgeons.

The sample sizes within the AAMC survey are not sufficient to analyze cardiology subspecialties separately. The cardiologist results for this analysis reflect predominantly responses from general cardiologists.

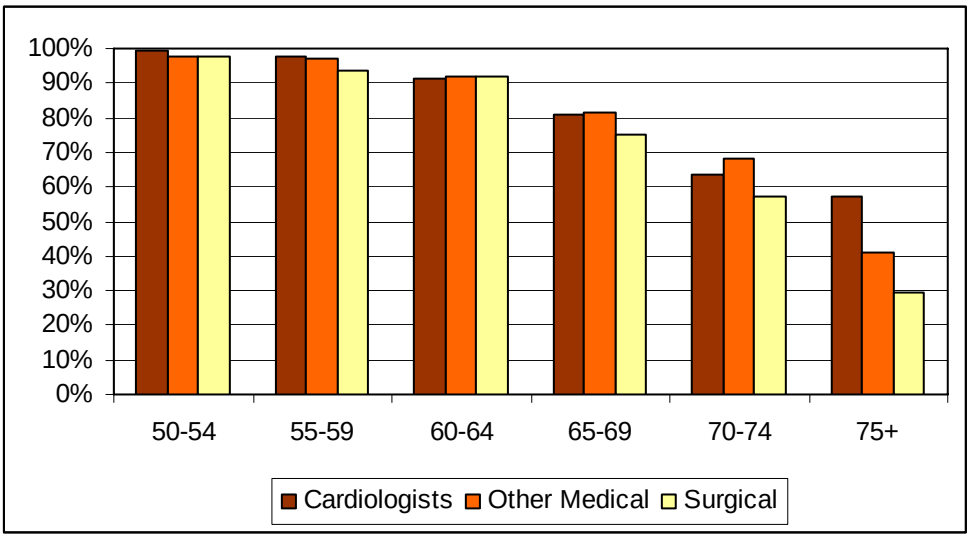
B. Descriptive Analysis

In this section, we provide an overview of responses to retirement related questions in the Over 50 Survey. We compare cardiologists' responses to those of other medical specialists and surgical specialists. We divide this analysis into four sections: overview of activity status, responses from retired physicians, factors influencing retirement, and assessment of part-time work.

1. Activity Status by Age and Specialty

Figure VIII-1 displays responses to the Over 50 Survey on whether physicians are currently active in medicine. The results are disaggregated into cardiology, other medical specialties and surgical specialties.

Figure VIII-1: Observed Proportion of Physicians Who are Active in Medicine By Age and Specialty Group*



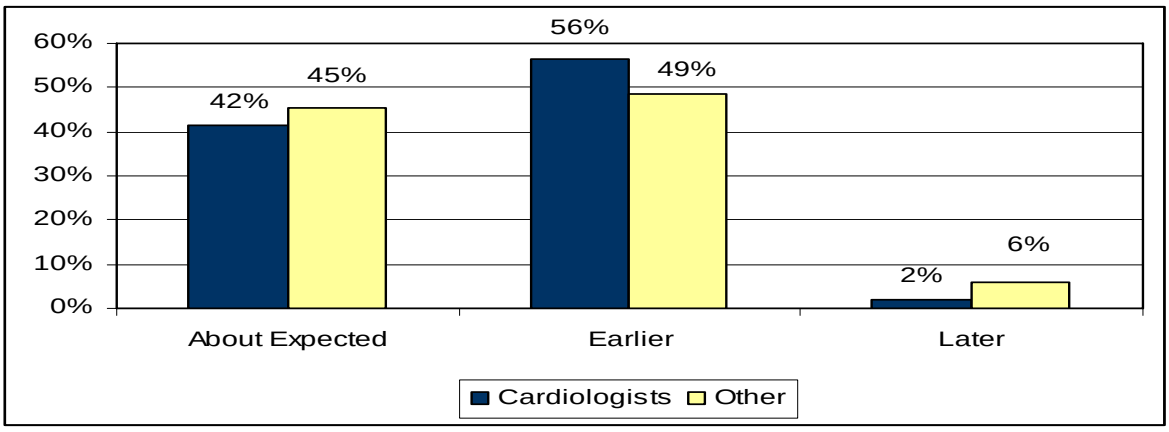
* Lewin analysis of the Over 50 Survey.

These results indicate that the specialty groups have similar rates of retirement through age 64. At age 65 and older, surgeons are much more likely to be retired than medical specialists. Cardiologists have similar rates of activity to other medical specialties through age 74. Beyond age 74, cardiologists appear more likely to be active than other medical specialties. However, these data are based on a small number of responses (N=55 cardiologists).

2. Responses from Retired Physicians

In our description of retirement rates in the supply analysis, Section IV above, we noted that physicians' historical retirement rates indicated physicians retiring somewhat later than planned retirement (Figure IV-5). Despite the observation that actual retirement patterns suggest that physician retire somewhat later than expected, when retired physicians were asked whether they retired earlier than planned, later than planned, or about when expected, (Figure VIII-2 below), most responded about when expected or earlier than planned. This was true for both cardiologists and other physician specialties.

Figure VIII-2: Did You Retire Earlier/Later than Planned or About When Expected? Retired Physicians*



*Analysis of Over 50 Survey by The Lewin Group. N= 90 Cardiology, N=622 Other.

As physicians age, they may update their expectations for retirement. If their health status and level of work satisfaction are greater than they anticipated they may increase their planned retirement age. This would be consistent with the observed results.

Physicians who retired earlier than planned were asked the reason they retired earlier than planned. These results are shown in Table VIII-1.

Table VIII-1: What Were the Reasons You Retired Earlier Than Expected? Retired Physicians*

Reason for Retiring	Cardiologists	Other Medical Specialists
Personal Health Issues	57%	39%
Lack of Professional Satisfaction	31%	23%
Insufficient Reimbursement Rates	19%	19%
Rising Malpractice Premiums	18%	20%
Practice Not Economically Viable	13%	14%
Inadequate Practice Volume	8%	6%
Need to Care for Family Member	7%	9%
Elective Career Change	7%	11%

* Lewin analysis of Over 50 Survey. Physicians could select more than one reason. Cardiologist N=41, Other N=292.

Personal health issues were the most often indicated reason for retiring earlier than planned for both cardiologists and other medical specialties. The second most often cited reason for both cardiologists and other medical specialties was lack of professional satisfaction.

3. Factors Affecting Retirement Plans

Retired physicians and physicians who were currently active in medicine were asked a series of questions in the Over 50 Survey about how different factors had affected/or were affecting their retirement plans. The first set of questions asked physicians how important each of a series of

fourteen factors was in their retirement plans. Physicians indicated whether the factor was 'Not Important', 'Somewhat Important', 'Very Important', or 'Uncertain/NA.' Table VIII-2 displays the percentage of cardiologists and other medical specialists who indicated each factor was 'Very Important.'

Table VIII-2: Proportion of Physicians Who Indicated Factor was Very Important In Their Retirement Planning*

Factor	Cardiologists	Other Medical Specialist
On-Call Responsibilities	54%	34%
Increasing Regulation in Medicine	50%	47%
Insufficient Reimbursement	45%	41%
Decreasing Clinical Autonomy	45%	42%
Stress of Practice	44%	42%
Rising Malpractice Costs	36%	37%
Lack of Professional Satisfaction	33%	32%
Personal Health Issues	25%	24%
Interest in Pursuits Other than Medicine	23%	27%
Effort Needed to Keep Up with Clinical Advances	20%	21%
Recertification Requirements	16%	15%
Increased Family Responsibilities	14%	13%
Increasing Competition in Specialty	11%	7%
Occupational Safety Issues	6%	7%

* Lewin analysis of the Over 50 Survey.

On-call responsibilities were the most often indicated factor for cardiologists. This factor was cited as 'very important' for 54% of cardiologists, but only 34% of other medical specialists. Increasing regulation in medicine was the second most often cited factor by cardiologists with 50% indicating this factor was very important. A similar percentage of other medical specialists (47%) also cited increasing regulation in medicine as a very important factor in their retirement planning.

We compared responses in the sample across three age ranges: 50-59, 60-69, and 70 or older. For most of the factors, the share of respondents reporting that the factor was very important was similar across age groups. However, for three of the factors there were substantial differences by age group. Among cardiologists and other medical specialists, on-call responsibilities were ranked very important by 50-59 year olds (60% and 39%) more often than by those 70 and older (44% and 26%). Similarly, among cardiologists and other medical specialist, insufficient reimbursement was ranked very important more often among 50-59 year olds (50% and 48%) than among those 70 or older (33% and 21%). Finally, stress of practice was ranked very important more often among 50-59 year olds (51% and 51%) than those 70 or older (27% and 26%) among both cardiologists and other medical specialists.

Physicians who are still active in medicine were asked what factors are/were the most important in motivating them to remain active in medicine. These responses are presented in Table VIII-3.

Table VIII-3: Proportion of Physicians Who Indicated Factor was Very Important In Their Decision to Remain Active in Medicine*

Factor	Cardiologists	Other Medical Specialists
Career Satisfaction	73%	68%
Financial Needs or Obligations	51%	56%
Good Income	43%	48%
Needs of My Patients	44%	40%
Difficulty Recruiting a Replacement	11%	9%
Need for Health Insurance	22%	27%

* Lewin analysis of the Over 50 Survey.

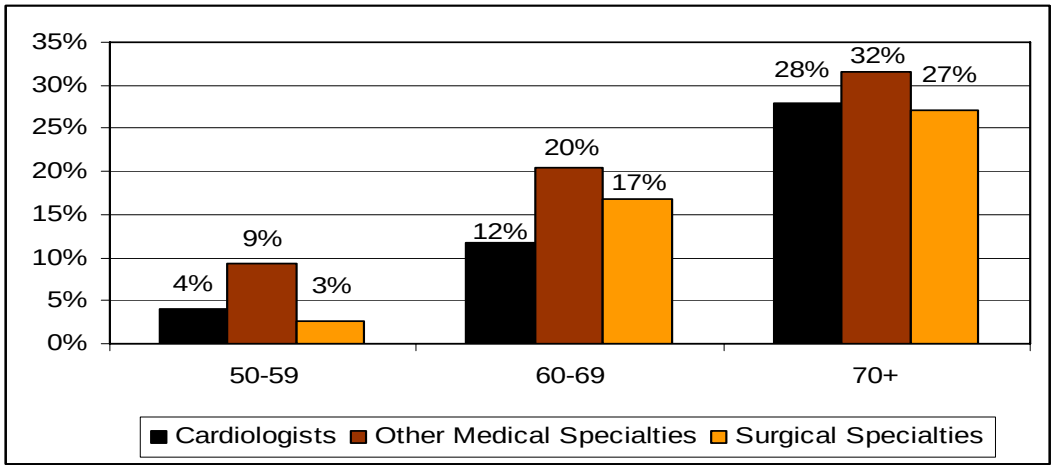
The most important factor for both cardiologists and other medical specialists was career satisfaction followed by financial satisfaction. Across age groups a similar share of physicians ranked each factor very important, with the exception of financial needs or obligations and good income. These two factors were more likely to be very important to the 50-59 year old age group than to the 70 years or older age group.

When active cardiologists were asked whether they would retire from medicine today if they could afford to, a majority said they would not. The share that indicated they would not retire increased with age with 57% of cardiologists 50-59, 64% of cardiologists 60-69, and 72% of cardiologists 70 or older indicating they would not. Other medical specialists were less likely than cardiologists to indicate they would not retire. The share that indicated they would not retire increased with age with 47% of other medical specialists 50-59, 55% of other medical specialists 60-69, and 64% of other medical specialists 70 or older indicating they would not.

4. Choice of Part-time Work

The Over 50 Survey asked physicians whether they were currently working part-time, whether part-time work was available at their current work setting, and whether they were interested in working part-time currently or in the future. Figure VIII-3 displays the proportion of physicians who are working part-time by age and specialty group. In all age groups, physicians in other medical specialties are more likely to work part-time than physicians in cardiology or surgical specialties.

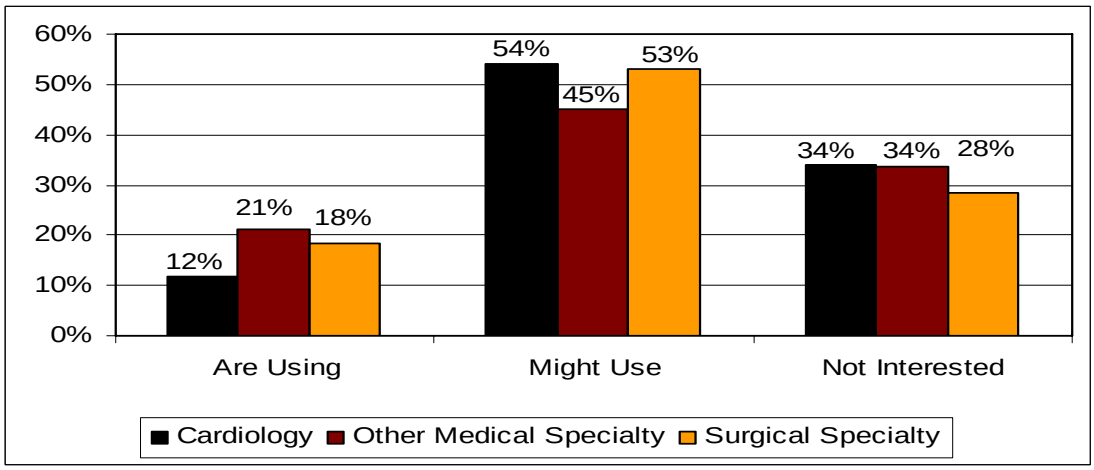
Figure VIII-3: Proportion of Physicians Who Work Part-time By Age and Specialty Group*



* Lewin analysis of the Over 50 Survey.

Figure VIII-4 displays the proportion of physicians who currently work part-time, those who are interested in working part-time if it is/were available in their current work setting, and those who are not interested in working part-time. The estimates are presented for cardiologists, other medical specialists, and surgical specialists. Cardiologists are much less likely to be currently working part-time than other specialties. However, relative to other medical specialists, a greater share of cardiologists indicated that they were interested in working part-time now or in the future. Approximately, two-thirds of physicians in each specialty group indicated they were currently working part-time or would considering working part-time in the future.

Figure VIII-4: Proportion of Physicians Who Indicate that They Work Part-time or Are Interested in Part-time Work

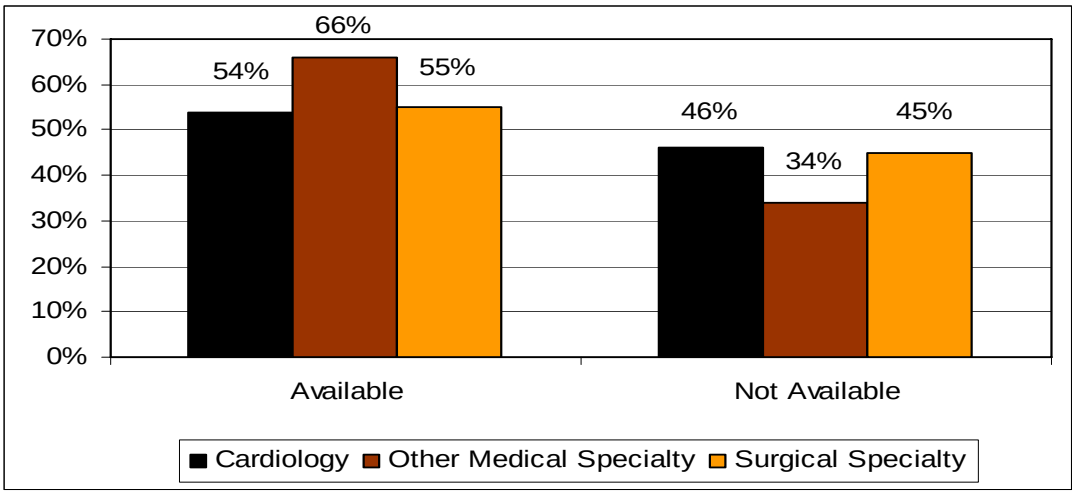


* Lewin analysis of the Over 50 Survey. Only physicians providing patient care currently or in the past were asked this question.

Figure VIII-5 displays the proportion of physicians who indicated part-time work was available in their current work setting. Only 54-55% of cardiologists and surgical specialists indicated

part-time work was available in their current work setting, however 66% of other medical specialists indicated part-time work was available in their current setting.

Figure VIII-5: Proportion of Physicians Who Indicate that Part-time Work is Available in Their Current Work Setting*



* Lewin analysis of the Over 50 Survey. Only physicians providing patient care currently or in the past were asked this question.

Overall, although cardiologists and surgical specialists indicated a similar level of interest in part-time work as other medical specialists, part-time work appears less available to cardiologists and surgical specialists.

C. Multivariate Results

We estimate two multivariate discrete choice probit models of the retirement decision. The first model is a bivariate model predicting full retirement. The second model allows three choices: full-time work, part-time work, or full retirement. Because of the structure of the model, which is called an "ordered probit" model, the larger the coefficient is algebraically, the more likely the physician is to work full-time. As the coefficient becomes increasingly negative, the probability that the physician will retire rises. Both models include the same set of independent variables. These variables include: personal demographics, health status, financial status, and location characteristics. The models are estimated separately for cardiologists and other medical specialists.

The benefit of estimating a multivariate model rather than just comparing means by subgroup is that the multivariate model allows us to control for multiple factors that may be influencing work choices. For example, observed differences in work status across specialties may be related to differences in health or financial status of survey respondents. The multivariate model allows us to isolate these impacts and differentiate them from impacts related to age or specialty.

1. Descriptive Characteristics

Table VIII-4 displays the means for the variables used in the regression analysis. The means indicate that cardiologists are more likely to be working full-time and other medical specialists part-

time. Cardiologists are more likely to be male and married. Cardiologists and other medical specialties have a similar racial and ethnic distribution and similar likelihood of being IMGs.

Table VIII-4: Means for Regression Variables for Cardiologists and Other Medical Specialists

Variable	Cardiologists	Other Medical Specialties
Number of Observations	739	3,946
Work Status		
Full-time	79.7%	70.2%
Part-time	9.9%	16.7%
Retired	10.4%	13.1%
Male	94.4%	82.6%
Married	84.1%	79.3%
Age Group		
50-54	23.4%	23.9%
55-59	31.1%	27.6%
60-64	18.2%	17.8%
65-69	13.1%	12.9%
70-74	8.0%	9.2%
75 or Older	6.2%	8.5%
Race		
White	78.0%	77.9%
Black	1.3%	1.7%
Hispanic	3.1%	4.0%
Asian	15.2%	14.1%
Other	2.3%	2.3%
International Medical School Graduate	27.9%	25.3%

Table VIII-5 displays means for additional variables used in the models. Cardiologists and other medical specialists have similar health status and location related characteristics. Cardiologists reported somewhat better financial status, with a higher proportion reporting excellent financial status and a smaller proportion reporting fair or poor financial status than other medical specialists. Cardiologists were more likely to be from the Northeast than other medical specialists.

Table VIII-5: Means for Regression Variables for Cardiologists and Other Medical Specialists

Variable	Cardiologists	Other Medical Specialties
Health Status		
Excellent/Very Good	68.4%	68.6%
Good Health	23.6%	21.9%
Fair/Poor Health	7.9%	9.5%
Financial Status		
Excellent	21.6%	15.5%
Very Good	33.5%	34.1%
Good	56.6%	65.5%
Fair/Poor	11.7%	15.2%
Region		
South	31.5%	29.7%
West	21.0%	23.4%
Northeast	28.3%	24.9%
MidWest	19.2%	21.9%
Location Characteristics		
State Income Tax Rate	5.2%	5.3%
Percent Uninsured	13.8%	13.8%
Percent Medicare Eligible	14.7%	14.5%
Median Household Income	$45,023	$45,189
Cardiologists per 100,000 Pop	11.2	NA

2. Retirement Model

We estimate two multivariate discrete choice probit models of the work decision. The first model is a bivariate model predicting the choice between any workforce participation and full retirement. The second model allows three choices: full-time work, part-time work, or full retirement. Regression results for the retirement choice model are reported in Table VIII-6 and for the work status model are presented in Table VIII-7.

In this section, we discuss the size and direction of the coefficient estimates from the model. In the next section, we conduct simulations to better understand the implications of these coefficient estimates. In both models, the more negative the coefficient, the more likely that an individual with this characteristic is retired. In contrast, the more positive the coefficient, the more likely an individual with this characteristic is working. In both the retirement and work status models, the coefficients related to age group, especially those 60-64 and older, are large and statistically significant. Thus, even when controlling for factors such as health and financial status, age retains its importance in the retirement decision. Health status is also very important in the retirement/work status decision. The estimated impact for poor/fair health in particular is large and significant.

