An Outcomes-Based Approach To The Question of Physician Workforce Diversification As A Means Of Eliminating Disparities

Omar M. Rashid, M.D, J.D.; Ali M. Rashid, M.S., M.D; Philip M. DeChavez M.D., M.P.H.

Abstract

Introduction. Physician workforce diversification provides a means of eliminating ethnic disparities in health care education and delivery. Latino and African-American physicians are more likely to provide care to underserved populations than Caucasian-American physicians. Furthermore, ethnicity provides a proxy for cultural and linguistic competency. A diverse Medical student population and a diverse physician workforce can therefore improve the capacity for Medical education institutions to teach these skills and health care delivery systems to improve the quality of care.

Methods. This study characterized the pipeline from kindergarten to residency for these ethnic groups, and proposed a mechanism for evaluating the outcomes of efforts to improve physician workforce diversity. It was hypothesized that Latinos and African-Americans were underrepresented at all points of the pipeline. The study was performed by calculating flow or transition frequencies and the volume or cohort progress across the six stages of the pipeline for each ethnic group.

Results and Conclusions. The results supported the hypothesis and provided flow-based, volume-based and time-based mechanisms for evaluating the outcomes of physician workforce diversification efforts. Further research is recommended to improve rates of Latinos and African-Americans pursuing and obtaining College and Medical education, to further examine the effectiveness of MCAT scores to predict Medical school performance, and to further establish the compelling interest for Medical schools to improve these outcomes. In addition, multiple strategies, in conjunction with physician workforce diversification, are recommended to eliminate the growing disparities in health care.

Introduction

Although there have been unprecedented increases in the ethnic diversity of the U.S. population, the composition of the physician workforce has failed to keep pace. Latinos compose 13% of the U.S. population and African-Americans compose 12.7% of the U.S.
population, but only 3.3% and 2.4% of physicians are Latino and African-American, respectively. By the year 2050, the Census Bureau projects that there will be no ethnic group that constitutes a majority. By that year, Latinos will constitute 25% of the entire U.S. population, while the size of the overall U.S. population will also continue to grow. In addition, a 2003 study on economic and demographic trends predicts that the demand for physician services will grow more rapidly than the supply, resulting in a shortfall of 200,000 needed physicians by the year 2025. However, today disparities already exist in health care based upon race, culture, ethnicity, gender, socioeconomic status and language.

Latinos and African-Americans are more likely to suffer from preventable diseases than Caucasian-Americans. Furthermore, Latinos and African-Americans are less likely to gain access to health care that is culturally appropriate and that produces a healthy outcome in comparison to Caucasian-Americans, even when controlled for class and health insurance. In addition, Latinos are less likely to receive linguistically appropriate services. Unfortunately, these disparities often persist even when controlling for the pathology of the disease process, socioeconomic class, access to health care and geography.

These disparities are not limited to one field of medicine alone, but instead systemically pervade all areas of medicine. For example, studies on colorectal cancer treatment, lower extremity amputation and even solid organ transplantation document cultural disparities in access, treatment and outcomes. Furthermore, as the studies

---

1 Census Bureau estimates and projections. [http://www.census.gov/](http://www.census.gov/)

2 2004 Sullivan Commission Report, funded by the Kellogg Foundation, administered by Duke University School of Medicine

3 Cooper, R. Medical Schools And Their Applicants: An Analysis. Health Affairs 2003


8 The Federal Department of Health and Human Services Advisory Committee on Organ Transplantation acknowledged in a May 2004 meeting that cultural disparities persist in solid organ transplantation, e.g. minorities wait twice as long as Whites for organs. ([HHS website](http://www.organdonor.gov/acot5-04.htm))
indicate, these disparities in the surgical treatment of disease often are the concomitant result of disparities taking place during the prevention, screening and referral portions of the health care process. In the area of prevention and risk modification, such as in diabetes and heart disease, the effectiveness of patient counseling can also be limited by the capacity to provide culturally and linguistically appropriate services.

For several reasons, these systemic disparities do not affect minorities alone. First, the communicability of disease extends the health risks of these cultural disparities to the entire population, following the principles of public health. For example, the outbreak of an epidemic in one community has the potential to spread to other communities, such that certain so-called Latino health problems have the potential to affect several, or even all subpopulations.

Second, the interrelated nature of health financing institutions also spreads the costs of the inefficiency produced by these disparities onto the entire system and all those who pay for health care services. In fact, third-party payers, such as Verizon and Aetna, have been calling on health care providers to eliminate the disparities in the quality of health outcomes that are being provided to the patients who are also employees and consumers of health insurance. Third, the consequent inefficiencies of lost economic productivity due to preventable illness limit the growth of the economy and economic opportunities for all.

