Perspectives on the Physician Workforce to the Year 2020

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Abstract

Physician supply and demand for the period extending to 2020 were assessed from three perspectives: physician utilization in group- and staff-model health maintenance organizations, physician distribution, and the future supply of nonphysician clinicians. The national norm for physician demand in 1993 was estimated to be 205 per 100 000 population. Demand is projected to increase 18 percent by 2020, because of both an expansion in beneficial services and a reduction in physician work effort. Supply initially will increase more rapidly, resulting in a surplus of 31 000 physicians (5 percent of patient care physicians) in the year 2000 and increasing to 62 000 physicians (8 percent) in 2010, after which the gap will narrow. Similar results were obtained when previous studies that had projected surpluses of 73 000 to 165 000 physicians (15 percent to 30 percent) in the year 2000 were reevaluated. However, physician distribution is not homogeneous, and the number of physicians per capita currently varies by more than twofold among states. Relative to the national norm, surpluses already exist in some states and shortages in others. In addition, the supply of nonphysician clinicians with independent practice authority is increasing. Their numbers are projected to double by 2010, equaling 60 percent of the number of patient care physicians. Measured as physician equivalents, their growth will equal the growth in physician supply.

Thus, in terms of physicians alone, there is no evidence of a major impending national surplus. Local surpluses will be influenced principally by how physicians distribute themselves geographically. The major determinant of overall physician surpluses in the future will be the extent to which patients continue to seek physicians for services that also will be offered by an expanded workforce of nonphysician clinicians. Policy is needed that encompasses the universe of clinicians who will be providing care to patients in the next century.

Apprehension is growing about an impending physician surplus. Indeed, concern over such a surplus began 20 years ago, just as the United States was finishing an unprecedented doubling of its capacity to train new physicians in response to the widely held view that there soon would be a shortage of physicians. In 1976, the Graduate Medical Education National Advisory Committee (GMENAC) undertook a study of physician supply. It predicted that by 1990 there would be a surplus of 70 000 active physicians (a 13 percent surplus) and by the year 2000 this surplus would increase to 145 000 (22 percent) [1,2]. Table 1. GMENAC’s projection for the year 2000 was accepted by many analysts, [3-5] and some predicted even larger surpluses, [6] but most concluded that physician supply will exceed demand by no more than 10 percent. [7-10]
During the past 2 years, the Bureau of Health Professions (BHP) and the Committee on Graduate Medical Education (COGME) have reexamined this matter \[11-14\] Table 1. In COGME's fourth report, the BHP projected a surplus of 80,000 physicians (15 percent) by the year 2000, increasing to 120,000 (18 percent) by 2020. \[11\] In an analysis prepared for the BHP, Weiner, using health maintenance organization (HMO) staffing patterns as a basis, projected a surplus of 165,000 physicians (28 percent of practicing physicians) in the year 2000, \[12\] a value similar to GMENAC's. \[1\] In a recent report to the BHP, Weiner raised this projected surplus to as much as 216,000 and projected a surplus of 270,000 physicians, 38 percent of all patient care physicians, by 2020. \[13\] Using similar methods, the BHP independently derived values more similar to those in COGME's fourth report, \[14\] which although lower are still alarming Table 1. This series of studies has raised deep concern about the potential for a significant physician surplus and has caused focused attention on ways to reduce the increase of physician supply by whatever means possible, particularly through constraints on the number of international medical graduates (IMGs) who train in the United States. \[11,15,16\]

In contrast, our previous studies indicate that while there will be a "bulge" in physician supply of as large as 10 percent in the early years of the next century, this surplus will shrink after 2010, as the increase in the number of physicians slows to a rate less than that of the general population. \[17,18\] While most would agree that future physician surpluses of 15 percent to 30 percent warrant some action, it is not clear that an overall surplus of 10 percent or less creates the same urgency. Reaching a consensus on what is and what is likely to be is a necessary prelude to a discussion of what steps, if any, should be taken to achieve a different outcome.

The following exercise was undertaken in an effort to build toward that consensus. It assesses physician supply and demand for the period extending to 2020 from three vantage points. First, like the studies of Weiner and the BHP, \[12-14\] the demand side of the Equation was derived from analyses of HMO experiences. This approach allowed the creation of national norms for physician utilization. Second, geographic variation in physician supply was assessed by examining the physician distribution in each of the 50 states, allowing a comparison to be made between these national norms and regional patterns of utilization. Finally, projections were made of the future supply of non-physician clinicians (NPCs) and of the impact that their rising numbers will have on the demand for physician services. Three perspectives emerged from this analysis.

From an idealized national perspective, focusing only on physicians, there is no evidence of a major impending surplus. Physician supply will exceed the national norm of demand by 5 percent to 8 percent between now and 2010, but the gap will narrow thereafter, and a small deficit of physicians is projected by 2020. Similar results were obtained when the studies of GMENAC, \[1\] Weiner, \[12\] and the BHP \[14\] were recalculated in accord with the methods presented herein.

However, from a geographic perspective, substantial surpluses already exist in some states, while others display relative shortages, and there are broad regional differences in physician utilization.

Finally, from a perspective that includes other providers of clinical care, the supply of NPCs will increase by a magnitude that is similar to the projected increase in physician supply, creating the potential for significant clinician surpluses in the future.
Thus, rather than simply a product of overall physician supply and demand, future physician surpluses will be determined largely by the degree to which physicians distribute themselves geographically and by the extent to which patients continue to look to physicians to provide services that in the future also will be offered by an expanded workforce of NPCs.

**PHYSICIAN SUPPLY**

The physician supply model used in this article was described previously. [17] It requires a series of assumptions that concern the training of new physicians and the size and characteristics of the US population they will serve.

Assumptions Concerning US Medical Graduates

The model assumes that the number of US allopathic and osteopathic medical graduates (USMGs) will not change appreciably. After having increased from 7400 in 1955 to 18 500 in 1990, the number of USMGs has remained relatively constant. [19] While no new allopathic medical schools are likely to open during the next 5 years, several new osteopathic schools are planned, and allopathic schools have projected an overall increase in class size of 1 percent. [20] However, decreasing levels of state support and decreasing clinical practice revenues are having a constraining effect on medical schools. For example, two schools recently merged, with a net reduction of 50 first-year places, and other mergers or closures can be anticipated. Therefore, the number of USMGs could vary by as many as plus/minus 500 per year during the next 10 years, affecting physician supply by plus/minus 6000 in 2010 and plus/minus 12 000 in 2020.