Table VIII-6: Regression Results – Probit Retirement Model for Cardiologists and Other Medical Specialists

	Cardiologists		Other Medical Specialists	
Variable	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Intercept	4.1048 **	0.3302	2.3445 **	0.0534
Male	-0.6383 **	0.1422	0.3299 **	0.0111
Age Group (Age 50-54 Excluded)				
55-59	-0.3037 **	0.1158	-0.1814 **	0.017
60-64	-1.1671 **	0.1087	-0.7272 **	0.0165
65-69	-1.6286 **	0.1087	-1.2928 **	0.0162
70-74	-2.2207 **	0.1109	-1.632 **	0.0165
75 or Older	-2.4052 **	0.1142	-2.2564 **	0.0166
Race (White Excluded)				
Black	6.3187	3316.307	0.7863 **	0.0501
Hispanic	0.5596 **	0.1573	0.0061	0.0207
Asian	0.4145 **	0.0876	0.068 **	0.0159
Other	0.4165 *	0.1942	0.0017	0.0326
Married	0.0568	0.0565	-0.0542 **	0.0101
International Medical School Graduate	0.214 **	0.0683	0.207 **	0.0133
Health Status (Excellent/Very Good Excluded)				
Good Health	-0.2882 **	0.0501	-0.4681 **	0.0103
Fair/Poor Health	-1.1462 **	0.0645	-0.9762 **	0.0125
Financial Status (Good Excluded)				
Excellent	0.0886	0.0586	-0.1338 **	0.0129
Very Good	0.0217	0.0522	-0.0152	0.0106
Fair/Poor	0.4284 **	0.0829	0.0958 **	0.0127
Region (Midwest Excluded)				
South	-0.1683 *	0.0716	-0.1708 **	0.0132
West	-0.0894	0.0833	-0.4042 **	0.0149
Northeast	0.4265 **	0.0715	0.3708 **	0.0132
Location Characteristics				
State Income Tax Rate	-1.59 *	0.77	2.08 **	0.14
Percent Uninsured	1.5 #	0.87	2.67 **	0.16
Percent Medicare Eligible	-4.3864 **	0.6713	-3.0676 **	0.1269
Median Household Income (X1,000)	-0.0129 **	0.0029	-0.0044 **	0.0005
Cardiologists per 100,000 Population	0.0106 **	0.0025	NA	NA

** Significantly different from zero at the 99% confidence level.
* Significantly different from zero at the 95% confidence level.
# Significantly different from zero at the 90% confidence level.

Both the retirement and health status models suggest that Black and Asian minorities and IMGs are less likely to retire and work part-time. Mixed results were found for Hispanics and other minorities.

Marital status has a minimal impact on the retirement and part-time work decision. Financial status has a limited impact on work decisions. Those with fair/poor financial status are less likely to retire or work part-time. Those with very good/excellent financial status are somewhat more likely to work part-time. Cardiologists with good/excellent financial status have no significant difference in retirement rates compared to those with good financial status. Other medical specialists with good/excellent financial status were slightly more likely to retire.

Region of the country is an important factor in the work status decision. Cardiologists and other medical specialists in the Northeast are significantly less likely and those in the South and West significantly more likely to retire or work part-time than their counterparts in the Midwest. Higher state income tax rates are expected to reduce the incentive to work. For cardiologists, higher state income tax rates were associated with greater likelihood of retirement or part-time work. However, for other medical specialties higher income tax rates were associated with a reduced likelihood of retirement and part-time work.

Table VIII-7: Probit Model of Work Status and Retirement Choice for Cardiologists and Other Medical Specialists

	Cardiologists		Other Medical Specialists	
Variable	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Intercept	1.272 **	0.2374	0.6467 **	0.04
Intercept 2	0.6353 **	0.0177	0.8714 **	0.004
Male	0.0268	0.0713	0.5735 **	0.0076
Age Group (Age 50-54 Excluded)				
55-59	-0.0142	0.0587	-0.2481 **	0.0099
60-64	-0.8097 **	0.0563	-0.6876 **	0.0104
65-69	-1.25 **	0.0577	-1.4218 **	0.0106
70-74	-1.9472 **	0.0617	-1.8258 **	0.0113
75 or Older	-2.2439 **	0.0659	-2.4005 **	0.012
Race (White Excluded)				
Black	0.8329 **	0.2214	0.3499 **	0.027
Hispanic	0.2756 **	0.1027	-0.0844 **	0.0157
Asian	0.1944 **	0.0608	0.0068	0.0112
Other	0.0691	0.1164	-0.1073 **	0.0215
Married	0.0207	0.043	0.0047	0.0073
International Medical School Graduate	0.2299 **	0.0502	0.2998 **	0.0096
Health Status (Excellent/Very Good Excluded)				
Good Health	-0.3808 **	0.0384	-0.3224 **	0.0077
Fair/Poor Health	-1.1859 **	0.0522	-0.9324 **	0.0101
Financial Status (Good Excluded)				
Excellent	-0.1103 *	0.0442	-0.2692 **	0.0092
Very Good	-0.0347	0.0405	-0.0541 **	0.0076
Fair/Poor	0.1939 **	0.0576	0.1421 **	0.0097
Region (Midwest Excluded)				
South	-0.2341 **	0.0526	-0.0221 *	0.0096
West	-0.1051 #	0.0633	-0.3043 **	0.0107
Northeast	0.2695 **	0.0518	0.2947 **	0.009
Location Characteristics				
State Income Tax Rate	-3.92 **	0.6	1.34 **	0.11
Percent Uninsured	3.52 **	0.66	3.69 **	0.12
Percent Medicare Eligible	0.0807	0.5534	-1.2786 **	0.0995
Median Household Income (X1,000)	0.0021	0.0023	0.0008 *	0.0004
Cardiologists per 100,000 Population	0.012 **	0.0021	NA	NA

** Significantly different from zero at the 99% confidence level.
* Significantly different from zero at the 95% confidence level.
# Significantly different from zero at the 90% confidence level.

3. Simulated Impacts Based on Work Status Model

In this section, we use the results of the work status model to simulate the impact of some of the independent variables in the model on labor force participation and choice of part-time work. The benefit of simulation is that we can isolate the impact of a single factor, such as a change in age, holding other factors such as financial status and health status constant.

a. Influence of Age

The size of the coefficients in the model for both cardiologists and other medical specialties suggest that age is a very important factor in the part-time work and retirement decision, even holding constant factors such as health and financial status.

Figure VIII-6 presents the simulated probability of full-time work by age group for a representative cardiologist or other medical specialist. We assume the representative physicians are USMDs, white, male, married, from the Midwest, and with average location characteristics (e.g., state tax rate, cardiologists per population). The representative physician is also in very good or excellent health and reports good financial status. We will discuss the implications of changes in these characteristics for the probability of working in the next several sections.

Cardiologists and other medical specialists are similarly likely to work full-time between ages 50 and 64. At ages 65 and older cardiologists are more likely than other medical specialists to work full-time. The differences are particularly sharp in the 65-69 year old age group (72% versus 59%) and 75 or older (34% versus 23%).

Figure VIII-6: Simulated Probability of Full-time Work By Age Group

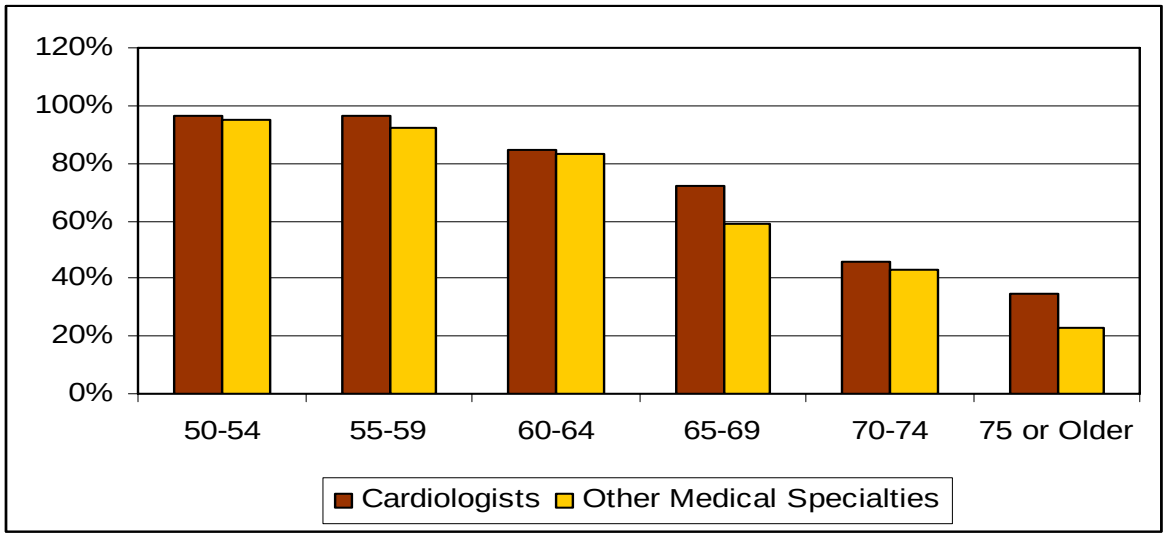
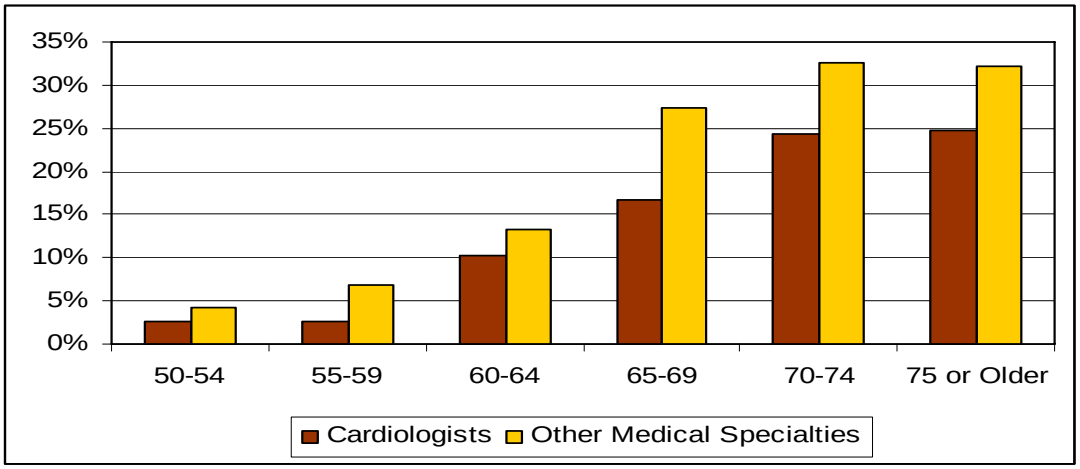


Figure VIII-7 presents the simulated probability of part-time work by age group for a representative cardiologist or other medical specialist. Other medical specialists are more likely than cardiologists to work part-time in all age groups. These data support the discussion of part-time work in Section VIII.B.4 which indicated that cardiologists were less likely than other

medical specialists to work part-time and that part-time work was less available to cardiologists than other medical specialists.

Figure VIII-7: Simulated Probability of Part-time Work By Age Group



b. Health Status

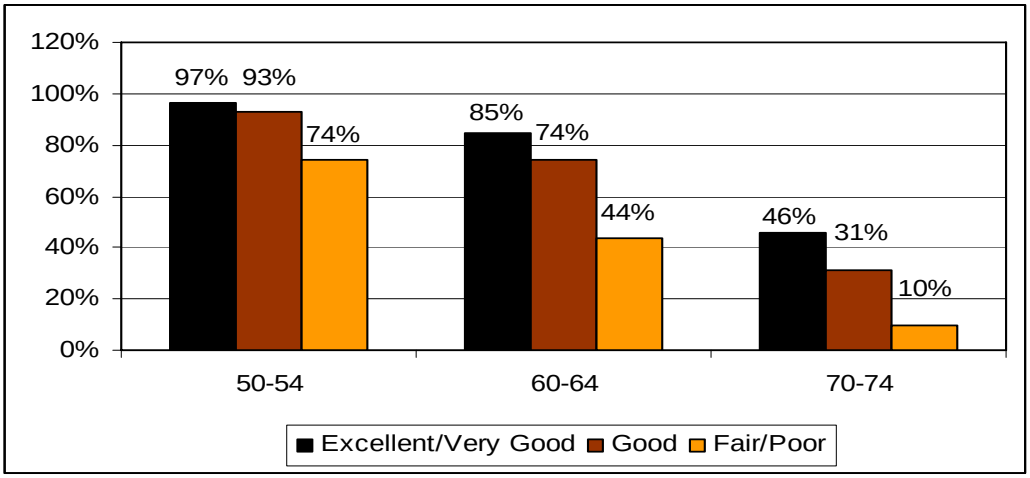
Table VIII-8 displays the reported health status of cardiologists and other medical specialists in Over the 50 Survey by age group. About 25% of the physicians in the 50-59 year old age group report good, fair or poor health. This climbs to about half of physicians in the 70 and older age group.

Table VIII-8: Reported Health Status By Age Group Among Cardiologists and Other Medical Specialists

Age Group	Good Health		Fair/Poor Health	
	Cardiologists	Other Medical Specialists	Cardiologists	Other Medical Specialists
50-59	21%	19%	7%	6%
60-69	24%	22%	9%	11%
70+	32%	29%	11%	19%

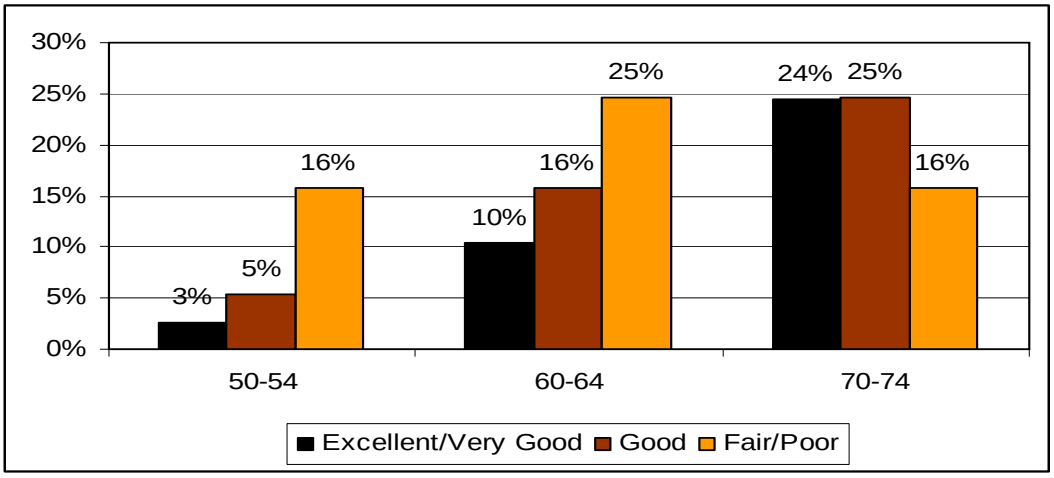
We simulate the impact of a health status change in each age group for the representative cardiologist described above varying only health status. Figures VIII-8 and VIII-9 display the simulated change in the probability of full-time and part-time work, respectively, related to health status by age group. For the 50-54 year old age group the shift from excellent/very good health status to good health status results in almost no change in the likelihood of retirement and a small increase (3% to 5%) in the likelihood of part-time work. For cardiologists 60-64 the impact is slightly larger with an additional 5% of cardiologists retiring and 6% moving to part-time work. In contrast, for cardiologists 70-74, the same change in health status is simulated to result in a substantial increase in retirements, but almost no change in the percentage working part-time.

Figure VIII-8: Simulated Probability of Full-time Work By Age Group



For all three age groups a shift to fair/poor health status has a large impact on retirement or part-time work. The simulated impacts are larger for the older age groups.

Figure VIII-9: Simulated Probability of Part-time Work By Age Group



Thus, health status changes appear to be an important factor in retirement particularly for older physicians.

c. Financial Status

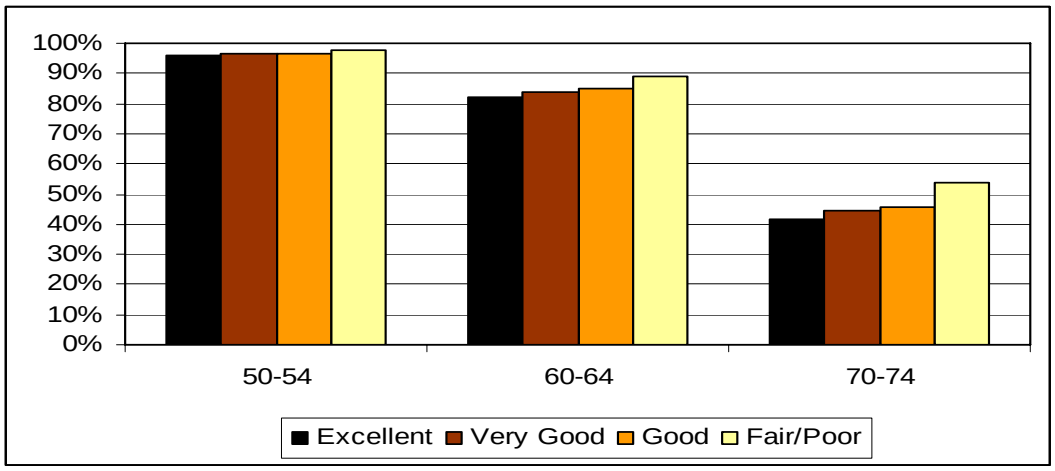
In this section, we estimate how financial status affects work status. Table VIII-9 displays the distribution of cardiologists and other medical specialists by financial status. In general, the distributions for cardiologists and other medical specialists are very similar with the exception of those 70 and older. Among those 70 and older, cardiologists are more likely to indicate excellent financial status and other medical specialists to indicate fair financial status.

Table VIII-9: Financial Status
By Age Group and Specialty

Financial Status	50-59		60-69		70+	
	Cardiologist	Other Medical Specialist	Cardiologist	Other Medical Specialist	Cardiologist	Other Medical Specialist
Excellent	40%	39%	31%	34%	27%	16%
Very Good	32%	36%	36%	34%	29%	35%
Good	21%	19%	24%	22%	32%	29%
Fair	6%	5%	7%	9%	9%	17%
Poor	1%	1%	2%	1%	3%	3%

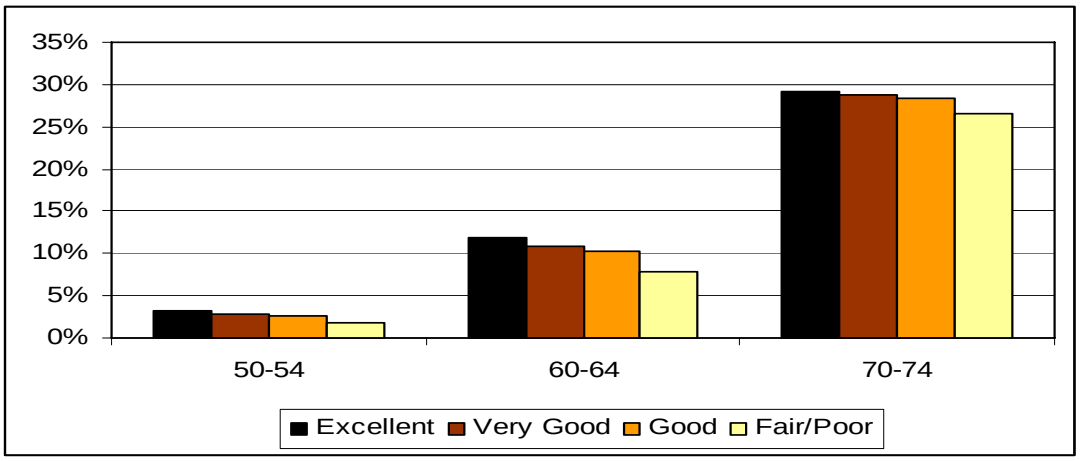
In Figure VIII-10, we display the simulated impact of changes in financial status on likelihood of full-time work for the representative cardiologist by age group. Financial status has little impact on likelihood of full-time work for those 50-54 and 60-64. However, among those 70-74, particularly the shift from good to fair/poor financial status increases the likelihood of full-time work from 46% to 54%.

Figure VIII-10: Simulated Probability of Full-time Work
By Financial Status



In Figure VIII-11, we display the simulated impact of changes in financial status on likelihood of part-time work for the representative cardiologist by age group. The impact on part-time work is modest for all the age groups.

Figure VIII-11: Simulated Probability of Part-time Work By Financial Status



Although financial status is influential in the retirement decision, these differences are not as substantial as those for age and health status.

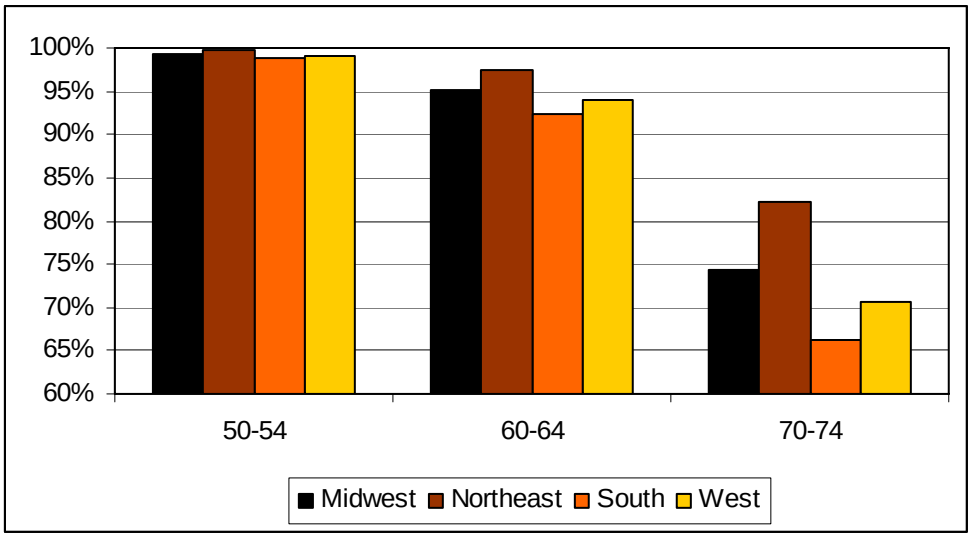
d. Location Characteristics

In this section, we simulate the impact of location characteristics on the likelihood that a cardiologist will retire. As above, the results in this section are based on the work status model and a representative cardiologist.