Finally, disparities in health care outcomes along sociologically constructed lines, rather than based on science, undermine public confidence in medicine as a science and raise fears of other possible systemic failures to appropriately apply scientific knowledge when delivering care. However, research is needed to understand potential scientific differences among populations in therapeutic and preventative interventions, as well as pathophysiology, as with the use of angiotensin converting enzyme inhibitors for antihypertensive therapy in Caucasian-Americans versus African-Americans, by including diverse populations in clinical studies.

An important element of a health care provider’s effort to eliminate these disparities includes providing culturally and linguistically competent care, which is mandated by federal law. The Department of Health and Human Services’
recommendations on how to comply with Title VI of the Civil Rights Act in health care delivery provide the following definitions:

“Culture: The thoughts, communications, actions, customs, beliefs, values and institutions of racial, ethnic, religious or social groups. Culture defines how health care information is received, how rights and protections are exercised, what is considered to be a health problem, how symptoms and concerns about the problem are expressed, who should provide treatment for the problem, and what type of treatment should be given. In sum, because health care is a cultural construct, arising from beliefs about the nature of disease and the human body, cultural issues are actually central in the delivery of health services treatment and preventive interventions. By understanding, valuing, and incorporating the cultural differences of America’s diverse population and examining one’s own health-related values and beliefs, a health care system responds appropriately to, and directly serves the unique needs of populations whose cultures may be different from the prevailing culture. Cultural and linguistic competence is a set of congruent behaviors, attitudes, and policies that come together in a system, agency, or among professionals that enables effective work in cross-cultural situations. Culture refers to integrated patterns of human behavior that include the language, thoughts, communications, actions, customs, beliefs, values, and institutions of racial, ethnic, religious, or social groups. Competence implies having the capacity to function effectively as an individual and an organization within the context of the cultural beliefs, behaviors, and needs presented by consumers and their communities."

Because of the fundamental centrality of culture to health care, cultural and linguistic competency comes into play at various points in the physician-patient interaction and throughout the medical decision making process.

A 2000 article on trust in the physician-patient relationship warns that the unexplained documentation of the variation of surgical procedure rates by race has called into question the factors that lead to “disparate operative indications,” eroding patient trust for surgeons. The article encourages “acts of compassion, effective, open communication and conducting patient-focused outcome research” to address these issues and improve patient trust for surgeons. However, it is difficult to accomplish this objective if the physician does not speak the patient’s language and does not understand the patient’s cultural construct of health. In addition, the combination of historic distrust

---

9 This portion HHS cites to Katz, Michael. Personal communication, November 1998.

10 This portion HHS cites to Based on Cross, T., Bazron, B.m Dennis, K., & Isaacs, M., (1989). Towards A Culturally Competent System of Care Volume I. Washington, DC: Georgetown University Child Development Center, CASSP Technical Assistance Center.

among minority patients for physicians and of documented physician bias/prejudice further complicates the issue of establishing trust in the patient-doctor relationship.12

In addition to establishing trust between physicians and patients, disparities also can emanate from several other points in the patient-physician interaction. For example, a 2000 article explored at least 8 major points where racial disparities in cardiac invasive procedures can occur.13 Race, culture and language, as well as both physician and patient attitudes related to them, can shape whether a patient recognizes the symptoms of heart disease, whether a patient has access to providers, how a patient presents and how physicians perceive that presentation, what initial recommendations the physician makes and whether the patient accepts those recommendations, and finally whether a referral will be made for further noninvasive, followed by invasive diagnostic tests as well as therapeutic interventions. These points illustrate examples of where knowledge of culture and language, development of trust, bias (conscious and unconscious) as well as compounding disparities in education, socioeconomic status, geography and supply of up-to-date physicians, have the highest probability of convergence to create disparities. However, the interpersonal nature of all health care encounters extends the possibility of creating these disparities beyond the eight points to virtually all corners of the medical universe.

There are at least three ways in which Latino and African-American physicians can eliminate racial and cultural disparities in medicine. First, Latino and African-American

12 For more information on the sources of the historic distrust among minority patients for physicians, consider the literature of unethical science that includes:
2. The use of birth and population control measures on Puerto Rican women (“The Grand Experiment” of the 1930’s, http://www.freerepublic.com/forum/a3926ba0b3bfa.htm)
3. The Yellow Fever study during the U.S. occupation of Cuba (Guerra-Burgueno, F. The Centennial of the Yellow Fever Commission and the Use of Informed Consent in Medical Research. Salud Publica de Mexico 2002)
4. The harvesting of anatomy course cadavers from the cemeteries of African-American churches (Dr. Daniel Schmitt introduction to Gross Anatomy, Duke University School of Medicine 2001.)