Assumptions Concerning IMGs

In 1988, 3500 IMGs entered the first postgraduate residency year, bringing the total to 120 percent of the number of USMGs. [16,19] By 1994, their participation had increased to 7500, bringing the total to 144 percent. To curtail further growth, some have called for constraints on the number of first-postgraduate-year residency positions, [15,16] and COGME has proposed restricting these positions to 110 percent of the number of USMGs. [3,11] Although such regulations may not be enacted, a number of dynamics are likely to decrease these numbers. Most hospitals are downsizing, and many are consolidating. Some municipal hospitals, in which substantial numbers of residents train, are being privatized, and others are being closed. At the same time, proposed cuts in Medicare-Indirect and Medicare-direct medical education payments are decreasing the economic incentives to employ residents. However, the expense of using staff physicians, advance practice nurses (APNs), or physician assistants (PAs) instead [21] may still encourage some hospitals to hire more residents. Therefore, for purposes of the present analysis, it is assumed that the number of first-postgraduate-year residents will decline to approximately 133 percent of USMGs. A rate of 145 percent would expand the projected number of physicians by approximately 25 000 in 2010 and 50 000 in 2020, whereas if COGME’s target of 110 percent [3] is slowly phased in, there will be 21 000 fewer physicians in 2010 and 55 000 fewer in 2020. This degree of variation could affect physician supply by plus/minus 20 000 (plus/minus 3 percent) in 2010 and plus/minus 50 000 (plus/minus 6 percent) in 2020.

Assumptions Concerning Residents

Residents account for almost 20 percent of patient care physicians Table 2, but their work effort is approximately two thirds that of fully engaged practicing physicians. [7,17] In projecting physician supply, this difference is taken as a downward adjustment, and the data are reported as “resident-adjusted patient care physicians.” Because the average length of residency training will decline as more residents train in primary care, the total number of residents in all years of training will decrease from 102 000 in 1993 [22] to approximately 94 000 by 2010. When expressed as a fraction of all patient care physicians, the number of residents will decrease from 18 percent in 1993 to approximately 11 percent in 2020, and when expressed relative to the population, the number will decrease from 39 per 100 000 to 27 per 100 000.

<table>
<thead>
<tr>
<th>Variable</th>
<th>1993</th>
<th>2000</th>
<th>2010</th>
<th>2020</th>
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<tr>
<td>Supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Practicing physicians</td>
<td>474 (183)</td>
<td>568 (204)</td>
<td>704 (227)</td>
<td>756 (219)</td>
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<td>Residents and fellows</td>
<td>102 (39)</td>
<td>97 (35)</td>
<td>94 (30)</td>
<td>94 (27)</td>
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<td>Patient care physicians</td>
<td>576 (222)</td>
<td>665 (238)</td>
<td>798 (257)</td>
<td>849 (247)</td>
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<tr>
<td>Resident-adjusted patient care physicians</td>
<td>540 (208)</td>
<td>631 (226)</td>
<td>765 (247)</td>
<td>816 (237)</td>
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<td>Demand</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Patient care physicians</td>
<td>532 (205)</td>
<td>600 (215)</td>
<td>703 (227)</td>
<td>829 (241)</td>
</tr>
<tr>
<td>Surplus [deficit]</td>
<td>6 (3)</td>
<td>31 (11)</td>
<td>62 (20)</td>
<td>[13] (41)</td>
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<td>Patient care physicians, %</td>
<td>1.4</td>
<td>4.9</td>
<td>8.1</td>
<td>[1.6]</td>
</tr>
</tbody>
</table>

*Numbers of physicians are in thousands with numbers per 100 000 population in parentheses.

Table 2. Physician Supply and Demand, 1993-2020
Projections of the Number of Patient Care Physicians

Based on these assumptions regarding the training of new physicians and assuming current rates of retirement and death for practicing physicians, the total number of patient care physicians is projected to increase from 576,000 in 1993 to 849,000 in 2020 [17] Table 2. Adjusted for resident work effort, the number of resident-adjusted patient care physicians will increase from 540,000 in 1993 to 816,000 in 2020. It is these resident-adjusted values that are used to calculate physician supply per capita herein. Considering variation in the number of students and residents, these figures have errors of plus/minus 5 percent in 2010 and plus/minus 8 percent in 2020.

Population Assumptions

The size of the physician workforce is expressed as the number of patient care physicians per 100,000 population. The Bureau of the Census (the Bureau) monitors the size of the US population and projects it into the future. In 1992, the Bureau increased its previous estimates of the US population by 2.5 percent for the year 2000 and 9.6 percent for 2020, [23,24] and in 1993 it increased these estimates by an additional 0.5 percent and 1.9 percent. [25] Its population estimate for the year 2000 was 20 million greater when estimated in 1993 [25] than in 1977. [26] The impact that changes of this magnitude have on physician workforce projections is reflected in a reassessment of the physician surpluses projected by COGME, [3,11] which used the lower 1989 estimates, [23] and GMENAC, [1] which used the estimates from 1977. [26] Using the most current estimates [23] instead decreases COGME's projected surplus for the year 2000 by 20,000 and GMENAC's by 35,000, and it decreases COGME's projected surplus for 2020 by 62,000 physicians Table 1.

The Bureau derives its population estimates from separate projections of births, deaths, and net immigration. Their most recent middle estimates assume that between 1993 and 2020 the fertility rate will increase 0.1 percent per year, life expectancy will lengthen by 3.0 years, and net immigration will remain unchanged. [25] These assumptions appear to be low relative to recent experience. During the past 15 years, fertility has increased at a rate of 1.3 percent per year, and life expectancy lengthened at almost double the rate projected by the Bureau. [27] Higher estimates for these two factors seem warranted. The major uncertainty is immigration. Some demographers have estimated rates much higher than those of the Bureau, [28] and a surge in immigration recently has been observed. [29] However, immigration into the United States already accounts for nearly half of the total immigration in the developed world, [30] and there is mounting pressure to impose constraints, [31] as has been done by all other Western democracies. [30]

The Bureau has constructed a high series of population estimates that assumes a continuation of the recent trend to increased fertility, a lengthening of life expectancy by 5.0 years in 2020, and a modest increase in the rate of immigration. [25] These high estimates exceed the middle estimates by 2.1 percent in 2000, 6.4 percent in 2010, and 11.4 percent in 2020. The population estimates used in the model developed herein are the midpoints between the Bureau's middle and high estimates. They project the US population to increase from 258 million in 1993 to 344 million in 2020 Table 3.