Table VIII-5 above indicates the distribution of cardiologists by region. These data indicate that there is a greater concentration of cardiologists in the South and Northeast (31.5% and 28.3%) than in the West and Midwest (21.0% and 19.2%).

Geographic location does have an impact on retirement rates as demonstrated by the simulation results in Figure VIII-12. The figure indicates that cardiologists in the Northeast and Midwest are less likely to have retired than those in the South and West. Older physicians are simulated to be more sensitive to these regional differences since almost all physicians 50-54 and 60-64 are active. The differences across the regions may be cultural or related to the types of job opportunities that are available for older physicians in different regions. Region is assigned based on the physician's current mailing address. Therefore, the difference in retirement rates may also reflect physicians relocating from the Northeast and Midwest to the South and West after retirement.

Figure VIII-12: Simulated Probability of Cardiologists are Active By Age Group and Region



Similar regional impacts were estimated for other medical specialists with the exception that those in the South had similar retirement rates to the Midwest for these specialties. However, being the Northeast was associated with later retirements and being in the West with earlier retirements for other medical specialties.

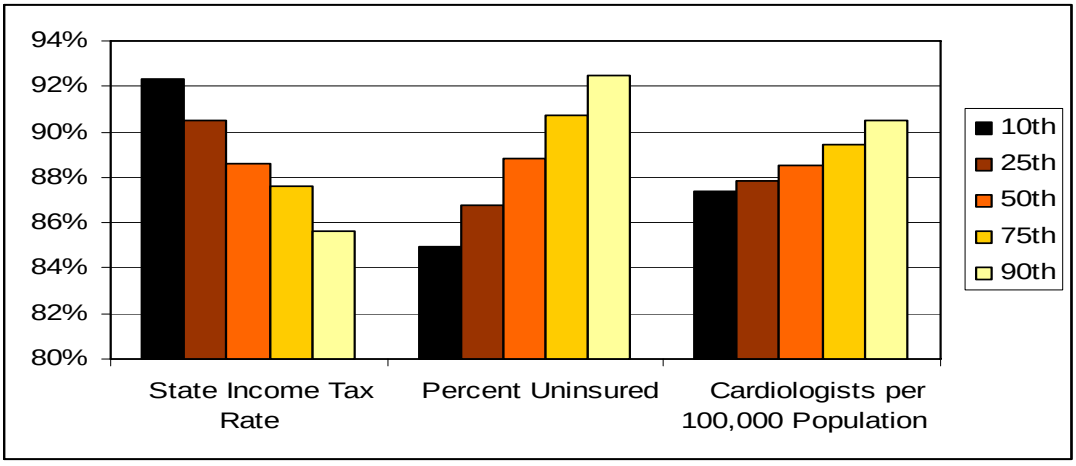
Table VIII-10 displays the distribution of location characteristics across the cardiologists in the Over 50 Survey sample. For cardiologists the percent Medicare eligible and the median household income of the location were estimated to have minimal impact on workforce status. State income tax rate was estimated to have a negative impact on labor force participation. Meanwhile, percent uninsured and number of cardiologists per 100,000 population were associated with delayed retirements.

Table VIII-10: Distribution of Location Characteristics Among Cardiologists

Variable	Percentiles				
	10th	25th	50th	75th	90th
Maximum State Tax Rate	0.0%	3.1%	5.8%	7.0%	9.3%
Percent Uninsured	8.3%	10.6%	13.5%	16.5%	19.7%
Cardiologists Per 100,000 Population	4.4	6.3	9.1	13.2	18.3
Percent Medicare Eligible	10.9%	12.4%	14.5%	16.4%	19.5%
Median Household Income	$31,531	$38,068	$42,457	$50,500	$63,118

In Figure VIII-13, we simulated the impact of state tax rate, percent uninsured, and cardiologists per 100,000 population on retirement patterns for a representative cardiologist 65-69 by percentiles of the distribution of these variables across cardiologists. Younger cardiologists will be less sensitive to changes and older cardiologists more sensitive.

Figure VIII-13: Proportion of Who are Active Cardiologists Age 65-69 By Percentiles of the Location Characteristic Distribution



While these location characteristics are influential in the retirement decisions, their influence is not as strong as that observed for age and health status.

e. Race and IMG Status

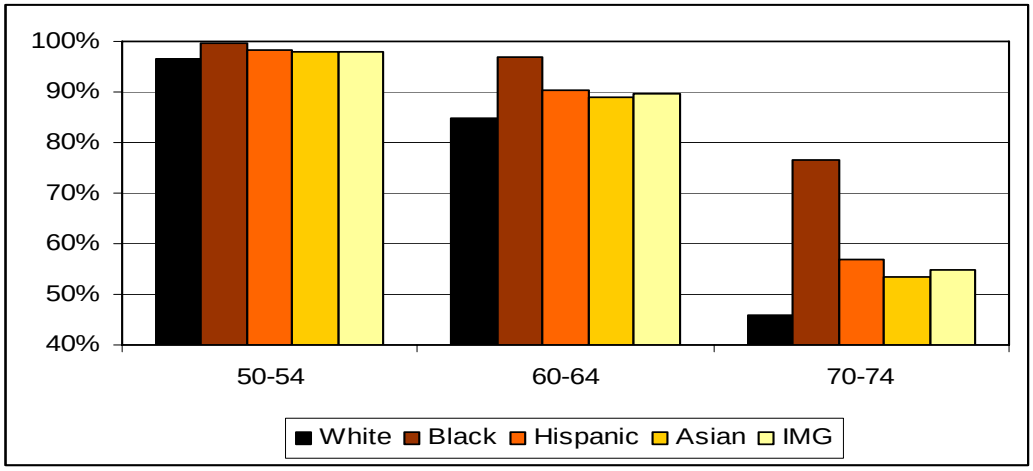
In this section, we look at the impact of race and IMG status on work status. Table VIII-11 displays the proportion of cardiologists over 50 by race and IMG status.

Table VIII-11: Distribution of Cardiologists by Race and IMG Status

Variable	% of Cardiologists
Race	
White	78.0%
Black	1.3%
Hispanic	3.1%
Asian	15.2%
Other	2.3%
International Medical School Graduate	27.9%

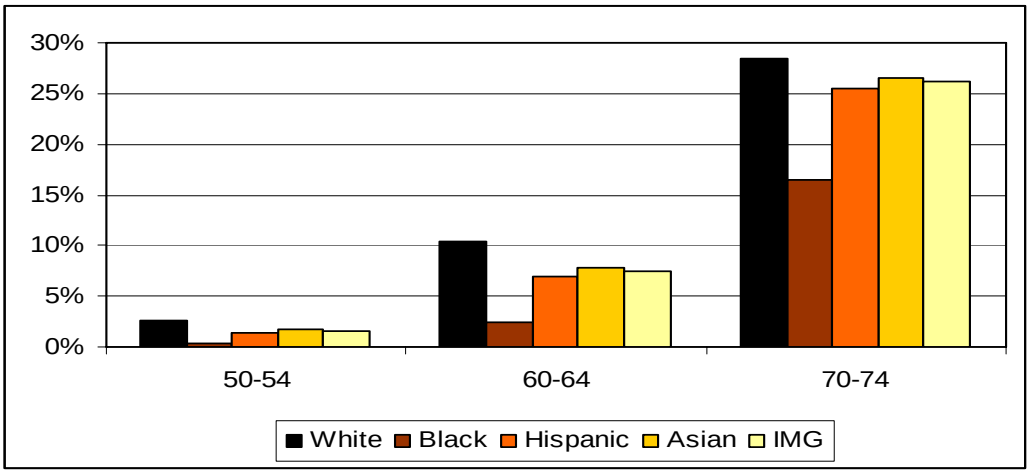
The regression coefficients indicate that cardiologists who are Black, Hispanic, Asian, or IMGs are more likely to work than white cardiologists and U.S. medical school graduates.

Figure VIII-14: Simulated Probability of Full-time Work By Race/IMG Status



The simulations indicate that Black cardiologists are much more likely to continue working into their 70s and those who are active are more likely to work full-time.

Figure VIII-15: Simulated Probability of Part-time Work By Race/IMG Status



The results for minorities and IMGs indicate that these individuals are more likely to remain active than white U.S. medical school graduates. These results should be used with caution, however, because although these differences were estimated to be statistically significant, the results particularly for Black (N=10) and Hispanic (N=21) cardiologists were estimates based on a small number of survey respondents.

D. Discussion

The main findings of the retirement analysis include:

Retirement

Based on our analysis of the descriptive responses and the retirement and work status model results, we find age, health status, professional satisfaction, financial status, and regional location to be important factors in the retirement decision. The evidence related to each of these factors is summarized here:

- *Age* – Even when controlling for factors such as health and financial status, age is one of the most important factors influencing retirement. However, many cardiologists (about 57%) choose to continue some level of work activity at age 75 or older.
- *Health Status* – Health status was the most common reason cardiologists cited for retiring earlier than planned (57%). Likewise, in the work status model, health status, particularly fair/poor health status resulted in substantial reductions in activity level. The influence of health status on activity increases with age.
- *Professional Satisfaction* – Lack of professional satisfaction was the second most commonly cited factor in early retirements listed by 31% of cardiologists who had retired earlier than planned. Several factors that were cited as important to retirement planning for cardiologists that might influence this lack of professional satisfaction are: on-call responsibilities, increasing regulation in medicine, insufficient reimbursement, decreasing clinical autonomy, and stress of practice. In contrast, 73% of active cardiologists indicated that career satisfaction was an important factor in their decision to remain active in medicine.
- *Financial Status* – Financial status was less influential in the retirement decision than age, health status, and professional satisfaction. Active cardiologists listed financial obligations (51%) and good income (43%) behind career satisfaction (73%) as a factor motivating them to remain in medicine. Similarly, when active cardiologists were asked whether they would retire from medicine today if they could afford to, 61% said they would not. However, many cardiologists did list insufficient reimbursement (45%) as an important factor in their retirement decision. The results of the work status model indicate that those with fair/poor financial status are more likely to work and to work full-time, but the differences are small. The model also indicated that higher state income tax rates are a disincentive to work.
- *Regional Location* – Cardiologists in the Northeast and Midwest remain active longer than cardiologists in the South and West, holding other variables constant. Further analysis is warranted to understand the factors that may be influencing these differences. Factors might include differences between these regions in: demand levels, practice structure, culture, and job opportunities in activities other than traditional patient care.

Overall, cardiologists have similar or slightly lower retirement rates relative to other medical specialists and surgical specialists. While age and health status will remain important factors in the retirement decision over which there is limited influence, professional satisfaction appears to be a key factor in the retirement decision, where improvements in areas such as on-call

responsibilities, increasing regulation in medicine, insufficient reimbursement, decreasing clinical autonomy, and stress of practice, are likely to result in delayed retirement. Understanding the regional differences in retirement patterns might provide insight into ways to influence retirement patterns.

Part-time Work

There appears to be a gap between cardiologists' interest in working part-time and availability of part-time opportunities for cardiologists:

- Relative to other medical specialists, cardiologists have a similar level of interest in working part-time with 66% of cardiologists and other medical specialists indicating they are currently working part-time or might choose to work part-time prior to retirement.
- However, cardiologists were less likely than other medical specialists to work part-time (12% vs. 21%).
- Cardiologists were more likely than other medical specialists to indicate that part-time work was not available in their current practice (46% vs. 34%).
- While only 12% of active cardiologists over 50 currently work part-time, an additional 54% would be interested in working part-time prior to retirement.

Addressing the gap between desire for and availability of part-time work among cardiologists might result in later retirements and greater career satisfaction.

IX. CARDIOLOGY PRACTICE EFFICIENCY

The current and anticipated future shortage of cardiologists will motivate practitioners to provide more efficient care. Currently, there is substantial variation in cardiologist practice characteristics. These differences include variation in the number of physicians in the practice, whether part-time physicians are employed, whether the practice is multi-specialty or single specialty, number of offices, whether part-time or outreach offices are used, practice setting, and type of ownership. In this section, we analyze how these differences across practices influence productivity measured via gross revenue and RVUs.

These results were developed based on three ACC practice surveys: adult private practice, pediatric practice, and academic practice. Practices in these files were linked to location characteristics in the Area Resource File based on the city of the practice.

We divide this analysis into two sections. In the next section, we present descriptive statistics on the practices included in our analysis. Then, we present the regression results. We model productivity based on three difference measures: revenue per FTE physician, gross practice revenue, and RVUs per practice. The similarities and differences between the results related to these measures provide insight into potential areas for cardiology practice efficiency improvements.

A. Descriptive Statistics

Three practice types were included in this analysis: private practices, academic practices and pediatrics practices. In this section, we present descriptive statistics separately for each of these practice types.

1. Private Practices

Table IX-1 displays descriptive statistics on the private practices responding to the ACC private practice survey. These data represent 326 of more than 3,800 private cardiology practices in the U.S. We divided the practices based on size to assess difference in practice structure that might be related to size.

Table IX-1: Descriptive Statistics on Private Adult Practices

	Practice Size (Number of Full-time Physicians)					
	Solo	**2-5**	**6-9**	**10-19**	**20-49**	**50+**
Number of Practices	23	77	63	79	60	24
Practice Staffing Levels						
# of FT Cardiologists	1.00	3.30	7.13	13.29	22.46	28.63
# of PT Cardiologists	0.17	0.43	0.46	1.42	2.05	1.04
# of FT Other Specialty Physicians	0.00	0.18	0.30	0.39	6.01	102.13
# of PT Other Specialty Physicians	0.00	0.03	0.05	0.53	0.52	6.88
Use of Mid-Level Practitioners						
% Not Reporting NP or PA Data	8.7%	13.0%	11.1%	17.7%	10.0%	4.2%
% Do Not Use NPs or PAs	65.2%	36.4%	22.2%	3.8%	10.0%	8.3%
# of PAs in Practice with NP or PA	0.67	0.77	1.38	1.68	2.69	3.38
# of NPs in Practice with NP or PA	0.67	1.18	2.07	3.55	5.46	4.62
Number of Offices						
Number of Full-time Offices	0.91	1.18	1.75	2.53	4.53	11.25
Number of Part-time Offices	0.43	0.29	0.73	0.77	0.87	1.00
Number of Outreach Offices	0.09	1.04	1.24	1.65	2.97	3.58
Practice Type						
Single Specialty Group	8.7%	76.6%	92.1%	87.3%	71.7%	29.2%
Multi-Specialty Group	0.0%	6.5%	3.2%	5.1%	13.3%	41.7%
Medical School	4.3%	0.0%	3.2%	3.8%	1.7%	12.5%
Solo	82.6%	6.5%	0.0%	1.3%	3.3%	0.0%
Hospital	0.0%	1.3%	0.0%	1.3%	3.3%	8.3%
Government	4.3%	9.1%	1.6%	1.3%	6.7%	8.3%
Urbanicity						
Large Urban	82.6%	48.1%	34.9%	51.9%	45.0%	41.7%
Small Urban	13.0%	36.4%	30.2%	27.8%	33.3%	33.3%
Region						
West	13.0%	15.6%	15.9%	19.0%	13.3%	16.7%
South	30.4%	39.0%	30.2%	29.1%	38.3%	37.5%
NE	26.1%	20.8%	20.6%	30.4%	25.0%	33.3%
Practice County Characteristics						
Mean Cardiologists per Population	10.74	9.51	9.63	9.33	11.01	9.84
Percent Uninsured	11.8%	13.2%	12.6%	13.2%	12.8%	13.3%
Median Household Income (in Thousands)	$46.29	$42.39	$42.64	$45.00	$43.82	$46.11
Percent Medicare Beneficiaries	14.6%	15.4%	15.0%	14.2%	15.4%	14.6%

We find that while larger practices are more likely to be multi-specialty groups, 72% of practices with 20-49 full-time physicians indicated they were a single specialty group.

About 12% of practices did not report data on use of NPs or PAs. Non-reporting may indicate that the practice does not use physician extenders, however, many practices did indicate zero in

these fields if physician extenders were not in use. Overall, larger practices are more likely to have NPs or PAs. However, among practices using NPs and PAs the ratio of NPs and PAs to physicians was much higher in smaller practice. For example, solo practices with NPs and PAs had an average of 1.3 NPs/PAs while practices using NPs/PAs with 20-49 full-time physicians had an average of only 8.2 NPs/PAs.

Practices with larger numbers of physicians tended to have more offices. However, the number of full-time physicians per full-time office increases with practice size. Practices with 2-5 full-time physicians had an average of three physicians per full-time office. Meanwhile practices with 50 or more full-time physicians had an average of 12 full-time physicians per office. Larger practices were more likely to have outreach offices.

The vast majority of cardiologist offices surveyed (73%) were cardiology only groups. About 9% were multi-specialty groups, and 8% were solo cardiology practices. The remainder were medical school, hospital, or government practices.

Practice location characteristics were derived based on the primary practice location; therefore, these characteristics may not be reflective of all office locations owned by a given practice. Location characteristics were similar across practice sizes with the exception that solo practices were much more likely to be located in large urban areas than the other practice sizes.

Private practices were asked to report, either the number of RVUs per FTE physician or gross revenue per FTE physician, Table IX-2 reports the distribution of these responses. There was substantial variability in responses across practices within size categories.

Table IX-2: RVUs and Gross Revenue per FTE in Private Adult Practices

	Practice Size (Number of Full-time Physicians)					
	Solo	**2-5**	**6-9**	**10-19**	**20-49**	**50+**
RVUs per FTE						
Less than 9,000	33%	32%	24%	21%	35%	23%
9,000-9,9999	17%	9%	24%	24%	8%	15%
10,000-10,999	33%	32%	34%	18%	13%	23%
Greater than or equal to 11,000	17%	27%	17%	38%	45%	38%
Number of Practices	6	22	29	34	40	13
Gross Revenue per FTE						
Less than $1 million	59%	33%	29%	22%	35%	64%
$1 million to $1.999 million	29%	36%	32%	47%	40%	18%
$1.2 million to $1.399 million	0%	20%	6%	20%	5%	0%
Greater than $1.4 million	12%	11%	32%	11%	20%	18%
Number of Practices	17	55	34	45	20	11

2. Academic Practices

Table IX-3 displays descriptive statistics on the academic practices responding to the ACC academic practice survey. These data represent 27 of the approximately 110 academic cardiology practices in the U.S. Similar to the analysis of responses for private practices, we divided the practices based on size to assess difference in practice structure that might be related to size.

With the exception of staffing levels larger academic practices had similar characteristics to the smaller practices. About half of both types of practices did not indicate use of mid-level practitioners. Thus, academic practices appear less likely than private practices to use mid-level practitioners. Larger academic practices tended to be in counties with more cardiologists per population.

Table IX-3: Descriptive Statistics on Academic Practices

	Number of Full-time Physicians	
	3-15	**16+**
Number of Practices	10	17
Practice Staffing Levels		
# of FT Cardiologists	8.70	27.82
# of PT Cardiologists	1.50	3.88
# of FT Other Specialty Physicians	0.10	1.88
# of PT Other Specialty Physicians	0.00	0.00
Use of Mid-Level Practitioners		
% Not Reporting NP or PA Data	10.0%	29.4%
% Do Not Use NPs or PAs	40.0%	23.5%
# of PAs in Practice with NP or PA	0.83	1.58
# of NPs in Practice with NP or PA	2.33	6.33
Number of Offices		
Number of Full-time Offices	1.50	3.35
Number of Part time Offices	0.50	0.82
Number of Outreach Offices	0.80	2.12
Urbanicity		
Large Urban	70.0%	64.7%
Small Urban	20.0%	23.5%
Region		
West	10.0%	11.8%
South	50.0%	35.3%
NE	20.0%	17.6%
Practice County Characteristics		
Mean Cardiologists per Population	10.43	13.91
Percent Uninsured	15.7%	14.1%
Median Household Income (in Thousands)	37.52	41.49
Percent Medicare Beneficiaries	14.6%	13.4%

Academic practices were asked to report both the number of RVUs per FTE physician and gross revenue per FTE physician, Table IX-4 reports the distribution of these responses. More than half of larger practices and 40% of smaller practices reported producing less than 9,000 RVUs per FTE. Ninety percent of smaller practices and 65% of larger practices reported gross revenue of less than $1 million per FTE.

