Lifetime Earnings for Physicians Across Specialties

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Background: Earlier studies estimated annual income differences across specialties, but lifetime income may be more relevant given physicians' long-term commitments to specialties.

Methods: Annual income and work hours data were collected from 6381 physicians in the nationally representative 2004–2005 Community Tracking Study. Data regarding years of residency were collected from AMA FREIDA. Present value models were constructed assuming 3% discount rates. Estimates were adjusted for demographic and market covariates. Sensitivity analyses included 4 alternative models involving work hours, retirement, exogenous variables, and 1% discount rate. Estimates were generated for 4 broad specialty *categories* (Primary Care, Surgery, Internal Medicine and Pediatric Subspecialties, and Other), and for 41 specific *specialties*.

Results: The estimates of lifetime earnings for the broad categories of Surgery, Internal Medicine and Pediatric Subspecialties, and Other specialties were $1,587,722, $1,099,655, and $761,402 more than for Primary Care. For the 41 specific specialties, the top 3 (with family medicine as reference) were neurological surgery ($2,880,601), medical oncology ($2,772,665), and radiation oncology ($2,659,657). The estimates from models with varying rates of retirement and including only exogenous variables were similar to those in the preferred model. The 1% discount model generated estimates that were roughly 150% larger than the 3% model.

Conclusions: There was considerable variation in the lifetime earnings across physician specialties. After accounting for varying residency years and discounting future earnings, primary care specialties earned roughly $1–3 million less than other specialties. Earnings' differences across specialties may undermine health reform efforts to control costs and ensure adequate numbers of primary care physicians.

Key Words: surgery, primary care, oncology, income, satisfaction

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Previous research demonstrates substantial differences in annual incomes and wages across specialties, especially between primary care and most other specialties.[1–3] Differences in pay likely influence medical students' choices of residencies and therefore affect the mix of specialties in the physician workforce.[4–8] Specialty mix, in turn, has implications for health care costs, outcomes, and access. Roughly 67% of US physicians are specialists, which contrasts sharply with the 30% to 50% of physicians who are specialists in other countries, and this difference is thought to contribute to the much higher overall costs of medical care in the United States.[9] Evidence suggests that primary care physicians provide more cost-effective care than specialists.[10–14] Using mortality and morbidity statistics, some studies suggest that population health is better in geographic regions where primary care physicians comprise a greater proportion of all physicians.[10,12] Finally, assuming that significant portions of the Affordable Care Act (ACA) survive political challenges, the expected increase in the insured population will place unprecedented demands on the nation's supply of primary care physicians, further squeezing public access to an already scarce resource.[9,12,15]

Pay differences also adversely affect physician morale. Evidence suggests that wide dispersions in income for persons with similar skills generate job dissatisfaction and relatively low earnings predict dissatisfaction among primary care physicians.[16,17] Job dissatisfaction, in turn, is linked to health problems[18] and exiting medicine altogether.[19] As testimony to the importance of these issues, differences in annual income have received considerable attention from policy makers and are mentioned in the ACA.[20–22] Finally, information on differences in pay is useful independent of the debate surrounding the mix of specialists or the morale of physicians: medical students and policy makers need relative pay data to inform their decisions.

Several authors have published estimates of annual income and/or wages across physician specialties.[1,3,22–30] However, some of these data are derived only from academic physicians[23,24,30]; some come from convenience samples of community physicians[25]; and some use data from the 1990s.[1,24,26] Only 2 studies, to our knowledge, adjusted for well-known predictors of earnings such as age and sex.[3,27] Another important limitation of prior studies is that all but one (which considered only 2 specialties)[28] estimated only annual earnings or hourly wages. Yet most physicians continue in their initially chosen specialty until retirement, such that annual differences accumulate over physicians' careers.

This study estimated lifetime earnings with data from the Community Tracking Study (CTS) physician survey[31]—a nationally representative sample of practicing physicians—together with present value models. Our estimates controlled for demographic, community, and market predictors of pay as well as years of residency. The latter adjustment is important because years of residency training vary considerably across specialties, and physician income is low during residency. We compared lifetime earnings across 4 aggregated physician categories (Primary Care, Surgery, Internal Medicine and Pediatric Subspecialties, and all Others) and 41 disaggregated specialties.