Table 3. Adjustments to Health Maintenance Organizations (HMO) Physician Utilization Estimates

Projections of Physician Supply per Capita

Combining the resident-adjusted physician supply projections and the midpoint population projections presented herein, the supply of patient care physicians per capita is projected to increase from 208 per 100,000 population in 1993 to 247 per 100,000 in 2010. It then will decline, reaching 237 per 100,000 in 2020 Figure 1, Table 2.
Figure 1. Physician supply and demand. Projections of physician supply, expressed as resident-adjusted patient care physicians per 100,000 population, were derived according to the model published previously [17] and the assumptions described herein, using primary data from 1993. [22,25,37,38] Physician demand, expressed as patient care physicians per 100,000 population, was derived from an analysis of physician utilization in health maintenance organizations and extrapolated to the general population in accord with the equations and assumptions described herein and using primary data from 1992 and 1993. [12,13,37,38] The maximum difference between supply and demand is 8 percent in 2010.

PHYSICIAN DEMAND IN HMOs

While both supply and demand present challenges, demand is the more difficult part of the equation. The data that best measure current physician demand are derived from assessments of physician utilization by group- and staff-model HMOs, [6,12-14,32,33] and they are the focus of this analysis.

Physician Utilization by HMOs

The data used pertain to 1992 and 1993 and were obtained from the Group Health Association of America (GHAA) [33,34] and from Weiner's surveys of HMOs. [12,13] These data are expressed as full-time equivalent (FTE) physicians per 100,000 enrollees. It was assumed that they included the total number of primary care physicians utilized, but that, as cautioned by the GHAA, [34] the number of specialists was understated. To derive the number of FTE specialists, the data were modified in those instances in which an HMO reporting unit failed to report the utilization of any specialists in one of the principal specialties (such as pathology, psychiatry, emergency medicine, and the major subdivisions of internal medicine and surgery), and a value equal to the mean level utilized by those organizations reporting such utilization was added. The result is an estimated utilization of 61 primary care physicians and 81 specialists per 100,000 enrollees, a total of 142 per 100,000, 43 percent of whom are primary care physicians.

Adjustment for Residents.---The total value of 142 per 100,000 enrollees includes HMO staff physicians and non-HMO physicians who provide service through contractual arrangements. However, it does not include residents or fellows. While some HMOs, such as Kaiser-Permanente and the Harvard Community Health Plan, rely on residents, others do not. Nationally, there are 39 residents per 100,000 population. If residents are utilized by HMOs at one tenth that rate, and adjusting for resident work effort, they would add three per 100,000 enrollees to the number of physicians required for HMO enrollees, bringing the total to 145 per 100,000 enrollees, 43 percent of whom are primary care physicians. While this is 20 percent higher than Weiner's earlier estimates, [12,13] it is similar to his recent estimate of 140 per 100,000 enrollees, 40 percent of whom are primary care physicians, jointly developed with the GHAA. [35]

Adjustment for Uncovered Services.---The data reported by HMOs exclude physicians who provide uncovered services out of plan. Weiner has estimated that the volume of these services is equivalent to approximately 10 percent of the services provided through HMOs. [12] That value is assumed herein, and it is assumed that these uncovered services are provided predominantly by specialists. With these adjustments, the number of FTE physicians utilized by HMO enrollees is estimated to be 160 per 100,000 enrollees, of whom 62 are primary care physicians and 98 are specialists, a relative distribution of approximately 40 percent:60 percent. This estimate is somewhat less than the recent estimate of 180 per 100,000, with 43 percent primary care, utilized by enrollees in mature staff-model HMOs in Seattle, Wash, and Minneapolis, Minn. [36]
DERIVING NATIONAL NORMS FROM HMO EXPERIENCES

The process of translating the HMO experience to a measure of the national demand for physicians has two confusing elements. The first confusing element is the term FTE physician. This term describes both a volume of service delivered and an aggregate physician work effort needed to deliver it. Therefore, the number of FTEs required is influenced separately by those factors that affect the demand for services and those that alter the work effort of physicians. Second, physician utilization by HMOs is expressed as FTE physicians per 100 000 enrollees, whereas physician supply is expressed in terms of physicians per capita. There is a critical transition from FTE physician to actual physicians.

Assumptions Concerning the Demand for Physician Services

To generalize the demand for physician services to the entire population, the HMO experience must be adjusted for five factors that affect the utilization of physician services: (1) demographic differences between HMO populations and the general population; (2) added volume of services in non-HMO practices; (3) physician services not normally provided by HMOs; (4) the expanded care that will result from new science and technology; and (5) the added burden of disease associated with an aging population Table 3.

Demographic Factors.--The elderly and the poor, who are not adequately represented in HMOs, require a disproportionate amount of care. Weiner has estimated these increments of service as 0.08 for patient age and 0.04 for socioeconomic factors, and these values were used herein.

Volume of Service.--For purposes of this exercise, physician practices are divided into either staff-and group-model HMOs plus other practices that like them have significant structure and management or less structured non-HMO practices, including networked HMOs, independent practice associations, and both managed and open fee for service. It is assumed that the proportion of patients in HMO practices will increase from 10 percent in 1993 to 30 percent in 2000 and 60 percent in 2020. An adjustment must be made for the greater volume of clinical service than is provided in non-HMO settings. It is assumed that this increment is approximately 5 percent, a value also assumed by Weiner, and that it consists principally of specialty care.