Table IX-4: RVUs and Gross Revenue per FTE in Academic Practices

	Number of Full-time Physicians	
	3-15	**16+**
RVUs per FTE		
Less than 9,000	40.0%	52.9%
9,000-9,9999	10.0%	17.7%
10,000-10,999	20.0%	11.8%
Greater than or equal to 11,000	10.0%	5.9%
Don't Record RVUs	20.0%	11.8%
Gross Revenue per FTE		
Less than $1 million	90.0%	64.7%
$1 million to $1.1999 million	10.0%	29.4%
$1.2 million to $1.399 million	0.0%	5.9%

3. Pediatric Practices

Table IX-5 displays descriptive statistics on the pediatric practices responding to the ACC pediatric practice survey. These data represent 66 of about 300 pediatric cardiology practices in the U.S. We divided the practices based on size to assess difference in practice structure that might be related to size.

Most smaller pediatric practices did not report on use of mid-level practitioners. Use of mid-level practitioners was more common in larger practices. Larger practices tended to be affiliated with hospitals and were more likely to be in counties with a greater number of cardiologists per population.

Table IX-5: Descriptive Statistics on Pediatric Practices

Characteristic	Number of Full-time Physicians	
	0-9	10+
Number of Practices	34	32
Practice Staffing Levels		
# of FT Cardiologists	3.91	18.59
# of PT Cardiologists	0.35	2.25
# of FT Other Specialty Physicians	0.09	6.06
# of PT Other Specialty Physicians	0.03	0.84
Use of Mid-Level Practitioners		
% Not Reporting NP or PA Data	44%	34%
% Do Not Use NPs or PAs	35%	13%
# of PAs in Practice with NP or PA	0.57	1.53
# of NPs in Practice with NP or PA	2.00	4.41
Number of Offices		
Number of Full-time Offices	1.09	2.16
Number of Part time Offices	1.79	3.50
Number of Outreach Offices	1.50	4.19
Practice Type		
Hospital	47.1%	84.4%
Private	52.9%	15.6%
Urbanicity		
Large Urban	70.6%	81.3%
Small Urban	23.5%	15.6%
Region		
West	20.6%	12.5%
South	44.1%	37.5%
NE	23.5%	25.0%
Practice County Characteristics		
Mean Cardiologists per Population	9.47	13.66
Percent Uninsured	14.2%	14.4%
Median Household Income (in Thousands)	$44.84	$42.31
Percent Medicare Beneficiaries	15.3%	14.1%

Pediatric practices were asked to report both the number of RVUs per FTE physician and gross revenue per FTE physician, Table IX-6 reports the distribution of these responses. Most pediatric practices (62%) do not record RVUs. There was substantial variability in reported RVUs and gross revenue per FTE across the practices. Few pediatric practices reported gross revenue per FTE greater than $1 million.

Table IX-6: RVUs and Gross Revenue per FTE in Pediatric Practices

	Number of Full-time Physicians	
	0-9	**10+**
RVUs per FTE		
1,000-2,499	11.8%	9.7%
2,500-3,999	5.9%	9.7%
4,000-8,999	11.8%	16.1%
Greater than or equal to 9,000	8.8%	3.2%
We Don't Measure RVUs	61.8%	61.3%
Gross Revenue per FTE		
$100,000-$249,999	24.2%	30.0%
$250,000-$499,999	33.3%	40.0%
$500,000-$999,999	36.4%	16.7%
Greater than $1.0 million	6.1%	13.3%

B. Regression Results

We present three sets of regression results in this section. The first set of results indicates the influence of practice characteristics on revenue earned per FTE physician. The second set of results indicates how gross practice revenue is influenced by various practice characteristics. Finally, the last set of results looks at the influence of practice characteristics on gross practice RVUs.

Data on gross revenue per FTE and RVUs per FTE were reported within categories for the ACC practice surveys. Category mid-points were used to create continuous variables for the regressions. For top categories 1000 RVUs or $100,000 were added to the minimum for the category and for the bottom category 1000 RVUs or $100,000 were subtracted from the maximum for the category.[26] The sensitivity of the regression results to these assumptions was tested and the results were found to be robust.

In the ACC academic and pediatric practice surveys, practices were asked to report both gross revenue per FTE physician and RVUs per FTE physicians. For these surveys, practices that did not report revenue or RVUs were excluded from regressions for that metric of productivity.[27] In the ACC private practice survey, however, practices were first asked to report RVUs per FTE physician. If they could not report this, they were then asked to report gross revenue per FTE. Therefore, for most private practices data was available only for either gross revenue or RVUs. For these practices, where RVUs were reported, but not revenue, we estimated gross revenue based on the RVUs by converting the RVUs to revenue based on the Medicare conversion factor ($38 per RVU), an adjustment factor for practice related expenses (1/.51), and another adjustment factor for the difference between Medicare and private practice payment levels (1.1). To address errors in this formula, we included a dummy variable in the regression for those

[26] For pediatric practices the minimum category was less than $100,000 per FTE. Only $50,000 was subtracted from this amount to create the continuous variables.

[27] As noted above 62% of pediatric practices did not report RVUs. Therefore, these practices are excluded from the regressions for practice RVUs.

private practices only reporting RVUs. In the regression results, the coefficient on this indicator is negative and significant indicating our conversion likely understates the actual revenue earned per RVU.

Regression results for gross revenue per FTE physician are presented in Table IX-7.

Table IX-7: Impact of Practice Characteristics on Revenue per FTE Physician (in Thousands)

	All Practices		Small Practices 1-9 Physicians		Larger Practices 10 or More Physicians	
Variable	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error
Intercept	1,012 **	44	1,013 **	58	1,001 **	117
Number of Fulltime Cardiologists	-3 *	1	-13	8	-2	2
Number of Parttime Cardiologists	-7 #	4	-11	20	-7 #	4
Number of Fulltime Other Physician	0	0	3	22	-1	0
Number of Parttime Other Physician	-1	2	-88	88	-2	2
Number of Physicians' Assistants	11 *	4	20	12	9 #	5
Number of Nurse Practitioners	9 *	4	34 *	15	7	5
Number of Fulltime Offices Owned	9 *	4	28	24	9 *	4
Number of Parttime Offices Owned	11 *	5	29 *	12	6	6
Number of Outreach Offices	3	3	5	6	0	3
Type of Practice (Solo Adult or Academic Group Excluded)						
Multi-Specialty Group	105 #	54	114	90	103	119
Cardiology Only Group	120 **	40	122 *	53	109	113
Medical School	46	73	47	152	24	133
Hospital	-25	89	-61	203	-28	141
Government	-48	62	-105	82	25	137
Other	18	96	185	152	-99	159
Academic	-93	58	-92	110	-107	123
Pediatric Hospital-Based	-598 **	52	-621 **	74	-575 **	121
Pediatric Private	-447 **	57	-488 **	70	-335 *	136
Urbanicity of Location (Non-Urban Excluded)						
Located in Large Urban Area	-8	27	-25	40	-3	38
Located in Small Metro Area	9	28	2	43	11	41
Reported RVUs Only	-308 **	22	-324 **	34	-281 **	32
Missing PA Data	-23	31	5	53	-32	41
Missing NP Data	54	39	24	56	104	63
Number of Observations	409		195		214	

** Significantly different from zero at the 99% confidence level.
* Significantly different from zero at the 95% confidence level.
# Significantly different from zero at the 90% confidence level.

The first several variables included in the model indicate practice staffing levels and number of offices. The estimates indicate that practices with larger numbers of cardiologists tend to earn less revenue per FTE physician. In contrast, use of PAs and NPs and increased numbers of offices tends to increase revenue per FTE physician.

The next set of variables describes practice type. These estimates indicate that most practice types have lower revenue per FTE physician relative to single specialty private adult practices. Hospital-based pediatric practices had the lowest earnings per FTE physician followed by private pediatric practices. Academic, government, hospital, and solo practices also had substantially lower revenue per FTE physician relative to single specialty group practices.

Multispecialty group practices had similar earnings per FTE physicians relative to single specialty groups.

Regression results for gross practice revenue are presented in Table IX-8.

Table IX-8: Impact of Practice Characteristics on Gross Practice Revenue (in Thousands)

	All Practices		Small Practices 1-9 Physicians		Larger Practices 10 or More Physicians	
Variable	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error
Intercept	162	1,011	604 #	351	2,095	3,465
Number of Fulltime Cardiologists	717 **	34	871 **	50	705 **	48
Number of Parttime Cardiologists	78	94	365 **	119	100	125
Number of Fulltime Other Physician	710 **	20	948 **	135	683 **	30
Number of Parttime Other Physician	308 **	93	-416	531	259 *	126
Number of Physicians' Assistants	337 **	104	117	74	337 *	153
Number of Nurse Practitioners	298 **	95	184 *	88	269 *	136
Number of Fulltime Offices Owned	774 **	120	158	144	721 **	163
Number of Parttime Offices Owned	-151	123	133 #	72	-116	189
Number of Outreach Offices	-1	66	7	39	38	102
Type of Practice (Solo Adult or Academic Group Excluded)						
Multi-Specialty Group	4,826 **	1,348	747	541	6,785 #	3,631
Cardiology Only Group	1,644 #	923	657 *	320	1,596	3,295
Medical School	2,150	1,723	259	914	1,868	3,934
Hospital	439	2,045	-128	1,223	799	4,127
Government	2,175	1,445	-370	494	5,154	4,154
Other	-1,013	2,356	911	911	-2,879	5,090
Academic	1,055	1,344	-382	663	-1,293	3,613
Pediatric Hospital-Based	-6,463 **	1,198	-2,923 **	446	-10,347 **	3,538
Pediatric Private	-3,447 **	1,306	-1,533 **	424	-8,399 *	4,063
Urbanicity of Location (Non-Urban Excluded)						
Located in Large Urban Area	44	618	-499 *	243	498	1,148
Located in Small Metro Area	609	660	-237	257	1,066	1,232
Reported RVUs Only	-3,253 **	521	-1,702 **	205	-5,265 **	969
Missing PA Data	215	731	-91	318	-602	1,251
Missing NP Data	2,050 *	902	85	334	4,776 *	1,860
Number of Observations	400		195		205	

** Significantly different from zero at the 99% confidence level.
* Significantly different from zero at the 95% confidence level.
# Significantly different from zero at the 90% confidence level.

The results indicate that each additional full-time cardiologist earns between $700,000 and $870,000 in gross revenue for the practice with smaller practices tending to have higher earnings per cardiologist. Regression results indicate that each additional NP or PA earns about $300,000 for the practice. This is about 40% of the earnings brought in by each additional physician. We estimate annual compensation costs for a PA to be about $115,000 per year. This is only about 30% of the annual compensation of an additional general cardiologist.[28] The results in the all practice regression indicate that multi-specialty group practices and cardiology only groups

[28] The Bureau of Labor statistics estimates mean wages and salary for a PA was $78 thousand in 2006 (http://www.bls.gov/oes/current/oes_nat.htm#b29-0000 downloaded on 8/28/08) and that wages and salary represent about 70% of total compensation (http://www.bls.gov/news.release/pdf/ecec.pdf based on data from March 2008. Nurse practitioners are included in the registered nurse category by BLS, so their wage and salary levels are not estimated separately.

tend to have higher earnings than solo practices after controlling for the number of physicians in the practice. The standard errors on these variables are large suggesting substantial variation across the practices in the sample.

The final set of regression results presented in Table IX-9 is for total practice RVUs. These results indicate each additional full-time cardiologist produces about 9,200 RVUs annually. Each additional PA produces about 2,800 RVUs annually for larger practices. Also, for larger practices additional full-time offices were related to substantially higher productivity. The type of practice results are generally not significant. The standard errors for the type of practice point estimate are large. Thus, the results should be interpreted with caution.

Table IX-9: Impact of Practice Characteristics on Total Practice RVUs

	All Practices		Small Practices 1-9 Physicians		Larger Practices 10 or More Physicians	
Variable	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error	Coefficient Estimate	Standard Error
Intercept	-11,967	17,912	2,062	5,126	-26,320	52,554
Number of Fulltime Cardiologists	9,209 **	506	9,225 **	801	9,235 **	719
Number of Parttime Cardiologists	2,814 **	875	5,380 *	2,094	2,882 *	1,150
Number of Fulltime Other Physician	9,425 **	291	8,473 **	1,458	9,361 **	417
Number of Parttime Other Physician	4,107 **	1,085	3,974	6,172	3,823 **	1,444
Number of Physicians' Assistants	2,810 *	1,177	1,252	893	2,955 #	1,711
Number of Nurse Practitioners	-711	1,271	2,192	1,418	-1,023	1,779
Number of Fulltime Offices Owned	7,569 **	1,652	-1,864	2,085	7,431 **	2,243
Number of Parttime Offices Owned	2,976	2,571	768	1,255	3,163	3,901
Number of Outreach Offices	-209	763	-252	582	-206	1,091
Type of Practice (Solo Adult or Government Excluded)						
Multi-Specialty Group	25,023	21,049	12,849 #	6,669	44,531	54,827
Cardiology Only Group	5,790	16,806	4,997	4,795	20,048	50,854
Medical School	-24,718	22,948	5,269	8,585	-17,888	57,174
Hospital	-7,216	23,300	-2,250	10,293	4,091	55,074
Government	875	41,906	-4,913	9,682	NA	.
Other	-59,330 #	32,836	NA	.	-48,514	61,120
Academic	-16,541	18,989	7,618	6,894	-9,271	52,264
Urbanicity of Location (Non-Urban Excluded)						
Located in Large Urban Area	-19	8,158	-4,370	3,190	3,051	13,815
Located in Small Metro Area	849	8,871	-4,753	3,492	5,621	15,479
Missing PA Data	2,217	12,926	-2,708	5,308	1,978	22,223
Missing NP Data	440	15,505	7,440	5,791	2,896	28,992
Number of Observations	161		60		101	

** Significantly different from zero at the 99% confidence level.
* Significantly different from zero at the 95% confidence level.
# Significantly different from zero at the 90% confidence level.

C. Discussion

Given the current shortage of cardiologists and the likelihood that this shortage will be exacerbated by demographic trends and technological advances over the next 20 years, cardiologists will be faced with increased pressure to improve practice efficiency to maintain quality of care and work-life balance. The results presented in this section suggest ways cardiologist practice efficiency might be improved.

- Increase use of mid-level practitioners – The regression results indicate about $300,000 in gross revenue is earned by a practice for each additional full-time NP or PA on staff. This is about 40% of the revenue earned for each additional physician. However, many practices did not indicate any use of mid-level practitioners. Larger practices that use NPs and PAs on average have lower ratios of mid-level practitioners per physician than smaller practices using NPs and PAs. This suggests there would be efficiency in increasing mid-level practitioners in larger practices.
- Research efficient practice for serving outreach communities – The regression results related to outreach offices were mixed. Further research is warranted into the costs related to supporting outreach offices and the benefits to the practice. In addition, as the supply shortage of general cardiologists becomes more extreme, provision of care to individuals in rural communities or other underserved areas will need to be addressed. This presents an opportunity for the cardiology community to investigate the most efficient methods of providing quality care to these communities.

Practice efficiency is modeled here based on gross revenue per FTE. Thus, while the results indicate that practices with larger numbers of physicians tend to earn less revenue per FTE and use of mid-level practitioners and increased number of offices tend to increase revenue per FTE, the results do not account for different cost profiles across practices. Additional data collection and further research on cardiology practice efficiency will aid the cardiology community as demand for cardiology services increases.

X. INTERNATIONAL MEDICAL GRADUATES

In this section, we provide an overview of IMGs in cardiology. Table X-1 displays the number and percent of active physicians in each cardiology subspecialty represented by IMGs. The counts of IMGs included in this table are based on the AMA Masterfile which includes only IMGs who are practicing in the U.S.

Table X-1: Number and Share of International Medical School Graduates in Cardiology by Subspecialty

Category	General Cardiologist	Interventional Cardiologist	Cardiac Electro-physiologists	Pediatric Cardiologist
All Age Groups				
IMGs	5,261	1,848	547	639
USMDs and IMGs Total	16,561	5,445	1,856	2,039
IMG Share	31.8%	33.9%	29.5%	31.4%
Cardiologists Under 45				
IMGs	1,258	935	292	259
USMDs and IMGs Total	4,217	2,164	896	799
IMG Share	29.8%	43.2%	32.6%	32.5%

We compared the number of cardiology fellows who were IMGs in the 1999-2000 and 2002-2003 academic years based on JAMA's medical education statistics to the number of IMGs who remain in the U.S. who completed training in cardiology between 2000 and 2006 based on the AMA Masterfile. Comparison of these counts suggests that about 97% of those who completed their training in this period remained in the U.S.

This share is supported by results from a survey of fellows completing training in New York which is conducted by the Albany Center for Workforce Studies. In the years between 2001 and 2007, the survey of fellows found that between zero to four percent of New York cardiology fellows left the U.S. upon completion of their training. Thus, the vast majority of IMGs who train in cardiology remain in the U.S. upon completion of training.

IMGs represent about 30% of active cardiologists in the U.S. The share of cardiologists who are IMGs appears likely to remain steady at this level with the exception of interventional cardiology where younger interventionalists are more likely to be IMGs (43.2%). Figures X-1 through X-4 display the age distribution of IMGs and U.S. medical school graduates by cardiology subspecialty.

Figure X-1: Number of Active General Cardiologists Practicing in the U.S., 2008 by Age/IMG Status

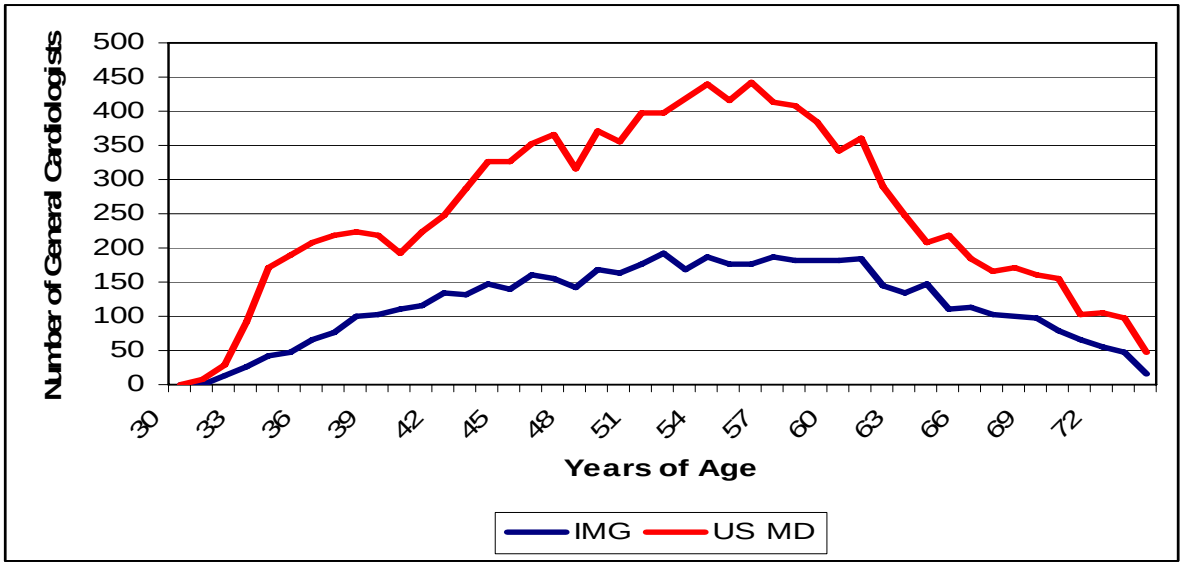


Figure X-2: Number of Active Interventional Cardiologists Practicing in the U.S., 2008 by Age/IMG Status

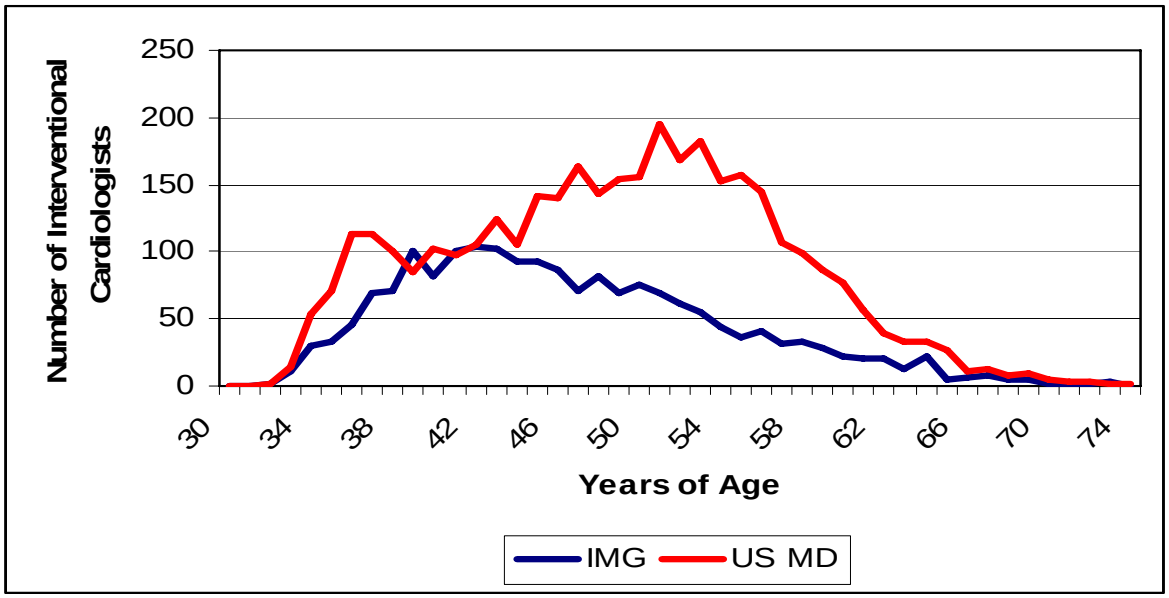


Figure X-3: Number of Active Cardiac Electrophysiologists Practicing in the U.S., 2008 by Age/IMG Status