METHODS

Data

Previous research used Round 4 (2004–2005) of the CTS physician survey to estimate wages per hour and annual work hours.[3,32] The representative sample was comprised of physicians who resided in the continental United States, practiced patient care, and were not employed by the federal government. Some hospital-based specialists such as radiologists, anesthesiologists, and pathologists as well as all residents and fellows were excluded.[31] The overall response rate was 53%. Annual earnings were measured as pre-tax income, net of all practice expenses, including malpractice insurance. Annual work hours were derived by multiplying the self-reported values of hours worked in the week before the survey with total weeks worked in the previous year. Our definition for work hours was derived from the CTS measure of time spent with "direct patient care, administrative tasks, and professional duties." Estimates for annual earnings were generated from the same sample of 6381 physicians as in our previous report on physician wages.[3] Briefly, the sample was restricted to physicians who reported working for more than 26 weeks in the previous year, working between 20 and 100 hours in the week before the survey, and who provided complete information for the variables used to produce regression-adjusted estimates. Annual incomes that were left-censored at 0 or right-censored at $400,000 were replaced with conditional expected values from a Tobit regression model.[3]

Four *broad* specialty categories included: Primary Care, Surgery, Internal Medicine and Pediatric Subspecialties, and all Other specialties. Forty-one specialties (Table 1) were sorted into these 4 broad categories as previously described.[3] Our previous studies[3,32] generated estimates for wages and hours after adjusting for key physician characteristics including age, sex, race, board certification, graduation from a foreign medical school, rural residence, residence in 9 regions of the country, practice ownership, employment by a medical school, and percent of revenue from managed care.

We drew estimates of the duration of residency training from the American Medical Associations' FREIDA database, which contains information from "nearly 9000 graduate medical education programs accredited by the Accreditation Council for Graduate Medical Education, as well as over 200 combined specialty programs."[33]

A present value formula was used to estimate mean lifetime earnings for physicians in specialty "*s*." We assumed that residency begins on the 28th birthday and, in our preferred model, that retirement begins just before the 65th birthday.

$$
\begin{aligned}
\text{Lifetime earnings}_s = {} & \text{residency earnings}_0 \\
& + \text{residency earnings}_1 * (1+r)^{-1} + \ldots \\
& + \text{residency earnings}_{t(s)^{-1}} * (1+r)^{-(t(s)-1)} \\
& + \text{postresidency earnings}_{s,t(s)} * (1+r)^{-t(s)} + \ldots \\
& + \text{postresidency earnings}_{s,36} * (1+r)^{-36},
\end{aligned}
$$

where "r" denotes the discount rate, which was 3% in our preferred model; $t(s)$ is the number of years of residency for specialty "s"; residency earnings$_0$ indicates annual earnings by physicians in the initial year of residency; residency earnings$_1$ indicates earnings in the second year; residency earnings$_{t(s)-1}$ indicates earnings in the final year for specialty "s"; and postresidency earnings$_{s,y}$ indicates the estimated average adjusted annual earnings for postresidency physicians age (28+y) years old, where $y = t(s), \ldots, 36$, corresponding to ages 28+$t(s)$ through age 64. Drawing from the AAMC Survey of Resident/Fellow Stipends and Benefits for 2010–2011[34] (the only Survey available with detailed data), we assumed national average residency stipends of $40,788 for 2004–2005 in the first year of residency and percentage increases every year of residency equal to the percentage increases based on 2010–2011 data. We therefore estimated lifetime earnings for the cohort of physicians who began residency training in 2004–2005, assuming that most would complete training by 2010–2011.

We used the method of population predictive margins to estimate annual income in the equation above while statistically adjusting for all other covariates.[32,35] After fitting a multiple regression equation with survey data, a population predictive margin for each desired specialty/age combination (s, a) was estimated by finding the survey weighted mean prediction when all respondents in our sample has specialty set to "s" and age set to "a" while allowing all other covariates to retain their original values. In our preferred model, the dependent variable was annual earnings in a linear regression that used the same independent variables as in our earlier work,[3] but with a different specification for age. In this study, we switched from using 10-year age groups to using a linear term (with values >65 trimmed to 65) and a binary indicator for ages more than 65. This age specification allowed for more tractable calculations and approximated an average age of 45 for our predictions. (A detailed prediction equation with explanation is available from the authors.)

We also generated estimates for 4 alternative models in a sensitivity analysis. In the first model, we assumed that all physicians worked the same number of annual hours, which was assumed to be the weighted sample mean, 2524. In the linear regression for the "constant hours" model, the dependent variable was hourly wages. This "constant hours" model estimates what economists call "earnings capacity." Although physicians may not have much individual control over their wages or fees, they may have some control over their hours. By assuming the same number of hours, we estimate what physicians have the capacity for earning but

TABLE 1. Residency Years, Annual Earnings, and Expected Lifetime Earnings for the Preferred Model: Varying Hours; All Retire at 65; Include Potential Endogenous Variables; 3% Discount Rate