Physicians Services Outside HMO Practices.--Many physicians provide care beyond the normal scope of HMO services. Included are those associated with organizations such as schools, factories, and businesses; those who staff trauma centers, drug and alcohol treatment centers, and public mental hospitals; physicians in preventive medicine and public health; and physicians engaged in services that are not normally covered by health plans, such as cosmetic surgery and psychoanalysis. Based on data from the American Medical Association, the American Osteopathic Association, the American Psychiatric Association, and the American College of Plastic and Reconstructive Surgeons, there are approximately eight per 100 000 population such other physicians. It is assumed that in per capita terms the demand for these physicians will remain constant.

Full-time academic physicians comprise another category, accounting for 10 percent of active physicians. Approximately half of all full-time clinical faculty list teaching or research, rather than patient care, as their major responsibility and, therefore, are excluded from this analysis. While some care for patients, it is assumed that the patient care they engage in, which is not accounted for herein, is offset by the decreased contribution to patient care of full-time faculty members who are counted among the patient care physicians but who practice at a reduced level, and no further adjustment has been made.

Science and Technology.--A major impetus for the increase of physician services has been the development of new diagnostic and therapeutic modalities. This increase is likely to continue as science and technology progress in the future. While significant effort will be expended to contain medical spending, it is assumed that much of that effort will be directed at reducing the level of payment for services rather than at simply reducing the volume of beneficial services offered. Indeed, pressure is mounting to ensure that the fruits of medical science are available to all who need them. Although vast increases in services are unlikely, it also seems unlikely that the demand for specialty care will decrease, as projected by the BHPY, or even remain frozen, as projected by COGME.

During the past 25 years, the utilization of physician services increased at a rate of approximately 2.0 physicians per 100 000 population per year, although physician supply increased more rapidly. In projecting the requirement for physicians in the future, it is assumed that technology will continue to fuel the demand for physician services from the baseline established by managed care, but at only one fourth the previous rate, decreasing further after 2010.

Aging.--By 2020, the number of persons older than 75 years will increase by 56 percent, and the number older than 85 years will double. Physician services are used disproportionately by the elderly, both in relation to chronic illness and to terminal disease. The former accounts for more than 70 percent of the services used by Medicare
At current rates of usage, the expanding elderly population will increase the demand for physician services by approximately 1.4 percent between 1993 and 2000, 3.6 percent by 2010, and 10.5 percent by 2020. Assuming a somewhat healthier elderly population in the future, these estimates have been reduced by one third during the next 15 years and one half thereafter.

A second aspect of aging concerns increasing life expectancy and the corresponding effects on death rates. A characteristic of a population with an increasing life expectancy is the phenomenon of deferred death. As annual increases in life expectancy become smaller, the number of deaths per capita actually increases, and this has begun to occur already. There will be a 7 percent increase in death rate by 2020, and it will rise steeply thereafter, before receding and stabilizing later in the 21st century. [25] Physician services are disproportionately associated with end-of-life illnesses. [40] It is estimated that, as compared with 1993, this increase in death rate will result in a 1.2 percent increase in the demand for physician services in the year 2000, increasing to 1.6 percent in 2010 and 2.4 percent in 2020.

Adjusting for Service Demand.--To adjust for these various factors affecting the demand for physicians, a formula was followed in which the volume of service received by HMO enrollees was denoted as /FTE/s, the percentage increases in service necessary to generalize this experience to the entire population over time were denoted as S, and the fraction of the population affected was denoted as Po. The total service demand that results was denoted as t/FTE/s:

\[
(1) \quad t/FTE/s = /FTE/s (1 + [S1 \times Po1] + [S2 \times Po2]...)
\]

The starting point in this Equation is the number of FTE physicians utilized by HMO enrollees. As presented herein, the quantity of physician services (/FTE/s) utilized by HMO enrollees is 160 per 100 000. Applying the various service adjustments to this number yields a generalized value of 194 per 100 000. This value is the total quantity of physician services, expressed as FTE physicians per capita, that is necessary to meet the current needs of the entire population.

Assumptions Concerning Physician Work Effort

Physician Age.--The physician workforce is aging, as the expanded cohorts of medical graduates of the 1970s and 1980s age and equilibrium is reached. Currently, 22 percent of practicing physicians are older than 55 years. [37,38] This number will increase to 31 percent in 2010 and 38 percent in 2020. Physicians aged 55 years and older practice 12 percent less than those younger than 55 years. [41,42] In terms of FTE physicians, these projections have the effect of reducing the physician workforce by approximately 2.6 percent in 1993 and by 4.6 percent in 2020. In addition, anecdotal evidence suggests that physicians are retiring earlier. [44]

Sex.--In 1993, 19 percent of practicing physicians were women. [37,38] By 2020, women will account for 35 percent of physicians, and the percentage will continue to increase. During the past decade, the work effort of women physicians has been approximately 15 percent less than that of men, and the differential widens among older physicians. [17,42,45] These factors have the effect of reducing the physician workforce by 2.8 percent in 1993 and by 5.6 percent in 2020.

Lifestyle.--The lifestyle and expectations of physicians are continuing to change. Younger physicians are seeking better balance between their personal and professional lives, [46] and most physicians are frustrated by schedules that are too crowded to allow for the "time, sympathy, and understanding" that Peabody taught "must be lavishly dispensed." [47] In part to accommodate lifestyle preferences, many physicians are changing their status from self-employed to employed. On average, employed physicians, particularly those in large groups, work fewer hours per week, have fewer patient contacts per week, and work fewer weeks per year than self-employed physicians practicing alone or in small groups. [41,43] The looming abundance of physicians and other clinicians offers opportunities to choose a less crowded work schedule. Indeed, the 15 percent decrease in patient visits during the past 15 years [9,41,43] may reflect an adjustment made possible by the increase in physician supply during that period. It is likely that physician work effort and the intensity of practice will continue to decrease, and in addition to the decreases anticipated because of age and sex, a decrease of 5 percent because of lifestyle is assumed during the next 25 years.
Adjusting for Physician Work Effort.-- These effects of age, sex, and lifestyle on work effort influence the number of actual physicians who are needed to accomplish the aggregate service (t/FTE/s) that is demanded. However, before adjusting for work effort, a tangible standard of actual physicians must be established against which the abstract notion of physician FTEs can be measured. Therefore, it is assumed that the volume of service (/FTE/s) of one HMO FTE physician is equivalent to the work effort of one actual, full-time, non-HMO physician. To adjust for effects of age, sex, and lifestyle, the percentage decrement in work effort due to each factor was expressed as a positive number denoted as dW, and the fraction of physicians affected was denoted as Ph. The demand for actual physicians was calculated as follows:

\[
\text{(2) Actual Physicians} = \frac{t}{FTE/s} \\
(1.0 + [dW1 \times Ph1] + [dW2 \times Ph2]...) 
\]