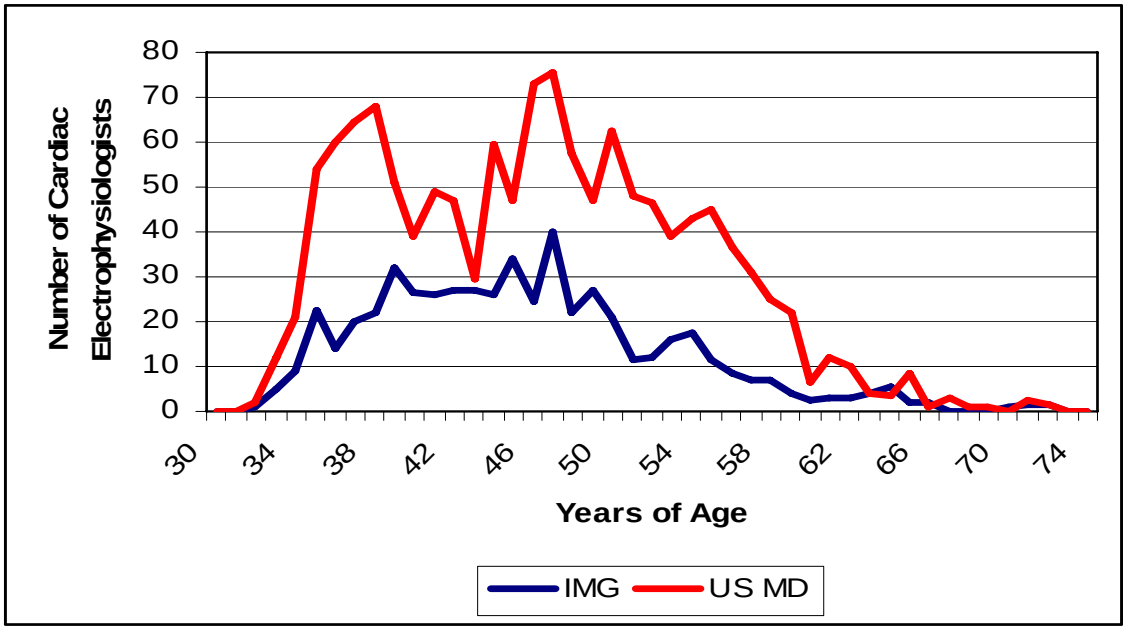


Figure X-4: Number of Active Pediatric Cardiologists Practicing in the U.S., 2008 by Age/IMG Status

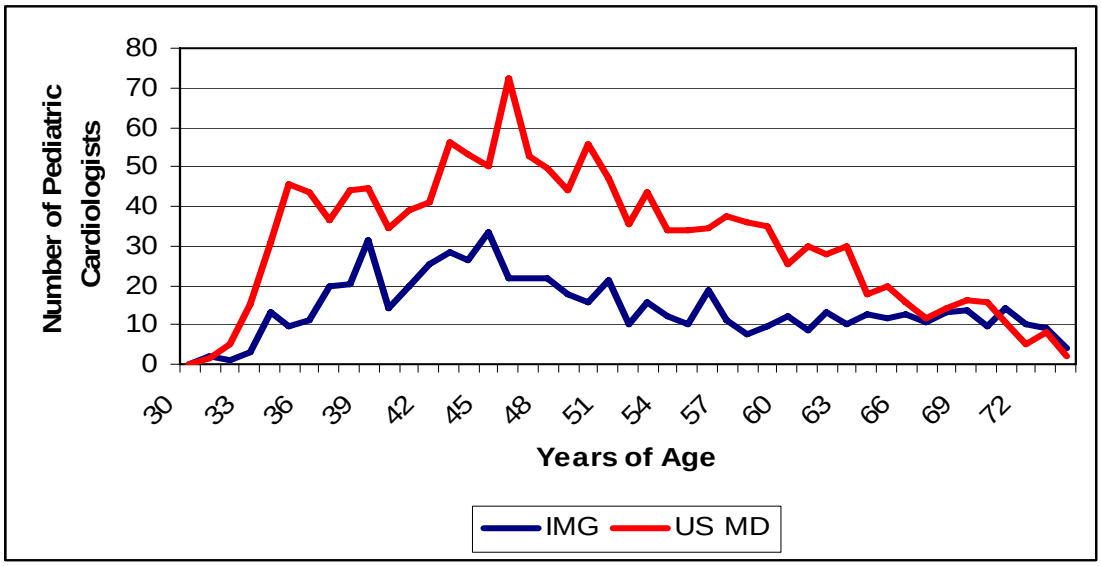
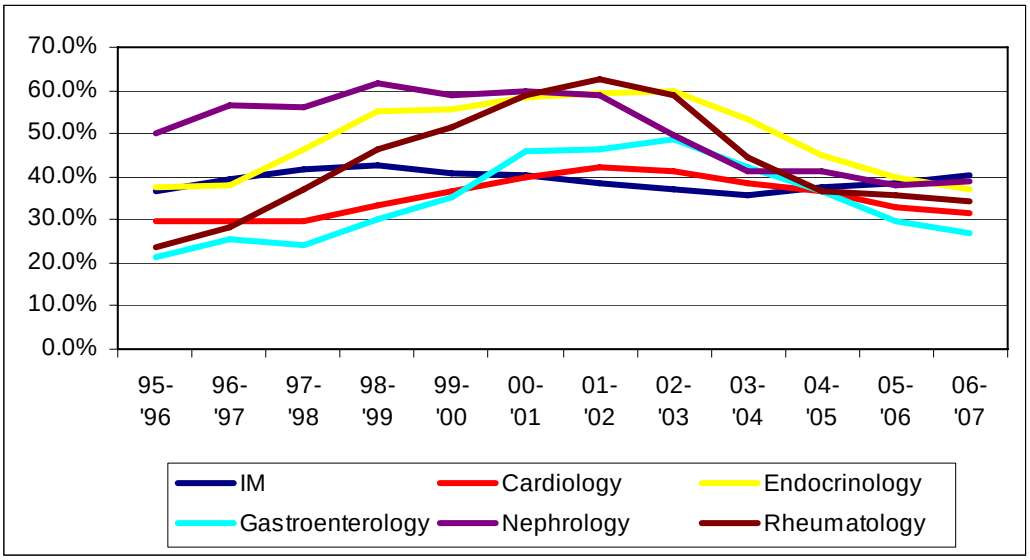


Figure X-5 displays IMGs as a share of internal medicine residents and fellows in internal medicine subspecialties. The share of IMGs in cardiology is similar to the share observed for internal medicine overall.

Figure X-5: International Medical School Graduates as a Percentage of All Residents/Fellows in the Specialty



Overall IMGs represent a substantial share of the cardiology workforce in the U.S. Their share has remained fairly consistent over time, with the exception of interventional cardiology where their share is increasing.

XI. UNDERREPRESENTED MINORITIES (URMs)

Although Black, Hispanic, and Native Americans constitute about one-quarter of the U.S. population, data collected by AAMC suggests that only 6% of practicing physicians are drawn from these racial and ethnic groups. Researchers have found that URM physicians are more likely than non-Hispanic white physicians to work in facilities and communities designated as health professional shortage areas. Thus, one reason to encourage greater URM participation in cardiology is that increasing the number of racial and ethnic minorities practicing medicine may increase access, improve quality of care, and increase patient satisfaction for minority patients.[29]

In the next two sections, we provide background data on URMs. In the first section below, we provide data on the rate at which URM internal medicine graduates pursue various internal medicine subspecialties. Then, we discuss the distribution of URM graduates across the U.S.

A. URM Recruiting Among Internal Medicine Subspecialties

Figures XI-1 and XI-2 display URM residents/fellows as a percentage of all residents/fellows in internal medicine and selected internal medicine subspecialties for Black, Hispanic, and Asian minorities, respectively. Members of URM groups overall tend to be less likely to subspecialize as indicated by Table XI-1.

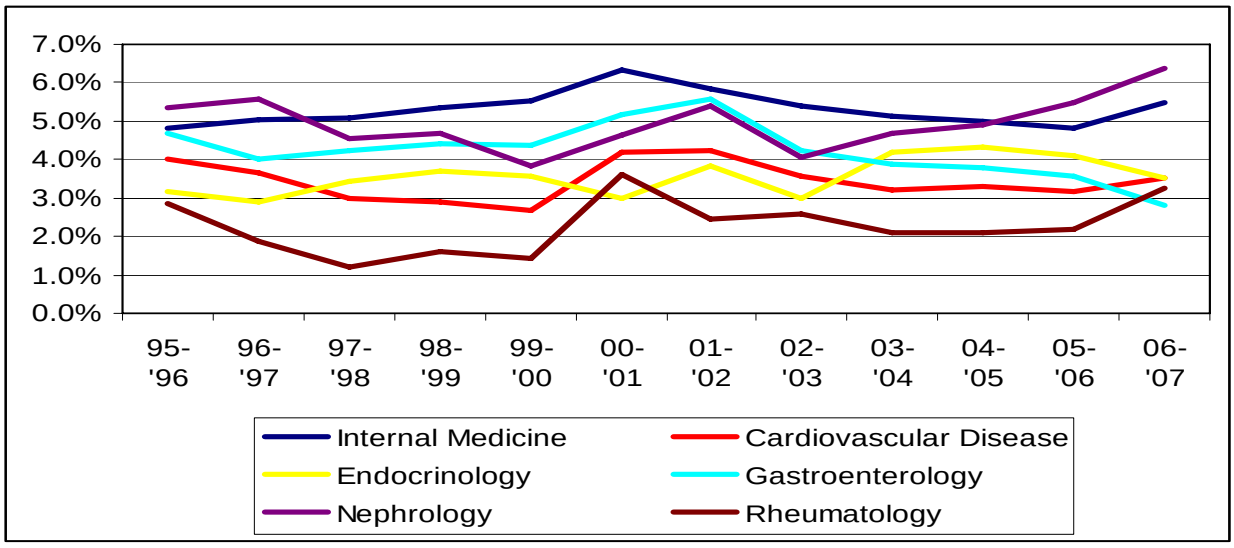
Table XI-1: Share of Internal Medicine Residents and Fellows by Racial and Ethnic Groups

	White	Black	Hispanic	Asian
Internal Medicine Residents	38.6%	5.5%	7.6%	37.6%
Graduate Fellows in Internal Medicine Subspecialties	52.8%	4.0%	6.0%	34.2%

Relative to the other internal medicine subspecialties listed, cardiology has a higher percentage of Black fellows than rheumatology and a level similar to endocrinology, but tends to attract a lower share than nephrology and gastroenterology. Cardiology consistently had a lower share of Black fellows than the internal medicine graduate population as a whole.

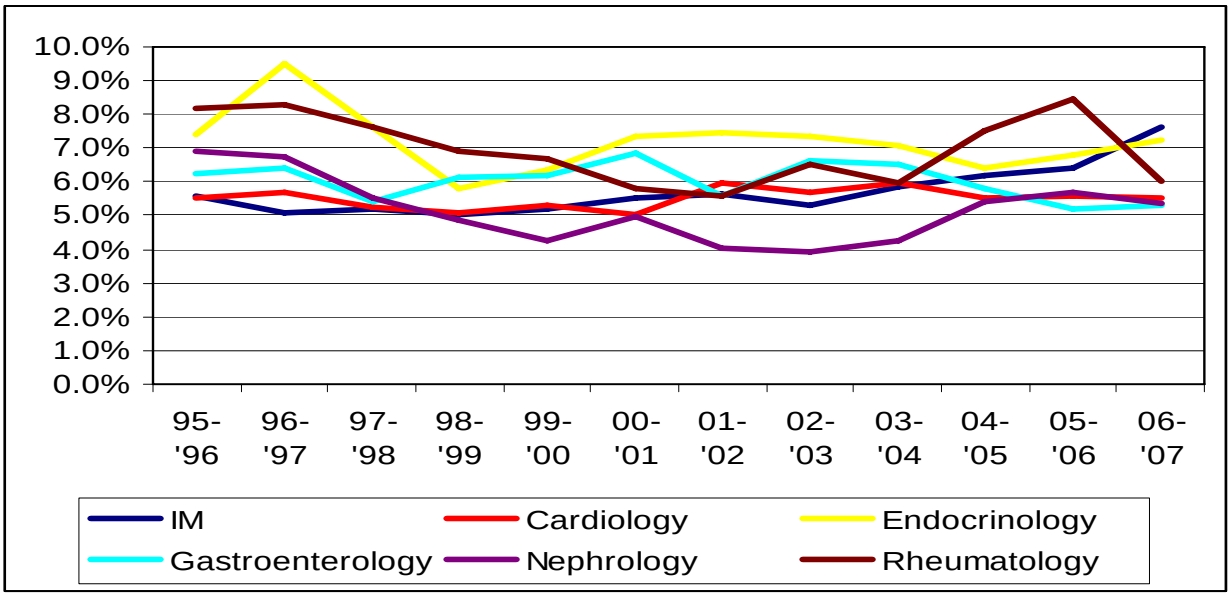
[29] AAMC Physician Diversity Fact Sheet.

Figure XI-1: Black Residents/Fellows as a Percentage of All Residents/Fellows in the Specialty



Endocrinology and rheumatology tend to attract a larger share of Hispanic fellows relative to cardiology. Until the last several years, Cardiology attracted a share of Hispanics fellows similar to the share of Hispanic residents who completed internal medicine training. In the last several years, the percentage of internal medicine residents who are Hispanic increased, while the share of cardiology fellows who are Hispanic declined and then remained flat.

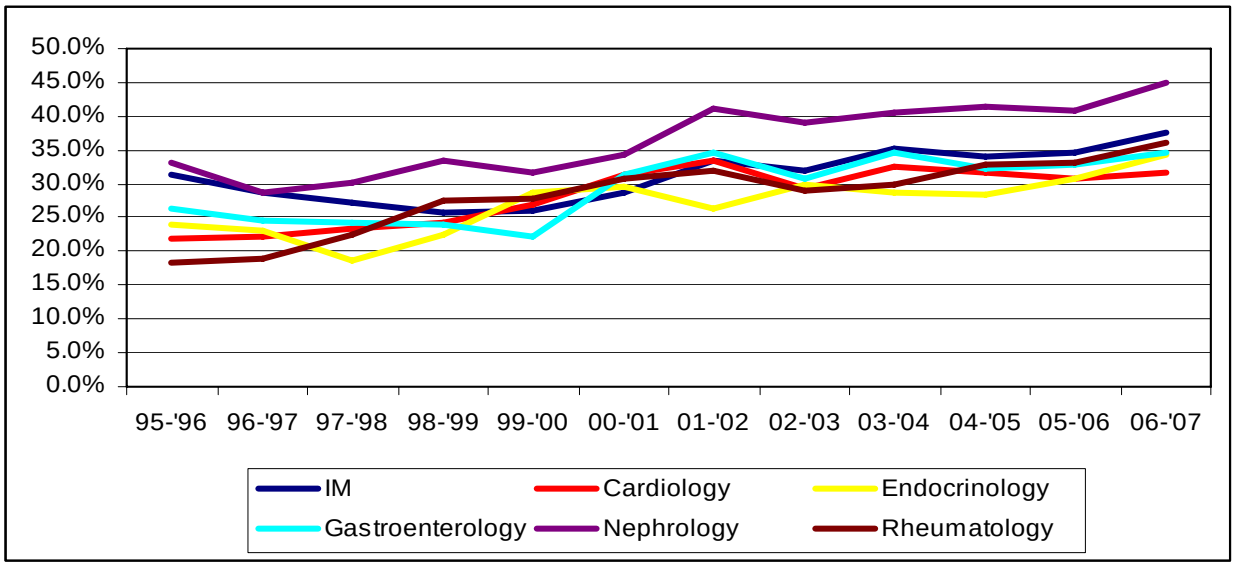
Figure XI-2: Hispanic Residents/Fellows as a Percentage of All Residents/Fellows in the Specialty



Although Asians represented only about 4.4% of the U.S. population in 2000, they represented 26% of internal medicine program graduates in that year. Their share of internal medicine

program graduates climbed to 38% in 2007. Nephrology tended to have a disproportionate share of Asians. Other internal medicine subspecialties had similar shares of Asian fellows.

Figure XI-3: Asian Residents/Fellows as a Percentage of All Residents/Fellows in the Specialty

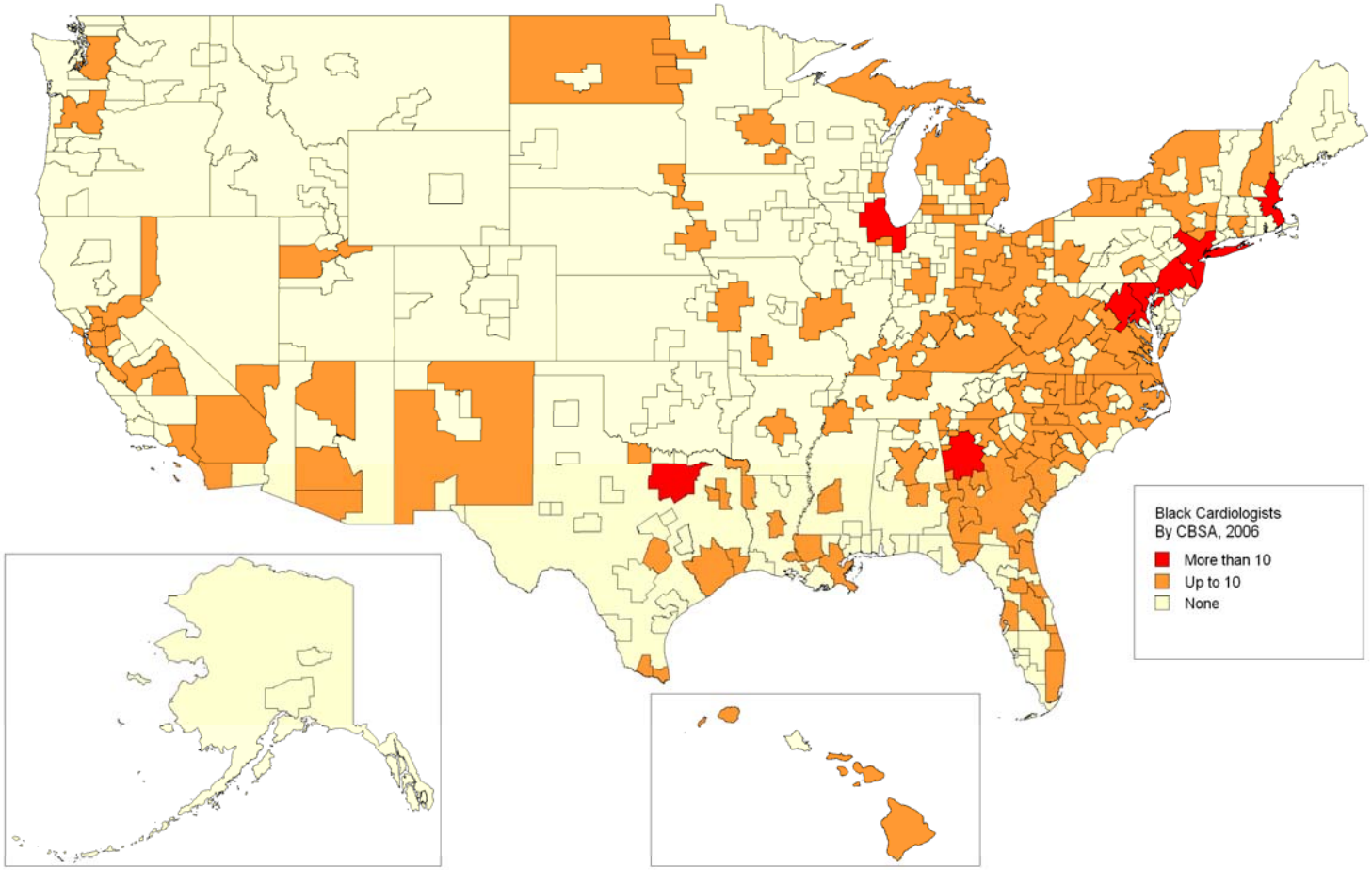


Overall, Black internal medicine program graduates are less likely to subspecialize than their non-minority counterparts. In the focus groups and interviews with cardiology training program directors, few program directors indicated they had formal programs to attract URM internal medicine graduates to their programs. Development of recruitment initiatives targeted to increasing the share of URM internal medicine graduates who pursue cardiology might be a first step at increasing minorities in cardiology. For example, if the share of Black cardiology fellows increased from 3.5 to 5.5% (the share of Black internal medicine residents), this would produce about 15 additional Black cardiologists annually.