	Years of Residency	Residency Earnings	Lifetime Earnings, Varying Hours	Lower and Upper 95% Limits	Comparisons with Primary Care (Difference)	*P*
4 broad specialty categories						
Surgery	4.9	$203,302	$4,588,249	$4,393,830–$4,782,669	$1,587,722	< 0.001
Internal Medicine and Pediatric Subspecialties	5.5	$227,312	$4,100,183	$3,864,842–$4,335,523	$1,099,655	< 0.001
Other Medical	4.1	$171,820	$3,761,930	$3,609,729–$3,914,131	$761,402	< 0.001
Primary Care	3	$124,384	$3,000,527	$2,895,058–$3,105,997	referent	
	Years of Residency	**Residency Earnings**	**Lifetime Earnings, Varying Hours**	**Lower and Upper 95% Limits**	**Comparisons with Family Practice (Difference)**	***P***
41 specialties						
Neurological surgery	6	$250,648	$ 5,860,154	$4,955,757–$6,764,551	$2,880,601	< 0.001
Medical oncology	5	$207,924	$5,752,217	$4,376,892–$7,127,543	$2,772,665	< 0.001
Radiation oncology	5	$207,924	$5,639,209	$4,709,463–$6,568,955	$2,659,657	< 0.001
Thoracic surgery	7.5	$315,459	$5,258,931	$4,704,542–$5,813,320	$2,279,378	< 0.001
Other surgical subspecialties	5	$207,924	$5,158,960	$4,072,172–$6,245,747	$2,179,407	< 0.001
Orthopedic surgery	5.5	$229,286	$5,134,574	$4,705,447–$5,563,701	$2,155,021	< 0.001
Vascular surgery	6	$250,648	$5,019,201	$4,403,536–$5,634,866	$2,039,648	< 0.001
Plastic surgery	6	$250,648	$4,625,690	$3,766,381–$5,485,000	$1,646,138	< 0.001
Hematology/oncology	5	$207,924	$4,583,949	$3,327,663–$5,840,236	$1,604,397	0.012
Cardiovascular diseases	6	$ 250,648	$4,470,421	$3,939,197–$ 5,001,644	$1,490,868	< 0.001
Obstetrics and gynecology	4	$165,544	$4,437,550	$4,156,541–$ 4,718,559	$1,457,998	< 0.001
Gastroenterology	6	$250,648	$4,382,540	$3,891,534–$4,873,545	$1,402,987	< 0.001
General surgery	5	$207,924	$4,380,523	$3,841,765–$4,919,282	$1,400,971	< 0.001
Ophthalmology	4.5	$186,734	$4,368,323	$3,961,179–$4,775,468	$1,388,771	< 0.001
Allergy and immunology	5	$207,924	$4,341,728	$3,682,268–$5,001,188	$1,362,176	< 0.001
Dermatology	4	$165,544	$4,308,115	$3,834,708–$4,781,522	$1,328,563	< 0.001
Otolaryngology	5	$207,924	$4,179,276	$3,481,880–$4,876,672	$1,199,724	0.002
Nephrology	5	$207,924	$4,150,088	$3,263,492–$5,036,683	$1,170,535	0.009
Neonatal/perinatal medicine	6	$250,648	$4,056,093	$3,719,829–$4,392,356	$1,076,540	< 0.001
Critical internal care medicine	4.5	$186,734	$3,986,974	$3,551,523–$4,422,425	$1,007,422	< 0.001
Urology	5	$207,924	$3,969,439	$3,410,928–$4,527,949	$989,886	< 0.001
Neurology	4	$165,544	$3,843,081	$3,335,119–$4,351,044	$863,529	0.001
Pulmonary diseases	5	$207,924	$3,823,512	$3,238,174–$4,408,850	$843,960	0.008
Occupational medicine	3	$123,534	$3,682,060	$3,215,577–$4,148,544	$702,508	0.002
Emergency medicine	4	$165,544	$3,666,895	$3,408,273–$3,925,518	$687,343	< 0.001
Physical medicine and rehabilitation	4	$165,544	$3,660,422	$3,093,946–$4,226,899	$680,870	0.014
Rheumatology	5	$207,924	$3,591,697	$2,917,563–$4,265,830	$612,144	0.087
Hospitalists	3	$123,534	$3,557,113	$3,203,120–$3,911,106	$577,561	0.004
Pulmonary critical care medicine	6	$250,648	$3,540,953	$2,489,025–$4,592,881	$561,401	0.311
Geriatric medicine	4	$165,544	$3,300,444	$2,720,571–$3,880,318	$320,892	0.291
Psychiatry	4	$165,544	$3,248,744	$3,015,795–$3,481,694	$269,192	0.032
Endocrinology	5	$207,924	$3,211,125	$2,906,163–$3,516,087	$231,572	0.167
Child and adolescent psychiatry	5	$207,924	$3,190,455	$2,755,993–$3,624,917	$210,903	0.376
General practice	3	$123,534	$3,029,597	$2,625,345–$3,433,850	$50,045	0.814
Pediatrics	3	$123,534	$3,028,785	$2,768,070–$3,289,501	$49,233	0.718
Infectious diseases	5	$207,924	$3,024,482	$2,382,863–$3,666,101	$44,930	0.893
Internal medicine	3	$123,534	$3,011,489	$2,855,047–$3,167,932	$31,937	0.778
Family practice	3	$123,534	$2,979,552	$2,838,637–$3,120,468	Referent	—
Other pediatric subspecialties	6	$250,648	$2,901,154	$2,449,293–$3,353,016	− $78,398	0.741
Pediatric emergency medicine	6	$250,648	$2,805,753	$1,737,857–$3,873,649	− $173,799	0.746
Internal medicine/pediatrics	4	$165,544	$2,681,411	$2,249,823–$3,112,999	− $298,141	0.222

may choose not to earn. This "constant hours" model allows for more standardized comparisons because for full-time physicians (the vast majority), fewer hours are generally preferred over longer hours for the same annual earnings.