From Equation 2, the estimated number of actual physicians (with varying work effort) required in 1993 is 205 per 100 000 population. This number is projected to increase progressively to 241 per 100 000 population in 2020 Figure 1, Table 2. Approximately half of this increase relates to growth in the volume of beneficial services (t/FTE/s) Equation 1 and half to anticipated decreases in physician work effort Equation 2 Table 3. These estimates of the demand for physicians are national norms. They are expressed in the same terms as the measure of physician supply--actual physicians-- and these measures can be compared directly, now and in the future.

Comparing the projections of demand with the earlier projections of physician supply reveals a surplus of approximately 8000 physicians (1.4 percent of patient care physicians) in 1993 Table 2, Figure 1. This surplus will increase to 31 000 (4.9 percent) in the year 2000 and 62 000 (8.1 percent) in 2010. This period represents the turn-of-the-century “bulge” in physician supply. After 2010 the difference between supply and demand will narrow, and by 2020 demand is projected to exceed supply by approximately 13 000 physicians (1.6 percent).

Limitations of Supply and Demand Projections

There are many limitations associated with this exercise. First among them is the fact that the 5 percent to 8 percent differences between supply and demand that have been estimated during the next 25 years are small and within the range of error of many of the assumptions and approximations that underlie them. Moreover, these assumptions are not static. They will change over time, and as they do, new projections will be possible using the template presented herein.

Supply.--Supply estimates are limited by predictions concerning the future number of USMGs and IMGs, as well as the future size of the US population. From 2010 to 2020, the former is associated with errors of plus/minus 5 percent to plus/minus 8 percent, and the latter is associated with errors of plus/minus 5 percent to plus/minus 8 percent, and the latter is associated with errors of plus/minus 5 percent to plus/minus 8 percent, and the latter is associated with errors of plus/minus 5 percent to plus/minus 8 percent, and the latter is associated with errors of plus/minus 5 percent to plus/minus 8 percent.

Service Demand.--Estimates of service demand are associated with three broad areas of uncertainty. First are those associated with science and technology. What will be possible in the future and what among those possibilities will society purchase? Second are the uncertainties inherent in the HMO data. These include the reporting error of physician utilization and the lack of information on resident utilization. In addition, some HMOs may not have reached their maximum levels of efficiency in the ways they utilize physicians, restrict service, and incorporate NPCs into their practices. Finally, the HMO data are not entirely representative of the nation as a whole, since they are drawn disproportionately from those states that have a high degree of HMO penetration, such as California, Massachusetts, Maryland, and Minnesota, each of which has a physician-to-population ratio that is greater than the national average. Therefore, the national norms that evolved from this analysis are likely to apply most directly to environments in which there is an abundance of physicians.

Work Effort.--Unlike some other labor markets where surpluses lead to unemployment, the elasticity of physician work effort tends to reduce the general level of effort among physicians, masking true surpluses. The magnitude of this elasticity is unknown. Questions persist concerning how physicians will change their work effort to accommodate their own lifestyle preferences and to compensate for physician surpluses in their communities.

Comparison With Previous Studies

GMENAC projected a surplus of 145 000 physicians in the year 2000, [1] Weiner projected a surplus of 165 000, [12] the BHPr projected 73 000, [14] and COGME projected 80 000 [11] Table 1. This study projects a surplus of 31 000 physicians. The range of difference of 134 000 physicians appears to have resulted from six differences in analysis and interpretation.
Physician Work Effort.--This study assumes that the practice output of one HMO FTE physician is equivalent to the output of one actual, full-time, non-HMO physician. It also assumes that not all physicians work to this capacity and, therefore, that more actual physicians are needed than the number of FTEs they create. Weiner approached this differently. [12, 13] He noted that employed physicians (eg, HMO physicians) spend 15 percent fewer hours engaged in patient care than do self-employed physicians (eg, non-HMO), [41] and he reasoned that for an equal amount of work 15 percent fewer non-HMO physicians would suffice, thereby reducing the necessary number of physicians by 25 000. [12] However, although they work fewer hours, the practice outputs of full-time HMO and non-HMO physicians are similar. [14, 41] Therefore, the current study made no such adjustment, nor did the BHP. [14]

However, another adjustment for work effort is important. It recognizes that not all physicians in or out of HMOs work full-time. Indeed, HMOs utilize more physicians than the number of FTEs they require. The current study identifies a number of factors (age, sex, and lifestyle) that have been operative for many years [9, 41-43] and that reduce the work effort of physicians to fewer than one FTE physician. It adjusts for these factors by means of positive values in Equation 2, increasing the number of actual physicians necessary to accomplish the task. Neither Weiner nor the BHP made this adjustment, accounting for 33 000 of their estimated surpluses. GMENAC could not have anticipated the reduction in work effort that occurred during the 15 years after their report. [9, 41-43] However, it accounts for almost half of GMENAC's projected physician surplus in the year 2000.

Underreporting.--To account for possible underreporting of physician utilization by HMOs and for the additional services utilized by patients in non-HMO practices, the BHP increased the estimates it derived from HMOs by 25 percent. Weiner chose not to adjust for either of these factors. [12] However, in his recent paper with the GHAA, Weiner increased his estimate of physician utilization by HMOs from 120 per 100 000 enrollees [12] to 140 per 100 000. [35] Using this more recent figure (which is slightly lower than the 145 per 100 000 estimate used herein) and adjusting it for out-of-plan services and for the extra services provided in non-HMO settings [12] accounts for 66 000 of his estimated surplus of 165 000.

Other Physicians.--Neither Weiner nor the BHP included the 20 000 other patient care physicians whose purview of care is outside the spectrum of care provided by most HMOs.