B. Distribution of URM Cardiologists Across the U.S.

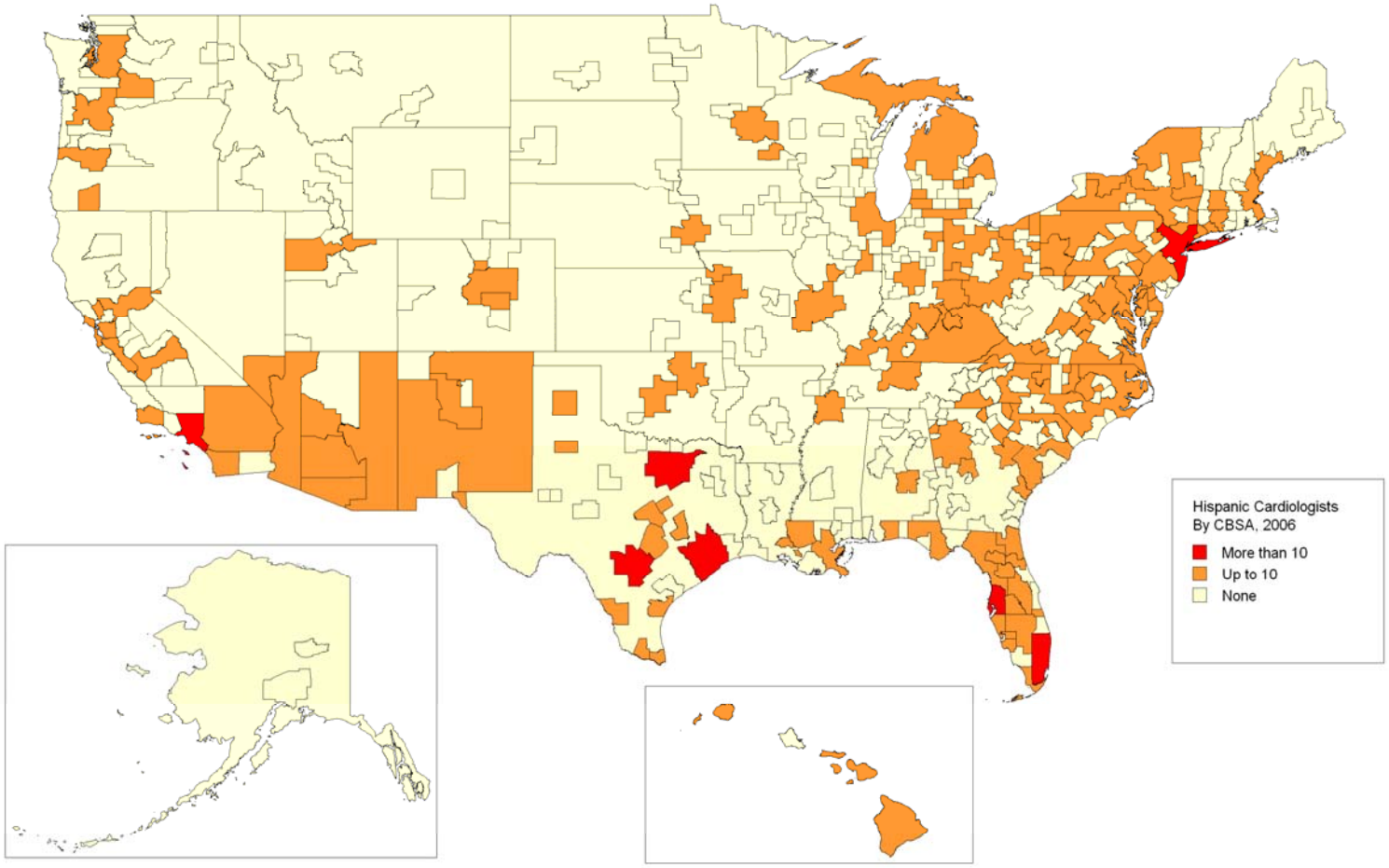
The maps on the next two pages display the distribution of Black and Hispanic cardiologists throughout the United States. With the exception of a small number of CBSAs with high concentrations of Black or Hispanic cardiologists, these maps reflect the general lack of diversity within the cardiology workforce.

Distribution of Black Cardiologists by CBSA



Cardiologists are non-pediatric (either primary or secondary specialty), active USMD cardiologists practicing in the US.
Black population is Hispanic and non-Hispanic Black population 15+ years of age.
Source: AMA Masterfile; AAMC Minority Physician Database; Census (provided by The Lewin group). Prepared by: Center for Workforce Studies, AAMC.

Distribution of Hispanic Cardiologists



Cardiologists are non-pediatric (either primary or secondary specialty), active USMD cardiologists practicing in the US.
Population is population 15+ years of age.
Source: AMA Masterfile; AAMC Minority Physician Database; Census (provided by The Lewin group). Prepared by: Center for Workforce Studies, AAMC.

C. Discussion

Although Black, Hispanic, and Native Americans constitute about one-quarter of the U.S. population, data collected by AAMC suggests that only 6% of practicing physicians and 3% of practicing cardiologists are drawn from these racial and ethnic groups.[30] Addressing this lack of diversity in the cardiology workforce will be a long-term process. Comparing the share of cardiology fellows in URM groups to the representation of these groups in internal medicine residency program highlights a gap that might be targeted as an initial step in a program to increase URM representation in cardiology.

Over the next 20 years a 50% increase in the size of the Hispanic population is projected by the Census Bureau. In the field of cardiology, studies have found disparities in the use of cardiac procedures by race and ethnicity.[31] This may be attributable to both insurance and other access issues as well as to cultural proficiency of the health system. As the general cardiologist shortage becomes more extreme over the next 20 years minority community access issues are likely to be amplified. It is critical for cardiologists to be advocates of increased access for underserved communities. Cultural proficiency within the provider community is fundamental to full access for minorities. Thus, regardless of the background of the cardiologist or fellow, it is important that cardiologists seek training to increase the cultural proficiency of their own practice. The dramatic projected increase in the Hispanic population should be met by a substantial increase in resources for cultural proficiency education in medical school, residency, and for continuing education.

[30] Data from AAMC indicates 411 and 391 practicing Black and Hispanic cardiologists, respectively.

[31] Working Group 3: How to Encourage More Minorities to Choose a Career in Cardiology. JACC Vol. 44, No. 2, July 21, 2004; p 241-5.

XII. RECOMMENDATIONS

In this section, we discuss our recommendations related to the results presented in this report. Estimates of supply and demand indicate substantial current excess demand for each of the four cardiology subspecialties we consider (i.e., general cardiology, interventional cardiology, cardiac electrophysiology, and pediatric cardiology). The baseline projections suggest that the gap between supply and demand will continue to increase for general cardiology, remain fairly constant for interventional cardiology, but will likely decline for cardiac electrophysiology and pediatric cardiology.

The growth in excess demand for general cardiology is driven by two major factors. On the supply side, increasing numbers of cardiologists will be entering an age range with high incidence of retirement. This will result in a decline in the supply of general cardiologists. On the demand side, population growth in general, and the aging of the population into age ranges with higher prevalence of cardiovascular disease in particular, increases total demand for the services of general cardiologists.

The gap between supply and demand will likely be mitigated by adjustments on the supply-side. Strong demand induces higher earnings, which will encourage practitioners to work longer hours and delay retirements. Higher demand will also induce practice efficiency improvements such as increased use of mid-level practitioners, improved scheduling/patient screening, less involvement of the practitioner in practice management, and improvements in information technology.

While these market factors are likely to mitigate the level of excess demand observed over the next 20 years, proactive interventions by the cardiology community can accelerate these trends and ease the burden on individual cardiologists. We recommend the following interventions:

- ***Support Expansion of the Number of Fellowship Positions:*** Currently, about 700 fellows complete general cardiology training annually. In the last several years, over 300 of these fellows have chosen to subspecialize in interventional cardiology or clinical cardiac electrophysiology, leaving only about 400 new general cardiologists entering the workforce annually. This is compared to our estimate of over 2,000 new open positions in general cardiology nationally. Thus, a substantial expansion of general cardiology training is warranted. Our analysis indicates that there are 1.8 applicants for each cardiovascular disease training position. Thus, if fellowship positions are expanded they are likely to be filled.
- ***Supply Information to Help Expand Opportunities for Part-time Work:*** There is a substantial gap in the desire for part-time work among cardiologists and the availability of part-time work. Cardiologists have a similar level of interest in working part-time relative to other medical specialties (66% indicate they are currently working part-time or might choose to work part-time prior to retirement). However, cardiologists are less likely than other medical specialists to work part-time (12% vs. 21%) and more likely than other medical specialists to indicate that part-time work is not available in their current practice (46% vs. 34%). More opportunity for part-time work might extend careers and increase professional satisfaction.

- ***Disseminate Information on Methods to Support Work Reductions Prior to Retirement:*** Our analysis indicates that the majority of cardiologists continue to work in their late sixties and early seventies. Physicians over 50 reported that on-call responsibilities and stress of practice were important factors in their retirement planning. Providing methods to support older physicians who wish to delay retirement through part-time work or modified practice responsibilities including reduced call time might extend the careers of many older physicians.
- ***Work to Improve Professional Satisfaction:*** Following health status, lack of professional satisfaction was the second most commonly cited reason for early retirement. In contrast 73% of active cardiologists over 50 indicated professional satisfaction was important to their decision to remain in practice. Factors influencing professional satisfaction that were cited by survey respondents as important to their retirement planning include increasing regulation in medicine, clinical autonomy, and sufficient reimbursement. Efforts by ACC to mitigate dissatisfaction in these areas are likely to have substantial impacts on retirement rates.
- ***Research Methods to Improve Practice Efficiency and Disseminate Information on Best Approaches:*** In focus groups, fellows indicated that they were attracted to practices with time saving information technologies, limited practice management responsibilities, and strategies for limiting call responsibilities. Widespread adoption of these types of efficiencies would allow cardiologists more time to focus on patient care and would improve professional satisfaction and retention.
- ***Support Expansion Training for Mid-Level Practitioners in Cardiology:*** Our evidence suggests that adding an NP or PA to a practice expands services provided by about 40% of what a full-time cardiologist would add. While over 80% of practices with more than 10 physicians use mid-level practitioners, there are substantial differences across these practices in the ratio of mid-level practitioners to FTE physicians suggesting that some practices may be more effective at utilizing mid-level practitioner support and may be able to share their strategies with the cardiology community.
- ***Periodically Track Trends in Supply and Demand for Cardiology Services:*** Substantial uncertainty exists in both supply and demand projections for cardiology services. On the supply-side about 40% of general cardiologists are over the age of 55 and their decisions about work effort will have a substantial impact on supply. On the demand-side, the spread of existing technology and development of new technologies will have a large impact on overall demand and demand by subspecialty. We recommend updating the components of the physician supply and demand model approximately every three to five years to address this uncertainty. A survey of individual cardiologists or cardiology practices should be conducted in support of the update.
- ***Track Access and Provide Incentives for Service in Underserved Communities:*** The growing shortage of cardiologists is likely to affect traditionally underserved communities such as low income and rural communities most profoundly. Incentive programs to encourage cardiologists to serve in these communities are needed. Given the substantial shortage of cardiologists projected for 2025, research into efficient methods to provide outreach to underserved communities is warranted. Partnering

with governmental and charitable organizations in this effort would help increase the resources available to serve these communities.

- ***Increase the Cultural Proficiency of the Workforce:*** Given disparities in health status and treatment patterns for Black Americans, Hispanic Americans and members of other minority groups and the dramatic projected increase in the Hispanic population in the United States over the next 20 years, additional resources for cultural proficiency education in medical school, residency, and continuing education are warranted.

While strong demand is likely to result in higher incomes for cardiologists over the next 20 years, proactively addressing the shortage of cardiologists will assure quality of care and help cardiologists improve their work-life balance. ACC is already active in advocacy, research, and education in many of these areas. Continuing and expanding these activities is warranted.

Other components of this research addressed the underrepresentation of women and URMs in cardiology. Despite strong demand for women in cardiology by hiring practices, women may be deterred from entering cardiology due to concerns about work-life balance. They may also be discouraged by the culture in cardiology. Many women fellows stated that they had difficulty fitting into the cardiology community because there are few women. They also believed they received less respect and that their commitment to medicine was perceived as less than that of their male counterparts. This research suggests that the following steps would encourage women to enter cardiology:

- ***Encourage Improvements in Work-life Balance During Fellowship and in Practice:*** Both male and female cardiology fellows reported that work-life balance was important in their choice of subspecialty and practice setting. Work-life related improvements that were cited include explicit maternity/paternity programs and improved call scheduling. Improvements in these areas would attract both male and female fellows.
- ***Educate the Cardiology Community about the Demand for Women in Practice:*** In focus groups fellows cited strong demand for women in cardiology practice. Research related to this demand is warranted. If the perceptions of strong demand for women are supported, education in the cardiology community and among internal medicine residents considering cardiology about the demand for women in practice is likely to encourage women to pursue cardiology and improve perceptions about the value of women in the field.

Focus groups with cardiology program directors suggested that few formal programs exist to attract minorities to cardiology. The following steps might be taken to encourage minorities to enter cardiology :

- ***Develop Outreach Programs to Target Minority Internal Medicine Program Residents:*** Black and Hispanics made up 5.5% and 7.6% of internal medicine program graduates, but only 3.5% and 5.5% of cardiology fellows in 2006. Increasing the share of Black and Hispanic internal medicine program graduates pursuing cardiology to a level similar to their representation among internal medicine residency programs might be an initial step in a program to increase minority representation in cardiology.

- ***Reduce Training Length or Provide Additional Financial Support to Minority Fellows:*** Regression results indicated that internal medicine graduates who attended HBCU are more sensitive to compensation and length of training relative to others when they make their specialty choice decisions. This results in HBCU graduates being more likely to remain in primary care than their counterparts. These differences are likely to be attributable to financial barriers that make it more difficult for these individuals to complete longer training programs and encourages them to be more focused on compensation levels upon graduation. Reduced training length or additional financial support for minority fellows will address this gap.

Attracting more underrepresented minorities and women into cardiology is likely to be a gradual process that will require changes in perceptions both in the cardiology community and among URMs and women completing internal medicine training. The interventions suggested here are intended to be initial steps in this process.

Appendix A:
Analysis of Trained Physicians Who Do Not Practice Cardiology

As a part of a workforce study for the ACC, The Lewin Group and AAMC were tasked to estimate the total number of active cardiologists in the United States in 2008. Initial estimates based on the AMA Masterfile indicate 7% of those trained in general cardiology and 10% of those trained in pediatric cardiology are not practicing cardiology as their primary or secondary specialty. Because the AMA Masterfile is updated periodically based on physician self-reports and many of these physicians indicated internal medicine or pediatrics as their primary specialty and unspecified as their secondary specialty, we hypothesized that many of these physicians had not updated their AMA Masterfile record subsequent to completing training in cardiology.

To assess whether these physicians are practicing cardiology, Lewin obtained contact information for 50 physicians trained in general cardiology and 50 physicians trained in pediatric cardiology. We attempted to contact the 28 general cardiologists for whom phone numbers were available; however, none of the doctors were available to verify their information at the time of our call and none called back to verify their information at a later time. However, through contact with the physician offices, when possible, Lewin determined what type of medicine the office is practicing. When phone contact information was not available, physicians were searched on the internet by name and location. The internet searches yielded publications, physician directory listings, and/or profiles from the physician's place of employment which included information on practice specialty. For 42 of the 50 physicians, phone contacts and internet searches indicated the type of medicine currently being practiced. Sixty-four percent of these physicians are practicing cardiology, 21% are practicing internal medicine, and 14% are practicing another specialty.

Because of the difficulty of contacting those trained in general cardiology by phone and the success of the internet searches, internet searches were used to assess the current practice of the sample of 50 physicians trained in pediatric cardiology. Current practice specialty was available through the internet for 44 of the 50 physicians trained in pediatric cardiology. Of these 41% are practicing pediatric cardiology, 43% are practicing general pediatrics, and the remaining 16% are practicing another specialty.

Appendix B:
Codes Used to Disaggregate Cardiology Services by Subspecialty

CPT-4 codes were used to disaggregate services by subspecialty.

Table 1: Cardiac Electrophysiology Procedures

CPT Code	Description	2001		2006		Annualized Trend	
		Number of Services	Total Payments	Number of Services	Total Payments	Services	Total Payments
	Total	169,195	$64,410,365	293,639	$86,459,294	11.7%	6.1%
93600	Bundle of His recording	1,013	$107,796	951	$89,006	-1.3%	-3.8%
93602	Intra-atrial recording	2,078	$220,891	3,245	$314,522	9.3%	7.3%
93603	Right ventricular recording	2,932	$331,119	3,824	$376,009	5.5%	2.6%
93607	Left venticle recording	225	$34,317	0	$0	NA	NA
93609	Map tachycardia, add-on	11,759	$5,235,592	13,480	$2,975,649	2.8%	-10.7%
93610	Intra-atrial pacing	1,967	$287,140	3,205	$432,644	10.3%	8.5%
93612	Intraventricular pacing	2,756	$403,150	3,581	$483,477	5.4%	3.7%
93613	Intracardiac electrophysiologic 3-dim mapping	0	$0	11,496	$3,552,660	NA	NA
93615	Esophageal recording	32	$1,333	49	$1,916	8.9%	7.5%
93616	Esophageal recording with pacing	143	$10,791	18	$1,133	-33.9%	-36.3%
93618	Heart rhythm pacing	1,381	$292,858	836	$155,099	-9.6%	-11.9%
93619	Comp EP evaluation	1,939	$711,747	1,236	$412,252	-8.6%	-10.3%
93620	Comp EP evaluation	33,987	$20,112,853	45,750	$23,849,492	6.1%	3.5%
93621	Comp EP evaluation	11,531	$7,282,837	22,822	$2,117,815	14.6%	-21.9%
93622	Comp EP evaluation	687	$373,624	1,371	$188,725	14.8%	-12.8%
93623	Programmed stimulation and pacing after intravenous drug infusion	13,457	$1,928,970	17,342	$2,184,836	5.2%	2.5%
93624	Electrophysiologic study	731	$158,560	612	$134,330	-3.5%	-3.3%
93631	Intraoperative endocardial and epicardial pacing and mapping	89	$33,502	135	$46,561	8.7%	6.8%
93640	Evaluation heart device	1,083	$191,703	2,835	$437,808	21.2%	18.0%
93641	Electrophysiology evaluation	23,744	$7,068,657	75,833	$19,582,116	26.1%	22.6%
93642	Electrophysiology evaluation	11,065	$2,769,633	15,677	$3,565,709	7.2%	5.2%
93650	Ablate heart dysrhythm focus	7,501	$3,931,646	8,996	$4,216,652	3.7%	1.4%
93651	Ablate heart dysrhythm focus	12,127	$9,776,277	23,462	$16,709,358	14.1%	11.3%
93652	Ablate heart dysrhythm focus	787	$683,526	1,561	$1,212,168	14.7%	12.1%
93660	Tilt table evaluation	25,966	$2,391,445	30,904	$2,558,524	3.5%	1.4%
93662	Intracardiac echocardiography during therapeutic/diagnostic intervention	159	$33,616	3,809	$463,768	88.7%	69.0%
33250	Ablate heart dysrhythm focus	6	$4,800	8	$3,852	5.9%	-4.3%
33251	Ablate heart dysrhythm focus	9	$3,867	16	$6,360	12.2%	10.5%
33253	Reconstruct atria	38	$25,706	581	$383,670	72.5%	71.7%
33261	Ablate heart dysrhythm focus	3	$2,409	4	$3,183	5.9%	5.7%