The second alternative model allowed for varying retirement rates across specialties. We assumed that 2% of Primary Care physicians retired per year beginning at age 55 and 4% per year of all other physicians also beginning at 55. These 2% and 4% rates were based on our interpretation of the Kletke[36] analysis that included an assessment of the Physician Masterfile of the American Medical Association for successive years between 1980 and 1997. The third alternative retained age, sex, race, and region as covariates in the regression, but eliminated possible endogenous variables: board certification, graduation from a foreign medical school, rural residence, practice ownership, employment by a medical school, and experience with managed care. The fourth alternative assumed a 1% discount rate. For the second through fourth alternative models, the dependent variable was annual earnings in the regressions.

To estimate mean lifetime earnings for broad specialty categories as well as by duration of residency, survey weighted linear combinations of specialty-specific lifetime earnings were computed, with the weight for each specialty being its within-category relative frequency. Survey-adjusted SEs and confidence intervals for lifetime earnings estimates accounted for the random sampling of covariate vectors used to generate the population predictive margins and the variance of regression coefficient estimates.[37] Statistical analysis was implemented using Stata/SE.[38]

RESULTS

Table 1 presents estimates from our preferred model that includes varying work hours, constant retirement age, possibly endogenous covariates, and a 3% discount rate. The top panel pertains to the 4 broad categories and the second panel, to the 41 specialties, ranked from high to low earnings. The first column of numbers indicates years of residency and fellowship training. For the broad categories, these are weighted averages and range from 3.0 for Primary Care to 5.5 for Internal Medicine and Pediatric Subspecialties; for the 41 specialties, they range from a minimum of 3.0 for general practice, family practice, internal medicine, pediatrics, hospitalists, and occupational medicine to a maximum of 7.5 for thoracic surgery. The second column indicates earnings in residency; again numbers for the broad categories are weighted averages and range from a minimum of $124,384 for Primary Care to a maximum of $227,312 for Internal Medicine and Pediatric Subspecialties. The third column of numbers shows lifetime earnings and the fourth, the lower and upper 95% confidence limits for lifetime earnings. The fifth column provides dollar estimates and the sixth, corresponding *P* values, for comparisons to Primary Care (for the broad categories) and to family practice (for the 41 specialties). Lifetime earnings for the broad categories of Surgery, Internal Medicine and Pediatric Subspecialties, and Other specialties were $1,587,722, $1,099,658, and $761,402 more than the broad category for Primary Care. The top 3 for the 41 specialties were neurological surgery ($2,880,601 more than family medicine), medical oncology ($2,772,665 more), and radiation oncology ($2,659,657 more); the bottom 3 were internal medicine and pediatrics (combined) ($298,141 less), pediatric emergency medicine ($173,799 less), and other pediatric subspecialties ($78,398 less). A total of 28 of the 41 specialties showed statistical significance; all 28 had higher earnings than family medicine.

Figure 1 presents a forest plot in which lifetime earnings for one category is compared with Primary Care in the top panel and each of the 41 specialties is compared with family medicine in the second panel. The broad categories of Surgery, Internal Medicine and Pediatric Subspecialties, and Other Medical, are estimated to earn roughly 53%, 37%, and 25% more than the broad category of Primary Care.

Figure 2 presents a forest plot that summarizes results from our preferred, base-case model and 4 alternative models in a sensitivity analysis. Three means and 95% confidence intervals appear for each model corresponding to 3 of the 4 *broad* categories. The first alternative model assumed constant hours. In calculations not shown, the forecasted difference in pay shrinks for Surgery (from 51% to 38% comparing preferred and the first alternative model) and Internal Medicine and Pediatric Subspecialties (from 35% to 24%) but increases for Other Medical (from 25% to 37%). In additional analysis we compared the 41 rankings for results in Figure 1 to the first alternative model (with constant hours). Four rankings changed by more than 10 places: dermatology rose from 16th (actual hours) to 5th (constant hours); physical medicine and rehabilitation rose from 26th (actual hours) to 10th (constant hours); vascular surgery dropped from 7th (actual hours) to 22th (constant hours); and critical care internal medicine dropped from 20th (actual hours) to 34th (constant hours).