Increased Demand for Beneficial Services Over Time.--Neither Weiner nor the BHP accounted for the increased demand for physician services that this study projected would occur between 1993 and the year 2000 because of advances in science and technology and the added burden of disease among the elderly. This underestimated demand by 15 000 physicians.

Population.--In projecting physician demand, both Weiner and the BHP used current population estimates for the year 2000. [12, 14] However, older Census Bureau estimates were used by COGME [11, 23] and GMENAC. [1, 26] Indeed, the 1977 estimates [26] used by GMENAC projected a population in the year 2000 that is almost 20 million less than current estimates. [25] These underestimations of the population resulted in overestimations of physician surpluses in the year 2000 of 20 000 by COGME and 33 000 by GMENAC.

Residents.--Finally, neither Weiner nor the BHP considered residents and fellows, who comprise 18 percent of all patient care physicians. [12, 14] While excluding them from both the supply and demand projections would seem to maintain balance, it fails to do so because of the sharp decrease that is projected in the number of residents per capita during the coming years. While this has only a small effect on year 2000 projections, it overstates the supply projections for 2020 by approximately 30 000 physicians.

Taken together, these various differences account for 159 000 of Weiner's projected surplus of 165 000 physicians in the year 2000, [14] 68 000 of the 73 000 projected by the BHP, [14] and 103 000 of the 145 000 projected by GMENAC. The population correction alone accounts for 20 000 of COGME's projected surplus of 80 000. The residual surpluses are not materially different from the projected surplus of 31 000 physicians derived herein Table 1.

It is principally from analyses of HMO experiences that the notion of a vast physician surplus was derived. [6, 12-14, 32, 33] However, on reexamination, these data provide no support for an impending national surplus of the magnitude projected previously. This conclusion is consistent with the conclusion reached by Kletke who, applying Weiner's methods [12] to the physician workforce in 1992, calculated that there would have been a surplus of 88 000 physicians (15 percent of patient care physicians), a phenomenon that was not apparent at the time. [48]

TRANSLATING NATIONAL NORMS TO LOCAL CIRCUMSTANCES

The considerations of physician workforce requirements described thus far view the nation as a whole. However, physician distribution in the United States is heterogeneous. For example, while in 1993 the overall physician-to-population ratio was 208 per 100 000, metropolitan areas had an average ratio of 226 per 100 000 and
nonmetropolitan areas had an average ratio of 118 per 100,000. [26,37,38] Fourteen percent of Americans live within health professions shortage areas, with ratios of primary care physicians to population of 30 per 100,000 or less, [3] and 0.2 percent live in counties with no physicians at all. [37] However, these small area differences may be less extreme than they appear, since patients living in areas of sparse physician supply often receive significant amounts of care from physicians in nearby areas of greater abundance.

A picture of macroheterogeneity develops when the physician-to-population ratios of the 50 states are compared, using data from 1993. [22,25,37,38] Five regions naturally emerge Figure 2.

![Figure 2](image_url)

Figure 2. Geographic regions of physician supply. Data are segregated into regions according to levels of physician supply per 100,000 population. Boston-Washington corridor, 227 to 294 per 100,000; East and West arms (and Florida), 190 to 212 per 100,000; Central zone, 147 to 181 per 100,000; Northern Rockies and Alaska, 132 to 143 per 100,000; and Mississippi, 118 per 100,000.

The Boston-Washington corridor has 21 percent of the population but 28 percent of the physicians and an average ratio of 270 per 100,000. Compared with the rest of the nation on a per capita basis, it has 35 percent more practicing physicians and more than double the number of residents.

The region referred to as the East and West arms includes one arm that stretches from the Mid Atlantic and North Atlantic into the Midwest and a second that stretches through a number of the western states. Florida, with a similar ratio, also is included. Collectively, this region encompasses 46 percent of the population and has 46 percent of the physicians. Its average ratio of 204 per 100,000 approximates the national norm. While overall this region is average for America, it includes communities with a significant overabundance of patient care physicians, such as San Francisco, Calif., with 394 per 100,000.

The vast Central zone has a ratio of 165 per 100,000. It extends from the Southeast through the central plains, reaching south to Texas and north to the Dakotas. It includes almost 40 percent of the land mass of the United States, but only 31 percent of the population and 25 percent of the physicians. Based on a national norm for demand of 205 per 100,000, there appear to be opportunities for physicians in this region.

A region including the Northern Rockies and Alaska encompasses 25 percent of the land mass of the United States but has only 1 percent of the population. It is served by 4000 practicing physicians and 80 residents, creating a ratio of 135 per 100,000. This region is of special interest because of its large area and its paucity of physicians. It compensates in part by having a large number of NPCs (R. A. Cooper and S. J. Stoflet, unpublished data, 1995). [49]

Finally, there is Mississippi, with 1 percent of the population and a ratio of 118 per 100,000. It has the lowest number of both physicians and NPCs in the nation (R. A. Cooper and S. J. Stoflet, unpublished data, 1995). [37,38,49]
Several insights flow from this analysis. First, there are marked differences in physician supply among the various states and among the various regions, but there are similarities between contiguous states and between contiguous regions. This finding suggests that there are factors at a macrogeographic level that influence how physicians choose practice locations and how communities accommodate to the resulting number of physicians. Yet, despite this range of variation, much of the nation is at or near the national norm, and 85 percent of the population live in states that are within plus/minus 25 percent of the norm. To the extent that physicians continue to move to smaller communities, as they have been doing for the past 15 years, [50,51] it is likely that a greater degree of homogeneity will occur throughout the nation. Moreover, it seems clear that they will have to do so if they wish to practice with reasonable panels of patients. The dynamics of this process will be critical in determining the balance between supply and demand. Two extreme circumstances warrant further comment.

One is the Boston-Washington corridor and those communities elsewhere that, like it, have large numbers of physicians. The manner in which they cope with their surpluses will have an important effect on the national balance. This corridor alone accounts for the entire surplus that has been projected nationally during the next 15 years. To bring this region to the national norm would require a decrease of 25,000 practicing physicians (20 percent of physicians) and 16,000 residents (40 percent of residents). The dislocations involved would be severe. Alternatively, it is possible that the health care systems in this region will equilibrate at levels higher than the norm, simply because physicians are so readily available. However, it is unlikely that in the near term this region could absorb more physicians per capita than now exist.