For more information on physician bias/prejudice, consider the following articles by Schulman, K.A., et al.:

physicians are more likely to practice in underserved areas and to have higher proportions of Latino and African-American patients, respectively, than other physicians. Second, Latino and African-American physicians are more likely to understand the culture and language of Latino and African-American patients, respectively, and thus are more able to provide culturally and linguistically appropriate care, with higher patient satisfaction, than other physicians.

However, this point raises several questions. First, how much cultural convergence is required to provide optimum care, i.e. must there be 100% ethnic and linguistic convergence between physician and patient, down to the municipality and sub-regional dialect? Or is there a lower level of convergence that would still eliminate disparities, such as fluency in Spanish with knowledge of colloquialisms, and understanding cultural constructs of health? The position of the National Hispanic Medical Association and the National Network of Latin American Medical Students in 2001 was for the AAMC to expand its definition of underrepresented Latino groups to include all Latino sub-ethnic groups in order to increase the supply of physicians who spoke Spanish and had an understanding of Latino cultural constructs of health in order to meet the needs of the growing patient population. Although such a change would not provide 100% convergence, it would improve the capacity to provide culturally and linguistically appropriate services. Second, is the definition of health care provider limited to physician, or will using a broader definition, such as a clinic, medical school, hospital or health system, provide a better scale upon which interventions can be made to improve the capacity to provide culturally and linguistically appropriate services? Although the physician-patient relationship is an important dynamic in health care delivery, it is also important to consider the dynamic that occurs between physicians as well as the dynamic between the patient and the health care team, patient and the institution providing services. Third, how does one measure the capacity to provide culturally and linguistically appropriate services in a way that is more specific than merely using ethnicity as a proxy for these skills? Prospective, qualitative studies are currently underway to answer this question. Fourth, it is currently being debated what benefit, if any, Latino and African-American patients are receiving in terms of morbidity and mortality from such a standard of care.
Finally, a diverse medical education and physician workforce environment enhances the quality of both the medical education and the medical services of all health care providers, at the institutional and individual level. Therefore, as a component of a broad initiative to eliminate cultural disparities, many have advocated for an increase in the diversity of the physician workforce by eliminating the barriers to health care professions which under-represented minorities face.\textsuperscript{14}

As a first step to eliminate these barriers, the purpose of this study is to quantitatively construct the pipeline from kindergarten to residency for Latinos, assessing the representation of Latinos at various points along the pipeline and comparing those figures to the analogous pipelines for African-Americans and Caucasian-Americans. The model would provide a baseline for the pipeline that would provide information about how much progress has already been made, how great the disparities already are, where along the pipeline interventions are most acutely needed, predictions about the future physician workforce as well as recommendations for further research. It is our hypothesis that Latinos, as well as African-Americans, are underrepresented at every point of the pipeline and that there is a difference between the representation of Latinos and African-Americans compared to Caucasian-Americans.

Materials and Methods

\textit{Data}. The data set is a compilation of aggregate data from the publications of the Census Bureau, the College Board, the American Medical College Application Service (AMCAS) and the Accreditation Council for Graduate Medical Education (ACGME). There was no uniform label used by all four sources to count “Latinos” or “Hispanics.” Therefore,
in order to obtain information specific for the Caucasian-American, African-American and Latino subpopulations, data had to be first organized to fit into these three main categories, an example of which is reported in Table 1.

Data from the Census Bureau were already organized by “Non-Hispanic White,” “Non-Hispanic Black” and “Hispanic.” Data from the College Board were already organized by “White” and “African-American.” But in order to count Latinos, the data from the following categories were summed: “Mexican American,” “Puerto Rican” and “Latin American, South American, Central American, or Other Hispanic or Latino.” Data from AMCAS were already organized by “Non-Hispanic White” and “Non-Hispanic Black.” But in order to count Latinos, the data from the following categories were summed: “Mexican American, Puerto Rican, Cuban, Other Hispanic and Combined Hispanic.” Data from ACGME were already organized by “White,” “Black,” and “Hispanic Origin.”

These data have several limitations. First, the data represent aggregate data regarding these three U.S. subpopulations. While the national aggregate data provide a general picture of the pipeline on a national scale, it does not necessarily provide individualized information about these students, their circumstances or how well individuals in each group track through, or fall out of, the various stages of the pipeline. A national, aggregate picture is useful because much of the process of applying for college, medical school and residency occurs on a national scale. However, such a national picture is limited because the preparation for college and medical school admissions often varies by region and locality, with varying histories of educational disenfranchisement and resource allocation for achieving educational equity. The reality of the pipeline is a mixed picture, composed of national and local, aggregate and individual components.