In the second alternative model (varying retirement ages), the forecasted difference in pay shrinks for all 3: Surgery (from 51% to 50%), Internal Medicine and Pediatric Subspecialties (from 35% to 34%), and Other Medical (from 25% to 23%). In the third alternative model (eliminating possible endogenous variables), the forecasted difference in pay increases for Surgery (from 51% to 54%) and Internal Medicine and Pediatric Subspecialties (from 35% to 36%) but decreases for Other Medical (from 25% to 24%). The fourth alternative provided the starkest dollar contrast. The Surgery difference increased to 56% or $2,360,880; Internal Medicine and Pediatrics increased to 40% or $1,680,318; and Other Medical increased to 27% or $1,129,833.

DISCUSSION

Differences in pay across different physician specialties, especially between primary care and procedural specialists, has provoked vigorous debate.[1–3,9,14,21,22] Measures of pay in earlier studies have included annual income, Resource-Based Relative Value Units, and wages per hour.[1–3] Earnings measured over a lifetime, however, may be the most relevant metric, given the long-term commitment physicians make to their specialties. Lifetime earnings'

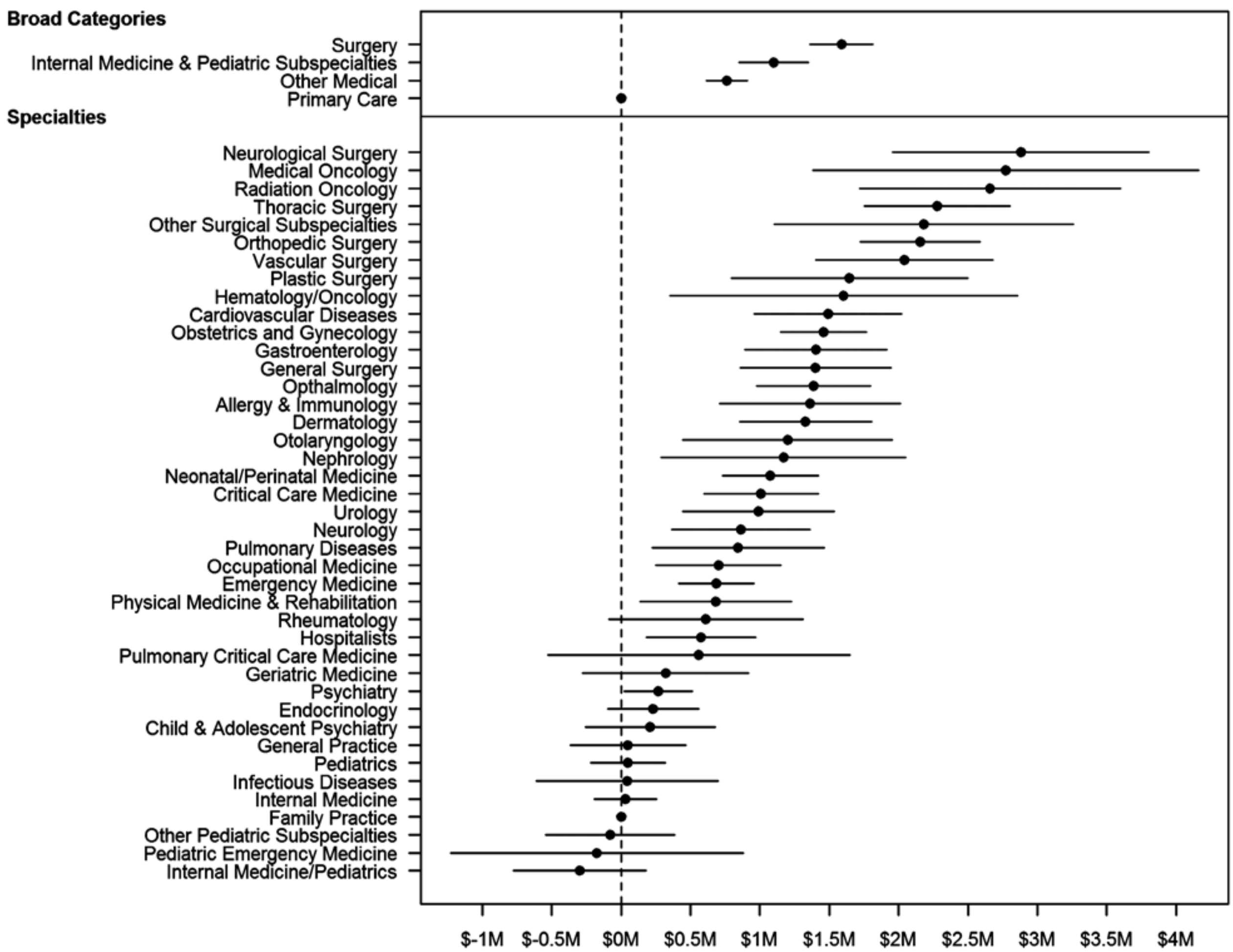

FIGURE 1. Difference in expected lifetime earnings and preferred model.

differences are over 20 times larger than annual income differences. But research on lifetime earnings is sparse. Most studies of which we are aware used data from before 1990 or ranked only a handful of specialties.[8,28,39–41] In one recent study, Vaughn et al[28] estimated that cardiologists earned $2.5 million (2008 dollars) more than primary care physicians.