The other extreme involves areas of the country that now have fewer than 160 physicians per 100,000 population (they average 148 per 100,000). However, because their population is so small, these areas do not have a major influence on the national balance. For example, while it would take an increase of 25 percent to 40 percent in the number of physicians by today’s standards to bring them to the norm, this increase accounts for only 13,000 physicians (2 percent of patient care physicians). Similarly, the health professions shortage areas collectively require only 5,000 physicians to bring them to minimum standards. [3] Thus, while from a social perspective it is important to address these areas of need, the manner in which this occurs will not have a significant effect on future physician surpluses or deficits.

NONPHYSICIAN CLINICIANS

Nonphysician clinicians are playing an increasing role in patient care. As a result, physicians no longer are seen as the sole providers of what is referred to herein as physician services. For example, while the Millis Commission on Graduate Medical Education declared in 1966 that “the primary physician will serve as the primary medical resource,” [52] a recent report from the Institute of Medicine states that the providers of primary care will be clinicians “who use a recognized scientific knowledge base” and who have the “authority to direct the delivery of personal health services to patients.” [53] Many professionals fit this definition, particularly when it is defined in their own terms.

There are three broad categories of NPCs whose scope of independent practice overlaps that of physicians Table 4: (1) APNs and PAs; (2) other traditional clinicians, including certified nurse anesthetists and midwives, psychologists, podiatrists, and optometrists; and (3) alternative clinicians, including chiropractors, naturopaths, and practitioners of oriental medicine. The number of states in which they are licensed or registered is increasing, as are their independent practice prerogatives, and an increasing number of states have mandated their access to reimbursement (R.A. Cooper and S.J. Stoflet, unpublished data, 1995). [49,54-56] HMOs utilize them extensively. While there is variation among plans [12,34] and significant variation among states, [49] the level of participation by APNs and PAs is approximately 30 per 100,000 enrollees (range, 0 to 67), and there is a similar level of involvement of other traditional NPCs. In addition, some HMOs are contracting with or employing alternative NPCs. [57] The projections of physician demand presented herein are based on the assumption that adequate numbers of NPCs will be available to aid physicians in delivering clinical services. Indeed, many more will be available to provide those services, and much of that service, particularly in primary care, will be provided independently.
Table 4. Nonphysician Clinicians, 1995-2010

<table>
<thead>
<tr>
<th>Type of Clinician</th>
<th>1995</th>
<th>2010</th>
<th>Increase 1995-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nurses and physician assistants</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advance practice nurses (APNs)*</td>
<td>39 000</td>
<td>102 000</td>
<td>63 000</td>
</tr>
<tr>
<td>Physician assistants (PAs)</td>
<td>27 000</td>
<td>75 000</td>
<td>48 000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>66 000</td>
<td>177 000</td>
<td>111 000</td>
</tr>
<tr>
<td><strong>APNs and PAs/100 000 population</strong></td>
<td>25</td>
<td>57</td>
<td>32</td>
</tr>
<tr>
<td><strong>Physician equivalents/100 000 population</strong></td>
<td>12</td>
<td>28</td>
<td>16</td>
</tr>
<tr>
<td><strong>Other traditional clinicians</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical and counseling psychologists</td>
<td>37 000</td>
<td>52 000</td>
<td>15 000</td>
</tr>
<tr>
<td>Certified nurse anesthetists</td>
<td>17 000</td>
<td>20 000</td>
<td>3 000</td>
</tr>
<tr>
<td>Certified nurse midwives</td>
<td>2500</td>
<td>5500</td>
<td>3000</td>
</tr>
<tr>
<td>Podiatrists</td>
<td>14 000</td>
<td>18 200</td>
<td>4 200</td>
</tr>
<tr>
<td>Optometrists</td>
<td>28 000</td>
<td>38 000</td>
<td>10 000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>98 500</td>
<td>133 700</td>
<td>35 200</td>
</tr>
<tr>
<td><strong>Traditional clinicians/100 000 population</strong></td>
<td>37</td>
<td>43</td>
<td>6</td>
</tr>
<tr>
<td><strong>Physician equivalents/100 000 population</strong></td>
<td>24</td>
<td>28</td>
<td>4</td>
</tr>
<tr>
<td><strong>Alternative clinicians</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chiropractors</td>
<td>50 000</td>
<td>102 900</td>
<td>52 900</td>
</tr>
<tr>
<td>Oriental medicine practitioners$</td>
<td>7200</td>
<td>24 000</td>
<td>16 800</td>
</tr>
<tr>
<td>Naturopaths</td>
<td>1800</td>
<td>5100</td>
<td>3300</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>59 000</td>
<td>132 000</td>
<td>73 000</td>
</tr>
<tr>
<td><strong>Alternative clinicians/100 000 population</strong></td>
<td>23</td>
<td>43</td>
<td>20</td>
</tr>
<tr>
<td><strong>Physician equivalents/100 000 population</strong></td>
<td>15</td>
<td>28</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total nonphysician clinicians</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total No.</strong></td>
<td>223 500</td>
<td>442 700</td>
<td>219 200</td>
</tr>
<tr>
<td><strong>Physician equivalents</strong></td>
<td>135 400</td>
<td>261 200</td>
<td>125 800</td>
</tr>
<tr>
<td><strong>Nonphysician clinicians/100 000 population</strong></td>
<td>85</td>
<td>143</td>
<td>58</td>
</tr>
<tr>
<td><strong>Physician equivalents/100 000 population</strong></td>
<td>51</td>
<td>84</td>
<td>33</td>
</tr>
</tbody>
</table>

*Includes nurse practitioners and certified nurse specialists.
[Physician-equivalent productivity equal to 0.65 physician productivity.]
§Includes acupuncture and herbal medicine.

**APNs and PAs**

In 1994, there were 66 000 active APNs and PAs (25 per 100 000 population). [58-61] They varied in number among the states from six to 56 per 100 000 population in proportion to the professional prerogatives granted to them by each state. [49] Based on recent and planned expansions of training programs, the number of APNs and PAs is projected to increase to 177 000 (57 per 100 000 population) by 2010, [62] double the number necessary to satisfy the current staffing needs in HMOs. Assuming that each APN and PA is equivalent to 0.5 FTE physician, [58] this increase is equivalent to 16 physicians per 100 000 population.