Second, the data are organized by three, broadly inclusive ethnic labels, i.e. Caucasian-American, African-American and Latino. As introduced above, the use of these classifications serves as a proxy for the cultural and linguistic competencies which the health care system must provide to eliminate disparities. The use of these classifications does not necessarily take into account the subtle differences within these three classifications, such as geography, socioeconomic status, historical discrimination, individual discrimination, access to resources, strength of the local education system, linguistic ability, citizenship status, level of acculturation, privilege or level of acceptance of
one’s own cultural heritage. As the citations in the above introduction indicate, however, the use of race as such a proxy follows from the studies of how African-American and Latino physicians can help eliminate disparities by enhancing the ability of health education and delivery systems to provide culturally and linguistically appropriate services.

Third, it should be noted that the debate continues regarding the accuracy of counting, including the data which the Census Bureau collects. In general, sociologists have argued that minority ethnicities and groups at the margin of society have a tendency to be under-counted for a variety of reasons. Furthermore, some argue that Latinos, especially considering the barriers of language and the complications of immigrant status, are even further under-counted than other groups, making current estimates and future projections fall short. However, because the data from the College Board and AMCAS were collected by surveying all who received their services, they do not face the same challenge in this regard as the Census data.

Study Design. Six stages were identified along the pipeline from kindergarten to residency to mark points of transition along the path of producing the physician workforce. The first stage considered what the high school graduation rate was for each group. The second stage considered what percentage of high school graduates for each group took the SAT, placing themselves thus in the college bound group. The third stage considered what percentage of those college bound students of each group actually attained a Bachelor’s degree. The fourth stage considered what percentage of those students of each group with a Bachelor’s degree actually pursued a Pre-med track. The fifth stage considered what percentage of those Medical School bound students of each group actually achieved an admission to a U.S. allopathic medical school. The sixth stage considered what percentage of those Medical students of each group actually attained a medical degree. All six stages, with corresponding transition frequencies, were characterized for all three ethnic groups for comparison, as illustrated in Figure 1. Furthermore, the respective pipelines were constructed for each ethnic group by transitioning a cohort of high school seniors (estimated by dividing the number of 18 – 19yr olds for each group by two) for each group through their respective pipelines, as illustrated in Figures 2 and 3.
**Analytical Methods.** For the first stage, the high school graduation rate for each ethnic group was calculated by dividing the number of 20 – 24yr olds in 2004 in an ethnic group with a high school degree by the total number of 20 – 24yr olds in 2004 of that same ethnic group, as illustrated in Table 2. These data were obtained from the Census Bureau. The purpose of using this age group, as opposed to 18 – 19yr olds in 2004, was to control for individuals who might require more time or take different avenues of attaining a high school degree than the traditional route, with the potential of therefore providing a more conservative estimate of the disparity between ethnic groups in transition frequencies at this stage. This conservative approach was taken in order to counterbalance the bias in the hypothesis that might be seeking to illustrate a disparity.

For the second stage, the college bound rate for each ethnic group was calculated by dividing the number of individuals in an ethnic group taking the 2004 SAT, by the number of 18 – 19yr olds in 2004 with a high school diploma of that same ethnic group, as illustrated in Table 3. The former data were obtained from the College Boards, the latter from the Census Bureau.

For the third stage, the college graduation rate for each ethnic group was calculated by dividing the estimated number of 22yr olds in 2004 with a bachelor’s degree of an ethnic group, Census data, divided by the number of individuals of the same ethnic group who took the 2000 SAT, College Boards data, as reported in Table 4. The estimated number of 22yr olds with a bachelor’s degree was calculated by dividing the number of 20 – 24yr olds in 2004 with a bachelor’s degree, Census data, by three because the vast majority of individuals with this degree would be 22, 23 or 24 years old.

For the fourth stage, the medical school bound rate for each ethnic group was calculated by dividing the number of individuals of an ethnic group who took the MCAT in 2004, AMCAS data, by the estimated number of 22yr olds in 2004 with a bachelor’s degree for each ethnic group, from Census data as described for stage three above, as reported in Table 5. These figures for the three ethnic groups were then compared to their respective representations in the population of students taking the MCAT in 2004, AMCAS data. The logic was that the number of students who actually took the MCAT represents the number of college graduates who were “pre-med.”
For the fifth stage, the medical school acceptance rate for each ethnic group was calculated by dividing the number of individuals of an ethnic group in the first year class of medical school, AMCAS data, by the number of individuals of the same ethnic group taking the MCAT, AMCAS data, as reported in Table 6. These figures for each ethnic group were compared to their respective representations in medical school as reported by the 2004 Sullivan Commission Report, Table 10. Furthermore, the mean MCAT scores for the admitted students of each ethnic group were compared with the mean MCAT scores of all admitted medical students, AMCAS data, Table 10.