For the 4 broad categories in our preferred model, we found lifetime earnings (2004–2005 dollars) of specialists approximately $762,000–$1,588,000 higher than our Primary Care category. For the disaggregated 41 specialties, we found lifetime earnings of the highest paid "top ten" specialties to be approximately $1,491,000–$2,880,000 higher than family practice. The Vaughn et al[28] comparison is consistent with the latter differences. Many of these "top ten" either perform surgery (neurological, orthopedic, ophthalmologic), or deploy expensive technologies or medicines to treat cancer (radiation or medical oncology). Many specialties with lower lifetime earnings do not involve procedures but rather rely on examining and conversing with patients. These results are consistent with other findings suggesting that rates of return on human capital investments in primary care do not fare well against returns from law, business, and dentistry.[40]

Substantial differences persisted in the 4 alternative models in the sensitivity analysis. It could be argued that some of the differences could be due to specialists simply working more hours. For the broad categories of Surgery and Internal Medicine and Pediatric Subspecialties, this argument has some merit; the difference between them and Primary Care shrank, but not by much. But the argument does not hold at all for the Other Medical category—which includes radiation oncology, physical medicine and rehabilitation, occupational medicine, emergency medicine, adult and child psychiatry, pediatric emergency, neurology, ophthalmology, and dermatology. The Other Medical category increased its difference to 38% when compared with the Primary Care category. It could also be argued that specialists retiring earlier than generalists could explain part of the gap. We believe this argument is correct. But there are 2 problems implementing it. First, reliable data for varying retirement rates are difficult to obtain.[36] Second, early retirement generally does not begin before age 55 or 60 and likely does not affect the majority of physicians. From the