Table 2: Interventional Cardiologist Procedures

CPT Code	Description	2001		2006		Annualized Trend	
		Number of Services	Total Payments	Number of Services	Total Payments	Services	Total Payments
Total		589,637	$265,019,328	911,249	$352,082,784	9.1%	5.8%
92980	Insert intracoronary stent	252,084	$184,457,146	364,980	$237,304,376	7.7%	5.2%
92981	Insert intracoronary stent	30,756	$6,366,071	48,730	$8,862,441	9.6%	6.8%
92982	Coronary artery dilation	53,314	$27,153,043	26,577	$12,462,906	-13.0%	-14.4%
92984	Coronary artery dilation	12,318	$1,836,555	7,812	$1,013,396	-8.7%	-11.2%
92986	Revision of aortic valve	324	$339,412	725	$785,389	17.5%	18.3%
92987	Revision of mitral valve	127	$130,884	174	$187,743	6.5%	7.5%
92990	Revision of pulmonary valve	13	$8,912	13	$9,367	0.0%	1.0%
92992	Atrial septectomy/septostomy	9	$7,389	0	$0	NA	NA
92993	Atrial septectomy/septostomy	2	$2,166	0	$0	NA	NA
92995	Coronary atherectomy	6,782	$3,826,121	909	$474,614	-33.1%	-34.1%
92996	Coronary atherectomy add-on	951	$153,696	233	$32,317	-24.5%	-26.8%
92997	Pul art balloon repr, percut	14	$7,472	17	$7,126	4.0%	-0.9%
92998	Pul art balloon repr, percut	8	$2,268	3	$737	-17.8%	-20.1%
35450	Transluminal Balloon Angioplasty	21	$8,532	20	$8,668	-1.0%	0.3%
35452	Transluminal Balloon Angioplasty	7	$2,168	9	$1,510	5.2%	-7.0%
35454	Transluminal Balloon Angioplasty	101	$20,282	51	$9,119	-12.8%	-14.8%
35456	Transluminal Balloon Angioplasty	80	$20,903	93	$23,719	3.1%	2.6%
35458	Transluminal Balloon Angioplasty	54	$24,475	52	$17,570	-0.8%	-6.4%
35459	Transluminal Balloon Angioplasty	21	$5,430	105	$31,287	38.0%	41.9%
35460	Transluminal Balloon Angioplasty	4	$875	5	$844	4.6%	-0.7%
35470	Transluminal Balloon Angioplasty	1503	$590,489	6,659	$2,082,599	34.7%	28.7%
35471	Transluminal Balloon Angioplasty	8274	$4,038,288	11,059	$5,504,659	6.0%	6.4%
35472	Transluminal Balloon Angioplasty	243	$51,546	355	$67,865	7.9%	5.7%
35473	Transluminal Balloon Angioplasty	5512	$1,152,773	9,304	$1,738,749	11.0%	8.6%
35474	Transluminal Balloon Angioplasty	7245	$2,001,904	19,339	$4,499,860	21.7%	17.6%
35475	Transluminal Balloon Angioplasty	1199	$512,840	1,791	$694,465	8.4%	6.3%
35476	Transluminal Balloon Angioplasty	993	$239,832	1,766	$387,367	12.2%	10.1%
35480	Atherectomy, open	4	$937	4	$1,692	0.0%	12.5%
35481	Atherectomy, open	2	$378	2	$208	0.0%	-11.3%
35482	Atherectomy, open	8	$2,433	3	$620	-17.8%	-23.9%
35483	Atherectomy, open	4	$700	99	$27,701	90.0%	108.7%
35484	Atherectomy, open	0	$0	1	$454	NA	NA
35485	Atherectomy, open	3	$1,169	38	$13,551	66.2%	63.2%
35490	Atherectomy, percutaneous	76	$39,356	70	$29,537	-1.6%	-5.6%
35491	Atherectomy, percutaneous	6	$1,994	28	$6,765	36.1%	27.7%
35492	Atherectomy, percutaneous	52	$12,170	357	$66,918	47.0%	40.6%
35493	Atherectomy, percutaneous	393	$139,175	11,818	$3,244,317	97.5%	87.7%
35494	Atherectomy, percutaneous	22	$10,484	135	$57,619	43.7%	40.6%
35495	Atherectomy, percutaneous	167	$65,022	5,644	$2,216,884	102.2%	102.6%
36000	Place needle in vein	11759	$250,107	41,362	$958,361	28.6%	30.8%
36002	Injection ext venography	0	$0	191	$16,597	NA	NA
36005	Injection ext venography	7688	$272,788	24,001	$1,426,819	25.6%	39.2%
36010	Place catheter in vein	2498	$207,027	4,304	$303,720	11.5%	8.0%
36011	Place catheter in vein	1650	$191,059	1,147	$106,160	-7.0%	-11.1%
36012	Place catheter in vein	226	$22,876	504	$57,647	17.4%	20.3%
36013	procedure for percutaneous treat pseudoaneurysm	337	$29,443	902	$55,768	21.8%	13.6%
36014	Place catheter in artery	280	$30,825	108	$12,081	-17.3%	-17.1%
36015	Place catheter in artery	130	$15,772	43	$6,423	-19.8%	-16.4%
36100	Establish access to artery	982	$114,806	567	$65,359	-10.4%	-10.7%
36120	Establish access to artery	280	$20,666	330	$17,671	3.3%	-3.1%
36140	Establish access to artery	5754	$321,447	10,311	$670,676	12.4%	15.8%
36145	Artery to vein shunt	891	$52,483	2,060	$109,198	18.2%	15.8%
36160	Establish access to aorta	88	$6,488	160	$9,136	12.7%	7.1%
36200	Place catheter in aorta	20702	$1,973,068	15,915	$1,887,357	-5.1%	-0.9%
36215	Place catheter in artery	16776	$2,246,591	28,619	$4,495,617	11.3%	14.9%

Table 2 (con't): Interventional Cardiologist Procedures

CPT Code	Description	2001		2006		Annualized Trend	
		Number of Services	Total Payments	Number of Services	Total Payments	Services	Total Payments
36216	Place catheter in artery	11876	$2,343,270	21,231	$4,980,276	12.3%	16.3%
36217	Place catheter in artery	2729	$690,667	5,018	$1,840,051	13.0%	21.7%
36218	Place catheter in artery	2265	$103,601	4,681	$339,474	15.6%	26.8%
36245	Place catheter in artery	65784	$11,971,239	96,109	$21,007,847	7.9%	11.9%
36246	Place catheter in artery	10243	$1,894,484	19,001	$3,612,288	13.2%	13.8%
36247	Place catheter in artery	5463	$1,089,267	26,602	$5,049,322	37.2%	35.9%
36248	Place catheter in artery	2025	$91,085	4,903	$230,793	19.3%	20.4%
36261	Revision of infusion pump	1	$26	2	$801	14.9%	98.5%
36262	Removal of infusion pump	1	$197	0	$0	NA	NA
37200	Transcatheter biopsy	5	$404	12	$2,201	19.1%	40.4%
37201	Transcatheter therapy infuse	982	$160,540	1,127	$155,234	2.8%	-0.7%
37202	Transcatheter therapy infuse	3956	$699,761	8,433	$1,353,382	16.3%	14.1%
37203	Transcatheter retrieval	237	$48,255	336	$61,789	7.2%	5.1%
37204	Transcatheter occlusion	398	$317,893	577	$421,850	7.7%	5.8%
37205	Transcath iv stent, percut	18185	$5,448,224	40,786	$12,639,737	17.5%	18.3%
37206	Transcath iv stent/perc addl	4026	$740,484	10,784	$1,884,022	21.8%	20.5%
37207	Transcath iv stent, open	149	$43,601	93	$25,247	-9.0%	-10.4%
37208	Transcath iv stent/open addl	39	$5,702	16	$2,609	-16.3%	-14.5%
37209	Change iv cath at thromb tx	88	$5,434	136	$7,601	9.1%	6.9%
37215	Transcatheter Placement of Intravascular Stents	0	$0	5,402	$4,452,818	NA	NA
37216	Transcatheter Placement of Intravascular Stents	0	$0	11	$8,719	NA	NA
37250	Intravenous Ultrasound first vessel add-on	785	$74,244	1,924	$176,539	19.6%	18.9%
37251	Intravenous Ultrasound each add vessel add-on	208	$14,480	729	$50,081	28.5%	28.2%
93571	Coronary flow reserve measurement during angiography	3,157	$265,420	7,342	$558,366	18.4%	16.0%
93572	Coronary flow reserve measurement during angiography	296	$20,314	1,095	$65,698	29.9%	26.5%
93580	Atrial Septal Defect/PFO closure	0	$0	1,383	$1,082,490	NA	NA

Appendix C:
Subspecialty Choice Model Verification

In order to test the performance of the subspecialty choice model, we randomly divided our sample of physicians completing internal medicine residency programs. Eighty percent of the physician observations were used to estimate the subspecialty choice model. The remaining 20% were used to test the accuracy of the model's predications.

The coefficient estimates for the model based on the 80% sample are reported in Table C-1. These estimates are similar to those for the full sample reported in Section VII.A.1 Table VII-4 above.

Table C-1: Coefficient Estimates for the Subspecialty Choice Model 80% of Observations

Variable	Coefficient Estimate	Standard Error
Compensation	0.121 #	0.062
Male * Compensation	1.131 **	0.038
IMG * Compensation	-0.565 **	0.031
HBCU * Compensation	0.253	0.242
Years of Training	-0.083 #	0.044
Male * Years of Training	-0.035 *	0.014
IMG * Years of Training	0.106 **	0.012
Black * Years of Training	-0.406 **	0.093

** Significantly different from zero at the 99% confidence level.
* Significantly different from zero at the 95% confidence level.
# Significantly different from zero at the 90% confidence level.

Table C-2 compares the actual and predicted values for the 20% sample excluded from the subspecialty choice model. The actual and predicted results are very similar with the exception of the Black male USMD group. Because there are only a small number of observations in this group there is more deviation between the actual and predicted values.

Table C-2: Comparison of Actual vs. Predicted Specialty Choice

	Overall		White Male US MD		Black Male US MD		White Male IMG		White Female US MD	
Specialty	Model Predicted	Actuals in 20% Sample	Model Predicted	Actuals in 20% Sample	Model Predicted	Actuals in 20% Sample	Model Predicted	Actuals in 20% Sample	Model Predicted	Actuals in 20% Sample
Internal Medicine	55%	56%	50%	52%	66%	60%	50%	50%	65%	65%
Cardiologist	11%	11%	17%	16%	11%	15%	13%	12%	5%	6%
Gastroenterologists	6%	7%	8%	10%	5%	6%	7%	7%	4%	4%
Nephrology	5%	5%	5%	4%	4%	6%	5%	7%	4%	3%
Infectious Disease	4%	4%	3%	3%	2%	6%	5%	4%	4%	4%
Hematology/Oncology	5%	4%	5%	4%	4%	3%	5%	5%	3%	4%
Endocrinologist	3%	3%	2%	2%	1%	0%	3%	3%	3%	4%
Geriatrics	3%	3%	2%	1%	2%	0%	3%	4%	3%	2%
Pulmonary Disease	6%	6%	6%	6%	4%	2%	7%	8%	6%	4%
Rheumatology	2%	2%	2%	2%	1%	2%	2%	2%	2%	3%
Number of Observations		16,376		5,868		62		4,642		3,553

Appendix D:
Summary of
Focus Groups/Interviews

Representatives from AAMC and The Lewin Group conducted focus groups and individual interviews with internal medicine program residents, cardiology fellows, and cardiology program directors inviting them to share their perspectives on the factors affecting specialty choice, the future supply of cardiovascular specialists, residency trends, and the changing cardiology workforce.

Focus groups and individual interviews with cardiology fellows and cardiology program directors were held during the ACC's Annual Scientific Sessions from March 29 through April 1, 2008. All cardiology fellows and program directors attending the sessions were invited to participate in a focus group or an individual interview. Fourteen male and seven female fellows volunteered to participate. The participating fellows were primarily in their 3rd or 4th year of training. Eight program directors participated. Focus groups with the fellows and program directors were conducted separately. The participants were volunteers, and thus, their opinions may not be representative of fellows and program directors generally.

Focus groups and individual interviews with internal medicine program residents were conducted during June 2008. Eighteen internal medicine residents at two separate residency training programs were interviewed. There was a mix of residents in all years of training, including several chief residents. Residents were asked about their current specialty choice plans, the factors influencing their specialty choice decision, interest in cardiology, and thoughts regarding their future practice setting.

In the next three sections, we summarize the results for internal medicine residents, cardiology fellows, and cardiology program directors, in turn.

A. Internal Medicine Resident Focus Groups/Interviews

This section presents a summary of the results of the internal medicine resident interviews/ focus groups.

Subspecialty Preferences of Interviewees

All but one resident had decided on a specialty at the time of the interviews, including those just beginning their first year of residency. The participants had decided on the following specialties: infectious disease (3), cardiology (3), endocrinology (3), pulmonary/critical care (2), nephrology (1), allergy and immunology (1), rheumatology (1), and hematology/oncology (1). One resident had completed a law degree and a Master's Degree in Public Health and is planning to become a hospital administrator. One resident is torn between gastroenterology and nephrology. None are interested in a career in primary care, though they recognize they may end up in the field if they do not match into a fellowship program.

Enjoying What You Do Extremely Important

When asked why they had selected the particular specialty, nearly everyone began by citing attributes related to the science or practice of the particular field of medicine and how that fits with their personality and interests. Some preferred focusing on one organ system and others preferred multi-system specialties. Others discussed liking complex patients and building longitudinal relationships with patients. Others were less comfortable with the patient

interaction aspects and preferred procedures. Ultimately, they were looking for a specialty that they enjoyed and could see themselves doing for the rest of their lives.

Several interviewees really struggled with their decision during the first year or two of residency when they discovered they did not enjoy their chosen field as much as they thought they would. They commented that the system forces you to make your decision early in order to have time to do research in the specialty and therefore be a competitive fellowship candidate. If you change your mind after you get exposure to the area, it can make it much more difficult to build a portfolio in another field in time for the fellowship application process.

Lifestyle

Many of the internal medicine residents indicated lifestyle played a strong role when they were deciding between a medical or surgical track. Lifestyle continued to be a factor for many when deciding among the various medical specialties and is also an important factor in terms of future practice setting. As with the cardiology fellows, many internal medicine residents indicated they plan to seek out a practice setting where they can achieve work-life balance. Some quotes from the residents related to work-life balance included:

> *I considered pulmonary/critical care but lifestyle is a drawback. In critical care, it is difficult to have a life outside the hospital.*
>
> *Lifestyle is a personal choice on how you manage it. It can be done in almost any specialty.*
>
> *It is extremely important for me to find a balanced work-life. I will address this up front when selecting a position. Work-life balance was more of an issue for me in deciding between a surgical career and medicine. My wife was concerned about my being in the ICU all the time if in critical care. But in cardiology you are on call, too. It is the same difference as far as I can tell.*
>
> *I will stay in academics as the lifestyle will be easier. Fellows get called first.*

Income/Debt

Most of the participants said they did not go into medicine for the money but that it can come into play when deciding between two specialties. Several chose less lucrative fields or settings because they are passionate about the specialty or academics and that outweighed the loss in income. Some quotes related to income and debt included:

> *Income and debt did not play a role. You are going to do well in medicine no matter what you do, but if you want a ton of money you don't go into medicine.*
>
> *I would be lying if I said money was not an issue. Procedures are more lucrative.*
>
> *Income was not the initial factor. In the end, I really liked cardiology. That it is paid well is the final kicker. The decision would have probably been tougher if it paid less. I probably would have ended up in the same place, but it would have been harder.*

Mentors

Several of the residents did not have a mentor, but those who did often had one in their chosen field. Some seemed more confident about their specialty choice decision than others. Those who struggled more indicated they did not have a mentor guiding them through the process. One of the residents who has chosen to pursue cardiology indicated:

> *Mentorship, mentorship, mentorship is behind my decision to pursue cardiology. I owe everything to my mentors.*

Cardiology

Those who did not decide on cardiology never really even seemed to consider it as an option, primarily due to lack of a connection with the field. Comments at one program indicated that some might be ruling it out because they know they will not be competitive since they are coming from an IMG heavy training program. One resident said:

> *What people aren't saying is that they probably wanted to go into cardiology but it is very competitive. People who have applied to cardiology from this program in the past have not matched well because there are a lot of IMGs here. IMGs don't match well in cardiology.*

Setting

Most seemed to have thought more about their specialty choice than setting but seemed to gravitate toward academics, possibly due to lack of knowledge of the private practice world. Few seemed very interested in research and most were looking for an academic setting that focused more on clinical care and teaching than research. A consistent theme in the discussions was, "I haven't had any exposure to private practice."

B. Findings from Cardiology Fellow Interviews/Focus Groups

1. Fellow Focus Groups/Interviews Summary

In this section, we summarize the opinions expressed in the cardiology fellow focus groups and interviews. Cardiology fellows were invited to share their perspectives on career influences including discussion of work-life balance, the decision to subspecialize, the role of mentors, and other important career factors. Below, we provide more detail on comments made during the focus groups and interviews.

Why Cardiology?

Cardiologists are clearly drawn to the field because they enjoy what they do. They feel there are few if any other medical specialties that offer the same range and variety of medical activities: patient care management, critical care, imaging, and procedures. As one participant noted:

> *Any kind of person can find something in cardiology. There is a wide range of options in cardiology ranging from preventive care to transplant.*

Fellows noted that they particularly enjoy the fact they can have such a dramatic, and often immediate, impact on patients' lives. One fellow said:

> *In the third year of medical school, I worked directly with a cardiologist who I followed to the cath lab. It was exciting to see someone fixed within the hour.*

Fellows find cardiology challenging, intellectually stimulating, and exciting. About half decided on cardiology during medical school and half during residency training.

Income and Debt

Few of the fellows directly attributed income potential as a factor in their decision to go into cardiology, though they recognize their income will be high. Debt did not appear to play a significant role in specialty choice for most, although some did acknowledge it was a factor in the decision to pursue cardiology. Debt does, however, appear to play a larger role in practice setting decisions. Several participants noted that academic careers are less appealing due to lower compensation. Some fellows noted they planned to seek out productivity-based compensation, rather than pure salary compensation to achieve higher income. One fellow captured this stating:

> *Income played a small role [in my decision to pursue cardiology]. Debt plays a role in the type of job I will take, but not in my specialty choice decision. There is a huge salary discrepancy in the academic setting.*

Several females also pointed out that their husbands' income allowed them a wider range of choices since they did not have to worry as much about their own income and debt.

Subspecialization

Despite receiving numerous contacts from recruiters, most of the fellows who participated in the focus groups are subspecializing in either interventional cardiology or electrophysiology. They noted that these are more lucrative than general cardiology though most say that money does not drive their decisions. The fellows indicated that they are attracted to interventional cardiology or electrophysiology because they love the procedures—particularly the instant gratification of the procedures. Several also noted the desire for more in-depth knowledge in the field that could improve the quality of care they provide. Some noted that there are market pressures in interventional cardiology that may lead to questionable treatment decisions. Some question whether the job market is becoming saturated in interventional cardiology. One fellow noted that in electrophysiology treatment decisions are more straightforward.

Choice of Future Practice

When focusing on choice of future practice setting, practice location was usually cited as the most important factor, followed by work-life balance. Fellows want to be either close to family or in a big city if that is where they grew up. Some settings, such as New York City and California, were seen as more competitive job markets than others. Several indicated they are looking to plant roots wherever they land after their training is completed, though they also recognize that people do tend to change job.

Work-life balance is difficult in cardiology, particularly for interventional cardiology, which often has strenuous call responsibilities. Cardiology fellows indicate they are seeking out balance when they look for a practice setting. Male participants were just as interested in work-life balance as females. Some indicated they are actively seeking practices, primarily large group practices, which offer salaried positions and fewer call demands. Several indicated they were looking for practices where they would have limited involvement in practice administration. Fellows also indicated they are very interested in finding a practice that

matches their personality, practice styles, and values. Several expressed concern that they did not want to be in a practice that was driven by generating RVUs. Fellows indicated they are heavily recruited, so they have the opportunity to pick the positions that will best suit their lifestyle. One fellow summarized this by saying:

> *There are always going to be jobs for cardiologists. I am more worried about finding a job where I will be the happiest.*

Several fellows indicated they were contemplating academic careers in order to have more flexibility if not fewer hours, though this is also motivated by love of research and teaching. Fellows cite the ability to spend time with their families in the evening and work on research papers during the late evening as a perceived benefit of an academic career. Some also mention the advantage in academic settings of having residents and fellows to assist with call and therefore reducing their on-call schedule.

Women noted that the job market is actually stronger for females than males saying:

> *Female cardiologists are a hot commodity. Practices are recruiting for them because their patients are requesting them.*

Overall, cardiology fellows are finding strong demand for their services. This allows them the flexibility to select the future practice setting that will best suit their personality, practice style and values.

Future Horizon

Fellows were asked their perspectives on the future of cardiology. They mentioned several new changes that could occur. The fellows were uncertain about the future of interventional cardiology. Some expressed concern that the job market is becoming saturated with interventionalists and that interventional procedures may be performed more frequently than appropriate. Others mention that the field might become more non-invasive due to increased imaging techniques, though others question if this will happen as imaging is expensive and invasive procedures are so well reimbursed. At the same time, other fellows noted that interventionalists are starting to expand into non-cardiology related procedures such as carotid endarterectomy.

Some fellows indicated that they believe cardiology will focus more on prevention in the future and there will be an increased role for diagnostic procedures.

Fellows mentioned several recommendations for future cardiology training programs, including 1) explicit maternity/paternity policies for fellows, 2) shortening/targeting training so that those who want to go into imaging, do not have to spend as much time on other aspects such as catheterization (though others say this would hurt the field due to increased specialization), 3) the need for more training on efficiency and what private practice will be like, and 4) reducing the length of training. On the issue of reduced length of training some thought it would make the field more attractive, while others expressed concern that this would diminish the quality of the training in general cardiology.

A few fellows had recommendations for practice models: 1) protected time for research in academic settings, 2) ensuring the practice is efficient, which is important for those who want to maximize

time in the office so they can have more time for their families, and 3) reducing competition between radiologists and cardiologists by forming centers that employ both and share revenues.

2. Why Cardiology?

Cardiologists are clearly drawn to the field because they enjoy what they do. They feel there are few if any other medical specialties that offer the same range and variety of medical activities: mix of patient care management, critical care, imaging, and procedures. They particularly enjoy the fact they can have such a dramatic, and often immediate, impact on patients' lives. Fellows find cardiology challenging, intellectually stimulating, and exciting. About half decided on cardiology during medical school and half during residency training.