**Other Traditional NPCs**

For many years, physicians have shared the responsibility for patients with a number of other independent clinicians. In 1994, there were 37 000 clinical and counseling psychologists. [63] At current levels of training, this number can be projected to increase 40 percent to 50 percent by 2010, [63] and there are likely to be additional psychiatric social workers, psychiatric nurse specialists, and other counselors and therapists. The number of podiatrists and optometrists also is increasing. [61] The number of certified nurse anesthetists (seven per 100 000 population) is similar to the number of practicing anesthesiologists, [37,38,58] and there are almost three per 100 000 certified nurse midwives. [49] Collectively, there were 98 500 traditional NPCs within these categories in 1994, and this number is projected to increase to 133 700 in 2010 Table 4. Assuming that each of these clinicians represents 0.65 physician equivalent, their combined growth during the next 15 years is equal to approximately four physicians per 100 000 population.

**Alternative NPCs**

Collectively, there were 98 500 traditional NPCs within these categories in 1994, and this number is projected to increase to 133 700 in 2010 Table 4. Assuming that each of these clinicians represents 0.65 physician equivalent, their combined growth during the next 15 years is equal to approximately four physicians per 100 000 population.
In 1994, there were 59,000 chiropractors, naturopaths, and practitioners of oriental medicine (23 per 100,000 population) (R. A. Cooper and S. J. Stoflet, unpublished data, 1995). Their spectrum of independent practice overlaps part of the spectrum of primary care practice, and their training programs are directed to meeting this need. Both their professional prerogatives and their access to reimbursement vary among states, but both are increasing. [54-57] and acceptance among patients is broad. [64] Chiropractors currently are licensed in all 50 states, whereas practitioners of oriental medicine (acupuncture and herbal medicine) are licensed or registered in 26 states and naturopaths in 10. [54-56] A survey of existing colleges indicates that the number and size of the programs in these three disciplines have expanded considerably during the past few years, and more expansion is planned (R. A. Cooper and S. J. Stoflet, unpublished data, 1995). As a result, the number of alternative NPCs is projected to increase more than twofold to 132,000 (43 per 100,000) by 2010. If these clinicians are considered to be equal to 0.65 FTE physician, the increase in their numbers between 1995 and 2010 would represent 13 physician equivalents per 100,000 population.

Increase in NPC Supply

In the aggregate, the three categories of NPCs considered herein will double in number between 1994 and 2010, from 223,500 (85 per 100,000 population) to approximately 442,700 (143 per 100,000 population) Table 4, Figure 3. They will increase from a level equal to 40 percent of the number of patient care physicians in 1994 to almost 60 percent in 2010. When assessed in terms of physician equivalent effort, the number of NPCs will increase from 51 per 100,000 in 1994, a level equal to 25 percent of patient care physicians, to 84 per 100,000 in 2010, which is equal to 34 percent of the physician workforce in 2010 Figure 3. The incremental increase of NPCs between 1994 and 2010, expressed as physician equivalents, is 33 per 100,000, which is identical to the increment of physician supply that is projected during the same period Figure 1 and Figure 3. While the data on NPCs are not as complete and reliable as the data on physicians, the order of magnitude of the projected growth in their numbers is likely to be correct, and it is large in proportion to any estimate of future physician surpluses. Moreover, there does not appear to be the capacity to absorb both the increased numbers of physicians that have been projected and a parallel workforce of NPCs of this magnitude. This phenomenon deserves intense examination and public debate.

CONCLUSION

There is no other profession for which more planning effort has been expended to achieve a workforce of appropriate size, nor one for which such a high degree of accuracy is sought. There are many reasons for this. First is the strong desire to have enough physicians. Undersupply was a national problem extending from the 1940s to the 1980s in many metropolitan areas, and underserved regions persist today, despite the current abundance of physicians. Oversupply raises a different set of concerns. One is the large expense involved in preparing individuals to be physicians—an expense borne both by medical students and by society. A second reason is the perception that an excessive number of physicians leads to an excessive amount of spending. [65] Achieving balance between supply and demand is a high priority. The exercise conducted herein leads to four general conclusions.
First, national norms for physician demand can be derived from analyses of HMO experiences. In 1993, that norm was 205 physicians per 100,000 population. It will increase to 241 per 100,000 in 2020, an overall increase of 18 percent during 27 years. Half of that growth will be due to an increased demand for beneficial services and half to a decrease in physician work effort.

Second, expressed in per capita terms, physician supply will increase more rapidly than these national norms of physician demand during the next 15 years, but the gap will narrow thereafter. The result will be a turn-of-the-century bulge in physician supply that, at its maximum in 2010, will be equivalent to approximately 8 percent of the total physician workforce (62,000 patient care physicians).

Third, from a geographic perspective, physician supply currently varies by more than twofold among the states. Compared with the national norm, large surpluses of physicians already exist in some regions and shortages in others. The extent to which each of these regions moves toward the national norm will significantly affect the balance of supply and demand in the future.

Fourth, NPCs add still another dimension. When measured as physician equivalents, the growth in the supply of NPCs during the next 15 years will equal the growth in physician supply. Most will be engaged in primary care. An important factor in determining the demand for physicians will be the degree to which patients utilize these other clinicians to provide services that traditionally have been within the province of physicians.

Thus, on a national scale, a small surplus of physicians exists, and this surplus is likely to be of modest size during the next 15 years, after which it will recede. The major surpluses are local and regional. It is unlikely that national policy will solve these local problems; rather, they will need local solutions. However, the projected national surpluses are small in proportion to the very large growth that is projected in the number of the NPCs who will have increasing authority to deliver personal health services. Policy is needed that encompasses the universe of clinicians who will be offering services to patients in the next century. While the size of any physician surpluses in the future will depend to a large extent on how physicians distribute themselves throughout the United States and how intensively they practice, ultimately it will depend on how the responsibility for patients is divided among licensed clinicians and what our society will want physicians to do.

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