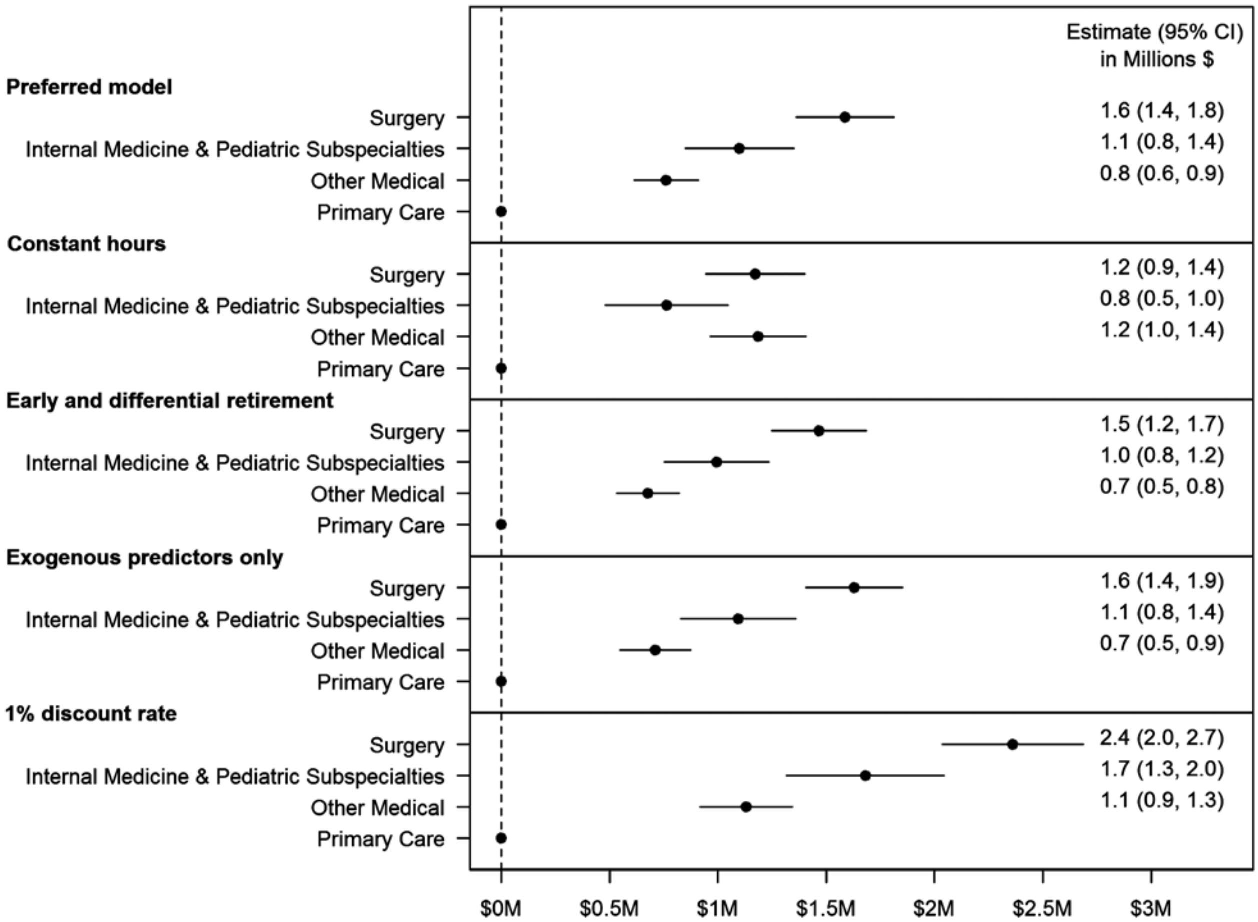

FIGURE 2. Difference in expected lifetime earnings, preferred, and 4 alternative models.

perspective of a 28-year old, discounting will minimize any difference. Our results for the second alternative model that assumes specialists retire at twice the rate of generalists from age 55 to 65 suggest only modest narrowing of differences. Future research with actual (rather than assumed) data on retirement rates may find greater narrowing.

The alternative model that, by far, altered the size of the differences was the one corresponding to the 1% discount rate. This 1% has been suggested as a social discount rate.[42] Society, presumably, lives longer than any one individual and future generations should be accounted for. Physicians provide services not just for adults but for children, newborns, and those still in the womb. Moreover, society—through Medicare, Medicaid, and government regulation—invests in training and paying physicians. If the 1% social discount rate is deemed relevant, the differences between specialists and generalists would expand by roughly 150%.

In an idealized free market, medical students would have information about lifetime earnings. High-earning specialties would attract an influx of prospective physicians and this increase in supply would drive down wages. Low-earning specialties would lose prospective physicians and this decrease in supply would drive up wages. Forces of supply and demand would tend to equalize lifetime earnings.[42] But even in an idealized market, there are forces that would maintain some earnings' differences across specialties. It is often alleged that the higher earnings of specialists are justified because of more years in residency; but our estimates already account for the longer residencies of specialists. It is also alleged that the longer residencies may be more rigorous per year than shorter residencies and that after residency, certain specialties require more shift work, on-call hours, and physical demands than primary care. For example, surgeons, emergency room, critical care, and ob/gyn physicians likely face more frequent stressful decision-making than many primary care physicians. Higher earnings for specialists may take the form of what economists call "compensating wages" for undesirable or especially taxing work. Although it is certainly plausible that compensating wages may explain some of the differences we find, we caution against an uncritical acceptance of this explanation. It is not obvious that specialists, as a group, have residencies or jobs that are more unpleasant than primary care physicians. For example, Baldwin et al[43] analyze a national random sample of residents, and find that their only 2 primary care categories—internal medicine and pediatrics—were in the upper range of the distribution of hours of work per week in residencies. Orthopedic surgery and otolaryngology reported more hours than primary care physicians but most specialists, including anesthesiology, ophthalmology, radiation oncology and dermatology, reported fewer residency hours per week. Finally, evidence for compensating wages in other labor markets—such as those for blue-collar workers—is disputed by some economists.[44]

Another market factor that might account for differences in earnings concerns substitutability of nonphysicians. It might be argued that part of the gap in pay is due to the greater number of physician assistants and nurse practitioners available to substitute for generalists. Additional market forces that may result in either a narrowing or widening gap between specialists and generalists include the aging of our population, shift from smoking-related to obesity-related disease, technological advances in pharmaceuticals, genomics, and medical devices as well as differences in innate ability of physicians selecting different specialties.

But there are also institutional and political forces operating on the physician workforce. At the broadest level, over 45% of national medical spending derives from governments, roughly half of US medical schools are public institutions, and Medicare has paid more than $7.5 billion annually in recent years to fund residency programs.[9] More narrowly, it can be argued that physician assistants and nurse practitioners also substitute for specialists. Roughly two thirds of physician assistants and over one third of nurse practitioners work in specialty fields.[9] Optometrists can substitute for ophthalmologists for almost all nonsurgical services. Certified Nurse Midwives can substitute for obstetricians doing most vaginal deliveries. In addition, we would argue that specialists have been more successful than generalists in their response to the threat of substitution. Specialists develop new procedures or interventions that only members of the specialty are capable of doing. Specialists, such as ophthalmologists, also erect "barriers to entry" through state "scope of practice" laws that restrict what well-qualified nonphysicians can do.