- *I decided on a career in cardiology during medical school in the fourth year CCU rotation and fell in love with cardiology.*
- *In the third year of medical school, I worked directly with a cardiologist who I followed to the cath lab. It was exciting to see someone fixed within the hour.*
- *I decided on cardiology during residency. My internal medicine program was cardiology heavy – we got to spend lots of time in the ICU and on cardiology consult.*
- *I became interested in cardiology during residency. I enjoy the ability in cardiology to change the course of health and the correlation between tests and outcomes.*
- *I enjoy reading about cardiology the way other people enjoy reading novels.*
- *I was interested in cardiology in medical school but my cardiology rotation in my residency solidified my decision.*
- *There is a full spectrum from seeing patients, longitudinal relationships with patients, floor rotations, ICU. In cardiology you can really help people get better. There are powerful tools that weren't there 20 years ago. I considered neuroscience, too, but that is mainly telling people what they have and what their new limitations are.*
- *I never wanted to be the one saying, "Where is the cardiologist?" I wanted to be the one with the answers who knew what to do next.*
- *Any kind of person can find something in cardiology. There is a wide range of options in cardiology ranging from preventive care to transplant.*
- *There are powerful trials and you get to practice evidence-based medicine.*
- *I am always reading about new developments in the field*
- *It was a no-brainer to go into cardiology. Cardiology is the right mix of surgery, patient care, and acute care. I like working with my hands and the instant gratification*
- *Worried I would get bored doing the same thing all the time in cardiology, but realized that cardiology is not doing the same thing over and over again.*

3. Income and Debt

Few directly attributed income potential as a factor in their decision to go into cardiology, though they recognize their income will be high. Debt does not appear to play a significant role in specialty choice for most, though some do acknowledge it was a factor in the decision to

pursue cardiology. However, it appears to play a larger role in practice setting decisions. Academic careers are less appealing due to lower compensation, which motivates some fellows to seek out productivity-based compensation, rather than pure salary compensation. Several females also pointed out that their husbands' income allowed them a wider range of choices since they did not have to worry as much about their own incomes.

- *Money was not the driving factor, but I knew I would lead a comfortable lifestyle.*
- *It helps that income is high – it is a payback for the length of training.*
- *Income played a small role (in my decision to pursue cardiology.) Debt plays a role in the type of job I will take, but not in my specialty choice decision. There is a huge salary discrepancy in the academic setting.*
- *Not enough people are going into academic medicine. The monetary reward is so bleak that the academic community could be losing potential leaders in the field to private practice.*
- *Income played a role in my decision to pursue cardiology but to a lesser extent. I decided to pursue preventive cardiology though it is one of the less lucrative of the cardiology paths. My schedule will be much more regular and under my control. I won't be beholden to schedule/night calls.*
- *Debt was never up front in my mind, but it is accruing. EP is more lucrative. (Note: he is pursuing EP.)*
- *Debt influenced my decision to pursue cardiology but I have slowly paid it off by moonlighting and with help from my family.*
- *I am married to an MBA who points out the perverse incentives for a career in academic research. (Note: She is going into academics nonetheless, and indicated that her husband's income prevented this from being a real issue.)*
- *Debt was not an issue in my specialty choice decision due to my husband's income.*

4. Interventional Cardiology and Electrophysiology

Most of the fellows who participated in the focus groups are subspecializing in either interventional cardiology or electrophysiology. They noted that these are more lucrative than general cardiology though most say that money does not drive their decisions. The fellows indicated that they are attracted to interventional cardiology or electrophysiology because they love the procedures – particularly the instant gratification of the procedures. Some note that there are market pressures in interventional cardiology that lead them to question the appropriateness of treatment decisions.

- *I definitely wanted to subspecialize. I want to know a narrow area front to back.*
- *Interventional cardiology is exciting because you get to save lives.*
- *I like the procedures and the cath lab. You can fully answer questions and make an impact.*
- *I am doing EP next. It took me a while to reach this decision. I like interventional, I like the cath lab, but there are too many problems. Are you doing the right thing? Too many reimbursement pressures. In EP, the appropriateness is less open to judgment. The mechanics of how hospitals make a profit are driven by the cath lab and leads to things being done that are questionably appropriate. I get an inkling this happens everywhere.*

- *I am pursuing an echo clinical research fellowship next year. Echo doesn't advance my standing. I am doing this in order to provide better quality care and enhance my abilities.*

5. Mentors

Many of the fellows noted that their mentors helped them understand and value patient interactions and a good bedside manner. Many females and some men had female mentors in cardiology, but those females are few and far between. Females indicated they did not have much access to female cardiologists early in their education and training.

- *My mentors interacted with patients at a high level.*
- *My first preceptor showed the importance of bedside manner. Another cardiologist with a lot of energy was important to my career development. Mentors in my residency program encouraged me to take a year off to do research in cardiology following my IM residency.*
- *My mentor is very helpful and talks up my research with other faculty and helps me to get known in the field. I work for a female research scientist who is very respected in the field. My husband pointed out that I want to be her when I grow up.*
- *A female mentor in my CCU rotation really influenced me (male). She was a role model in terms of skills and how to interact with patients.*
- *My mentor had a big influence on me as a woman in cardiology. Other mentors have been males, though mentorship from attendings is more difficult due to concerns about propriety, spending a lot of time together.*
- *In my IM residency, what got me looking at cardiology was the attendings in cardiology. They were always happy to talk to you and were role models for house staff.*
- *In Texas, I never met a female cardiologist. I met my first one at a conference.*
- *All of the role models are men.*

6. Road Not Taken

The cardiology fellows had often considered other specialties during their early education and training in a search of fields with better work-life balance, but ultimately choose what in their minds is a more professionally challenging and rewarding field. Other specialties of prior interest for cardiology fellows include ophthalmology, endocrinology, gastroenterology, rheumatology, and pulmonology. Several also considered obstetrics and gynecology or surgical careers, including cardiothoracic surgery.

- *I wish I liked other specialties due to lifestyle, emergency medicine for example.*
- *I also considered GI. I had to think about work-life balance but love of the topic (cardiology) outweighed the demands of the specialty.*
- *I tried to like rheumatology and endocrinology for work-life balance but didn't think it would lead to job satisfaction.*
- *I did a year of ophthalmology due to balance but ultimately went back to cardiology.*
- *I considered surgery but realized I would miss the patient interactions.*
- *In primary care you are just managing care, not fixing anything.*

- *I considered other specialties but like the speed and action of cardiology. I also considered surgery and OB/GYN but came back because cardiology is more of a thinking specialty.*
- *I did my best not to be a cardiologist. I looked at pulmonary, critical care, cardiac surgery, and other fields but cardiology was the most interesting. Work has to get you up in the morning and justify being away from your family.*

7. Downsides of the Field of Cardiology

The fellows indicated that the training is long, physically demanding, and increasingly competitive.

- *The length of training is a little long. As a PGY-6, you sort of want to say "enough."*
- *You hear a lot of talk about alternative career paths in lounges – in medical school, residency and fellowship. People compare themselves to peers in other fields who have already started their careers, are making good money, buying houses. I am tired of hearing about it.*
- *The super-competitiveness of the field bothers me. I have to constantly prove myself.*
- *I am put off by the competition within the specialty, particularly the application/interview process and competition for jobs in New York City.*
- *Training programs are very competitive.*
- *Cardiology is very stressful.*

Women face added challenges of feeling like they are not treated the same as their male colleagues and of not being part of the "boys club." Female fellows believe they are often unfairly questioned about their commitment to medicine.

- *Attendings talk to us differently than they talk to the male fellows.*
- *You should hear the things they (male cardiologists) say, even when we are around.*
- *Some people even ask why I am going into interventional cardiology. "Don't you know it will be difficult on your family?" Even women question this and raising a family.*
- *My commitment to medicine and to working was questioned during interviews.*
- *We are left out of the boys club.*
- *As a single woman, it is more difficult to hang out with married male fellows. I am definitely left out of the boys club which centers around ball games.*
- *I am treated like a "little girl."*
- *You have to defend yourself if you need to take time for family.*

Some question whether the job market is becoming saturated in interventional cardiology. However, most fellows mentioned receiving numerous contacts from recruiters. Women noted that the job market is actually stronger for females than males due to the growing patient requests for female cardiologists.

- *There are always going to be jobs for cardiologists. I am more worried about finding a job where I will be the happiest.*

- *I get emails from recruiters all the time.*
- *I get five emails a day looking for a cardiologist.*
- *I have some concern whether I am making the right choice. Is the job market getting saturated? PCI volume is down and with drug eluding stents, there are fewer repeat patients.*
- *Female cardiologists are a hot commodity. Practices are recruiting for them because their patients are requesting them.*
- *Men think we have it easier in the job market, and maybe we do.*
- *I was initially influenced by the stability of cardiology, but now I am concerned about looming issues in interventional cardiology such as lifestyle, job availability …and reimbursements. The pot is getting smaller and interventional may have overdone things in the past few years. Cardiology will have to battle with other fields in the coming years over procedures, particularly with radiology.*

8. Selecting a Practice Setting

When deciding on a practice setting, fellows indicated three main factors that are for the most part considered in this order when finding a practice setting: 1) practice location; 2) work-life balance; and 3) practice culture.

Practice Location

When focusing on a setting, practice location was usually cited as the most important factor, followed by work-life balance. Fellows want to be either close to family or in a big city if that is where they grew up. Some settings, such as New York City and California, were seen as more competitive job markets than others. Several indicated they are looking to plant roots wherever they land after their training is completed, though they also recognize that people do tend to change jobs.

- *Location is the biggest factor in searching for a position. I am looking in California but I realize that market is highly competitive. I found a position in a 5-person practice. We have a one year track to partnership. I want to stay but am aware that most people leave their initial position.*
- *I am from NYC and want to stay in a big city (found a position in Philadelphia.)*
- *I want to stay in this position, develop roots in the community from a family and a career perspective.*
- *California is a competitive market, but my family is in LA. My wife also likes California. I received a lot of emails and letters from practices in the Midwest and South. My rank order of decision factors when selecting a practice is: 1) geography – family, CA, 2) work life balance, 3) group of people I will be working with. I will make a careful decision about my initial practice and play to stay for the long term as I don't like hassle.*
- *I am looking for a practice near where I grew up, not near my training site even though you lose connections.*
- *If I stay in northern California, a position in Kaiser would be ideal – particularly if they have fellows. Time to teach is very important. My fiancé's job market is much thinner (radiation oncology). I might have to follow her but we will stay on the West Coast.*

- *I signed onto a private practice job in Ohio to be close to family. My wife is in the area. I hope to stay at my first job forever.*

Work-life Balance

Work-life balance is difficult in cardiology, particularly for interventional cardiology, which often has strenuous call responsibilities. Nonetheless, cardiologists are seeking out balance when they look for a practice setting, and do not see this as a sign of a lack of commitment to their careers. Many of the male fellows indicated they are actively seeking out practices, primarily large group practices, which offer salaried positions and fewer call demands or management responsibilities. All of the comments except the last one are from male fellows.

- *Wanting work life balance doesn't mean that you don't want to work.*
- *I want no part of the business side.*
- *I don't want to be my own boss. If I wanted to do business, I would have gone into that in undergraduate school. I prefer to leave that to others.*
- *I have signed on with a mid-size practice with equal call distribution and some support from 2 NPs in the practice.*
- *Interventional cardiology is challenging for work-life balance. You are usually one of the few guys left when everyone else has gone home.*
- *I share the concerns of my colleagues regarding lifestyle and call schedules in interventional cardiology, but I like the field and am willing to make sacrifices for now.*
- *After choosing cardiology, I had moderate concerns over lifestyle, call schedule, etc. It certainly affected my job search and lifestyle was the number one factor in my selection of a practice setting. I ultimately chose as close to an 8-5 job as I could find. This means that the practice may not be as financially rewarding as others but it will still be a nice salary. All of the practice members share concern with protecting time for family. They have developed a call schedule that is one week every 6-8 weeks, working off hours (5PM-8AM), with no other responsibilities that week. You just have to take call. This is a fair system for everyone and helps with long term scheduling around kids and other priorities.*
- *Work life balance was a factor in my specialty choice decision. Preventive cardiology has the advantage of fewer middle of the night calls.*
- *I want to be able to go to my kid's soccer game or play, and be able to leave early sometimes.*
- *When doing interviews, I will work to find out what the typical work week, call is like, ask about the number of hospitals so you don't have to spend time going from place to place.*
- *I am looking for a large group practice that offers: balance; enough interventional cardiologists so we can share call; a practice model that includes academics; minimal practice management responsibilities; and is collegial.*
- *In order to find out about the practice, I talked to others, asked about their hours, call responsibilities, vacation. My wife also did reconnaissance by asking the wives the same questions. This is where the real answers are. "Use all of your vacation?"*
- *I am a fan of bigger practices because they can absorb maternity/paternity leave, vacations, etc.*

- *I am likely to go into imaging due to lifestyle and this is also where I want my research to go. I am interested in part-time opportunities if available.*

Others are contemplating academic careers in order to have more flexibility if not fewer hours, though this is also motivated by love of research and teaching. Fellows cite the ability to spend time with their families in the evening and work on research papers during the late evening as a perceived benefit of an academic career. Some also mention the advantage in academic settings of having residents and fellows to assist with call and therefore reducing their on-call schedule.

- *I want more control over my life and in academics you can do more work at home, go on vacation. I may not work less, but I have control over when and how I work. I sometimes work over weekends, but only for an hour or two.*
- *Academic careers offer more work life potential, but this is not the driving factor. Teaching and complex patients are much more influential.*
- *The lifestyle is better in academics versus private practice as the first line of call is the residents/fellows.*

Practice Culture

Fellows are very interested in finding a good fit in terms of personalities and practice styles and values, as well as the balance objectives mentioned earlier. Several expressed concern that they did not want to be in a practice that was driven by generating RVUs.

- *Kaiser is a good model. You are more immune to financial pressures to see patients/do procedures.*
- *Being close to family was important but I ended up farther away in order to find a practice with the work style and values I wanted. I was definitely trading money for time, but that is a good bargain from my perspective. My rank factors are: quality care, similar visions, ie, dollar is not driving how much work or how many procedures need to be done, salary-based, see CME as a priority – I want to stay cutting edge.*
- *I am looking for a group of guys that I can hang out with.*
- *I am looking for a team that I can work well with and that will stimulate me intellectually. I can't decide on academics or private practice.*

9. Future Horizon

Fellows mentioned several new changes that could occur. Interventional cardiologists are starting to expand into non-cardiology related procedures such as carotid endarterectomy. Some cited increasing roles for diagnostic procedures and increased attention on prevention. There were mixed feelings about reducing the length of training. Some thought it would make the field more attractive, and others expressed concern that this would diminish the quality of the training in general cardiology. Another concern frequently noted is that private practice is very procedure driven leading young cardiologists to worry that they will be forced to place profits ahead of patient needs. There is a growing feeling that many of these procedures are performed unnecessarily due to high reimbursement rates. Fellows appear to be seeking out and work settings where they think that such issues are outside of the practice culture and environment, even if this leads to lower compensation. Others mention that the field might

become more non-invasive due to increased imaging techniques, though others question if this will happen as imaging is expensive and invasive procedures are so well reimbursed.

- *There is some possible competition between cardiology and vascular surgery and interventional radiology. Cardiology is branching out from just the heart to the carotid and other areas.*
- *Cardiology is taking procedures from radiologists. They can refer to themselves.*
- *Imaging techniques are more effective than invasive techniques these days, but invasive pays more.*

Recommendations for Cardiology Training

Fellows mentioned several recommendations for cardiology training programs, including 1) explicit maternity/paternity policies for fellows, 2) shortening/targeting training so that if you want to go into imaging, you do not have to spend as much time on other aspects such as catheterization (though others say this would hurt the field due to increased specialization), and 3) the need for more training on efficiency and what private practice will be like.

- *As you get older, you start to reassess your priorities due to family considerations. Explicit maternity policies for fellows might make it easier for women to go into the field. You may also want to shorten/target training to make it easier for women to sub-specialize. If you know you want to go into imaging, you might not need to spend as much time on other aspects.*
- *We are entering an era where everything is so specialized, so it is important to spend time in general training. I am a systems guy, so I think that there could be better training on efficiency and on what private practice will be like.*
- *I know there is talk of shortening the IM training requirements, but this would lose something. I would suggest shortening cardiology training instead.*
- *Shortening the pathway does make sense.*
- *I don't feel the third year is time well used. Training is so long and debt is so high.*
- *I wish the training covered going into practice.*
- *Continue the bright futures program and visiting professors program. This gives women exposure to the field.*
- *There should be incentives for cardiologists to practice in underserved areas.*

Recommendations for Practice Settings

A few fellows had some recommendations for practice models: 1) protected time for research in academic settings, 2) ensuring the practice is efficient, which is important for those who want to maximize time in the office so they can have more time for their families, and 3) reducing competition between radiologists and cardiologists by forming centers that employ both and share revenues.

- *Protected time for research. Academics is a tough field due to research and grant requirements. You are treated like a junior and have no protected time for research.*
- *It would be good to have contracts that specify the percent of time in each activity (patient care, teaching research.)*
- *Practice logistics makes a difference. The one I am in is very inefficient.*

- *I like an imaging center model that employs both radiologists and cardiologists. The overall goal would be to share revenue and thereby wouldn't have to compete with each other.*
- *I want to be very efficient with my time and use technology so I can have more time. I want to come in, work hard, do my job, and forget work when I am away from it.*

C. Findings from the Program Director Interviews/Focus Groups

1. Program Director Interviews/Focus Groups Summary

In this section, we summarize the results of the program director interviews/focus groups. Below, we provide more detail on the comments made by the program directors.

Work-life Balance

Program directors are very skeptical of the new generation of physicians and their interest in work-life balance. There is a growing disconnect between the program directors perceived requirements for adequate training and the generational demands of younger physicians. A few program directors acknowledge that this issue will continue to get worse, particularly in the new era of residency work hour restrictions. Program directors acknowledge feeling "let down" by more cardiologists entering private practice, despite professing interest in research during their application and interviews for fellowship.

Increasing Training Slots

Program directors noted that small increases in training positions would likely depend on soft money. The use of soft money makes such increases less appealing, given the significant adjustments to schedules and workflow which may have to be changed again if the funding goes away. If no external funding were available, programs would have to ask faculty to take pay cuts to support the additional trainees since fellows do not generate billable income.

URM Recruitment

Few program directors had formal programs for recruiting URM physicians. They primarily recruit from their undergraduate institutions and medical schools. One program director said their internal medicine program recruits from the Masters in Public Health program to attract minorities.

2. Work life Balance

Program directors are very skeptical of the new generation of physicians and their interest in work life balance. There is a growing disconnect between the program directors perceived requirements for adequate training and the generational demands of younger physicians. A few program directors acknowledge that this issue will continue to get worse, particularly in the new era of residency work hour restrictions. There are also mixed feelings about maternity/paternity leave for fellows. Some, possibly iconoclasts, think they should not really have any special accommodations. Others are reworking schedules to accommodate maternity/paternity leave, but find it somewhat challenging, particularly if there are multiple pregnancies at once. Program directors acknowledge feeling "let down" by more and more young cardiologists entering private practice despite professing interest in research during their application and interviews for fellowship.

- *This new generation is into multitasking but I think that multitasking is dangerous.*
- *If I even get a whiff they are worried about hours or time off, I will not accept them.*
- *I try very hard not to accept people who are 'lazy'.*
- *Medicine is more of a business than a profession to this generation.*
- *Many fellows have homes and SUVs already.*
- *In 8 years, lifestyle will be an even bigger concern.*
- *When I was in training, the head of the cath lab was pregnant out to here and wearing three aprons. She came back to work immediately. That is the way it should be.*
- *We rearrange schedules to accommodate not being in the cath lab during pregnancy.*
- *Sometimes other fellows object to maternity leave, but with men now taking paternity leave, there is less ill will.*
- *A single pregnancy is easily handled, but multiple pregnancies are more challenging.*

3. Increasing Training Slots

Program directors noted that small increases in training positions would likely depend on soft money. The use of soft money makes such increases less appealing, given the significant adjustments to schedules and workflow which may have to be changed again if the funding goes away. If no external funding were available, programs would have to ask faculty to take pay cuts to support the additional trainees since fellows do not generate billable income. They also pointed out the need to increase the pipeline of internal medicine residents.

- *Every program could increase 20-50% without a problem.*
- *Most new funding is on a short-term basis. I don't want to fight that fight every year.*
- *We recently doubled from 3-6 fellows because we expanded to a second hospital, but this was really more of a redistribution.*
- *I would need a sustained source of funding. It cannot come and go as you have to revise your schedule constantly. I have received temporary funding to support a particular fellow, usually an international medical graduate, and then have to change my schedule back once that fellow leaves and the funding source goes away.*
- *It costs about $75,000 per year to train a fellow and you can't bill for their services. Who is going to pick up this expense?*
- *Some new positions are funded by corporations, particularly EP and interventional cardiology slots.*
- *There are RRC challenges to increasing training slots, too.*
- *Most programs are pieced together in terms of funding sources.*
- *We need more internal medicine residents so we can increase the pool to choose from.*
- *I recommend increasing interest in cardiology at the medical school level.*

4. Minority Recruitment

Few program directors had formal programs for recruiting minority physicians. They primarily recruit from their undergraduate institutions. One program director said their medical school recruits from the Masters in Public Health program to attract minorities, though this is further down the pipeline from cardiology fellowship programs.

- *We talk to house staff but don't have an organized program.*
- *We recruit from our medical school – that is really the best opportunity.*
- *We have a Masters in public health program that is affiliated with our medical school and our medical school recruits minority students from that program who have a demonstrated interest in health issues, but maybe had never thought about going to medical school.*