Another political force is the American Medical Association's Specialty Society Resource Based Relative Value Scale Update Committee, or RUC. This committee makes annual recommendations to Medicare regarding the relative pay scales for a wide range of specialists and generalists. Many private insurance carriers also adopt these scales. But specialists out-number generalists as much as two-to-one on the RUC and therefore likely have more political power to negotiate higher rates for themselves. In recent years there has been increasing acrimony in the debates surrounding Medicare payments for procedures versus general office visits among physicians representing different specialty groups.[45] A lawsuit has recently been filed by 6 primary care physicians in Georgia alleging that the RUC favors specialists over generalists and that its influence on Medicare is illegal.[46]

Our results have implications for costs and shortages. A number of observers allege that this country's high ratio of specialists-to-generalists is one cause of the high costs of medical care in the United States compared with all other countries.[9] The increasing enrollments of medical students in specialist residency programs in recent years have led to forecasts of ever higher costs and worsening primary care shortages for the future.[47,48] Steinbrook[49] cites evidence for the current shortage: the percentage of residencies filled by US medical school graduates for anesthesiology, radiology, and orthopedic surgery were 10–20 percentage points higher than those for family medicine, internal medicine, and pediatrics. Moreover, the trend over time is falling for primary care; for example, the percentage of family practice residencies filled by US medical school graduates declined from roughly 62% in 1999 to 42% in 2009.[49]

These problems of shortages have been addressed in the Patient Protection and Affordable Care Act through provisions that attempt to make primary care more financially attractive. However, these provisions may still prove inadequate. For example, debt forgiveness of, say, $200,000 for practicing primary care for 8 years in an underserved community is only 10%–25% of the differences we estimate. Bach and Kocher[50] suggest that trainees in specialties requiring more than 3 years of residency should not receive any earnings while in residency. Under this proposal, our Table 1(preferred model) analysis suggests that specialists would forego roughly $172,000–$203,000 (for an average of roughly $188,000) of lifetime earnings. Given that specialists' advantages are $761,000–$1,588,000 over primary care, the Bach and Kocher proposal would reduce lifetime differences by 12%–25%. But current and future medical students may still not be strongly inclined to select primary care.[51] In addition, as a result of the Great Recession, there are strong currents of pessimism running through college graduates regarding economic futures and these fears may lead them to weigh expected lifetime earnings more heavily than they otherwise would.[52]

To more fully address shortages and the acrimony among physicians, our results suggest that legislators, health insurance administrators, medical group directors, health care plan managers and executives, residency directors, and other health policy makers should consider actions that would reduce the difference in pay, especially between generalists and specialists. Reducing this difference should improve access to primary care services and facilitate implementation of the medical home model, which is expected to deliver better health care outcomes at lower costs.[53,54]

Our study has limitations. First, we assumed that earnings did not change (in constant dollars) after residency until retirement. Second, our estimates are forecasts. If used by medical students today, these estimates would include forecasts for years in the decade of 2040, obviously introducing uncertainty. Despite that fact that similar substantial differences in lifetime pay have been noted for at least 40 years,[39] future decades may face different challenges. The ACA is transforming medicine. Greater reliance will be placed on Accountable Care Organizations which, in turn, heavily rely on primary care physicians as well as nonphysician providers such as physician assistants, nurse practitioners social workers, and psychologists.[55] Increased reliance on primary care physicians will increase demand for them but substitution with nonphysician providers will decrease demand. The net effect is therefore unclear for physician earnings. Third, our data from the Community

Tracking Survey excluded radiologists, anesthesiologists, and pathologists which may have the effect of reducing estimated pay differences between generalists and specialists. Several additional limitations were addressed in previous reports, including self-reported, cross-sectional data; and some specialties with fewer than 30 respondents; and measures of work hours that ignore time "on-call."[3,32] But our study also has advantages: nationally representative data that have been widely used; analysis of over 40 specialties; and accounting for years and earnings in residency.

As with most observational studies, it could be that self-selection and unobserved variables might bias our results. Some medical students might take special delight in helping children and consequently choose pediatrics. Given the difficulty with finding openings in highly desirable specialty residencies, students with the highest intellectual abilities might be the only ones who match with residencies in radiology, ophthalmology, anesthesiology, or dermatology. In cross-sectional data, instrumental variables are sometimes suggested to minimize these biases. But valid instruments are difficult to obtain and invalid ones can do more harm than good.[56] The most likely candidates for instruments—age, race, sex, and test scores—also predict earnings. We chose to present results for "base case" least squares regressions that can be used for comparison against future research using alternative data and techniques that will attempt to control for self-selection and unobserved variables bias.

A related critique involves possible endogenous variables bias arising from including covariates reflecting practice ownership, board certification, and revenue from managed care. Again, the valid instruments required to estimate equations for these variables are not immediately apparent. Nevertheless, we did also estimate an equation—results in Figure 2, third alternative model—that eliminated the most likely potential endogenous variables and our basic results were largely unaffected.

Substantial variation in lifetime earnings across physician specialties was found in this study, with the gap between primary care and subspecialists being particularly noteworthy. These data may be useful for the debate surrounding physician pay as well as to inform decisions by medical students, medical school and residency program administrators, hospital financial officers, practicing physicians, policy makers, and Medicare administrators.

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