For the sixth stage, the medical school graduation rate for each ethnic group was calculated by dividing the number of individuals of an ethnic group that matriculated into medical school four years ago, AMCAS data, by the number of individuals of the same ethnic group graduating in 2004, AMCAS data, as reported in Table 8. These figures for each ethnic group were compared to their respective representation in the population of medical graduates, Table 7, and in the population of medical residents, Table 9. The ethnic composition of the medical graduate population was calculated by dividing the number of individual medical school graduates of an ethnic group, AMCAS data, by the total number of medical graduates, AMCAS data. The ethnic composition of the medical residents in all specialties was calculated by dividing the number of medical residents of an ethnic group in all specialties in 2003 by the total number of medical residents in all specialties in 2003, ACGME data.

Although a Markov model was considered for analyzing the data set, such a model was not appropriate for this pipeline because transition from one state to another is not independent from transition at the previous states. For example, one would expect performance at high school to influence performance in college, thus one’s probability of transition through stage 1 would also influence the probability of transition through stage 2. Although statistical analysis was considered for analyzing the data set, the aggregate nature of the data, without the appropriate information to track individuals through the pipeline, also precluded statistical analysis. Therefore, the analysis of the transition frequencies and representation for the different ethnic groups was by comparison of the percentages, graphically and numerically, between the three groups, Figures 1, 2 and 3.

Results
Stage 1: High School Degree Attainment Rates. The high school degree attainment rate for Caucasian-Americans was 91.55%, for African-Americans 80.70%, and for Latinos 65.36%. The African-American high school degree attainment rate was 80.15% of the same rate for Caucasian-Americans. The Latino high school degree attainment rate was 71.39% of the same rate for Caucasian-Americans, 80.99% of the same rate for African-Americans. However, this study did not provide information about grade point average or reputation of the institution.

Stage 2: College Bound Rates Estimated by Rates of Taking the SAT. The college bound rate for Caucasian-Americans was 51.86%, for African-Americans 42.32%, and for Latinos 38.48%. The African-American college bound rate was 81.6% of the same rate for Caucasian-Americans. The Latino college bound rate was 74.2% of the same rate for Caucasian-Americans. However, this study did not provide information about how well the students performed on this exam.

Stage 3: Bachelor’s Degree Attainment Rates. The bachelor’s degree attainment rate for Caucasian-Americans was 75.13%, for African-Americans 44.04%, and for Latinos 44.62%. The African-American bachelor’s degree attainment rate was 58.62% of the same rate for Caucasian-Americans. The Latino bachelor’s degree attainment rate was 59.39% of the same rate for Caucasian-Americans. However, this study did not provide information about grade point average or reputation of the institution.

Stage 4: Medical School Bound Rates Estimated by Rates of Taking the MCAT. The medical school bound rate for Caucasian-Americans was 6.76%, for African-Americans 10.79%, for Latinos 11.12%. The Caucasian-American medical school bound rate was 60.79% of the same rate for Latinos. The African-American medical school bound rate was 97.03% of the same rate for Latinos. However, of all the students taking the MCAT, 58.4% were Caucasian-American, 9.17% were African-American, and 7.84% were Latino. The African-American representation among MCAT takers was 15.7% of the representation of Caucasian-Americans. The Latino representation among MCAT takers was 13.42% of the representation of Caucasian-Americans. For Caucasian-Americans the mean MCAT score was 25.4, for African-Americans 18.7, and for Latinos a grand mean of 21.

Stage 5: Medical School Acceptance Rates. The medical school acceptance rate for Caucasian-Americans was 35.64%, for African-Americans 19.12%, and for Latinos 24.19%. 
The African-American medical school acceptance rate was 53.65% of the same rate for Caucasian-Americans. The Latino medical school acceptance rate was 67.87% of the same rate for Caucasian-Americans. The median MCAT score for all matriculated first year medical students was 29.9, for Caucasian-Americans 30.5, for African-Americans 25.3, and for Latinos 27.16. Of the total medical student population, 51% were Caucasian-American, 2.40% were African-American, and 3.3% were Latino. The African-American representation among medical students was 4.71% of the representation of Caucasian-Americans. The Latino representation among medical students was 6.47% of the representation of Caucasian-Americans.

**Stage 6: Medical School Graduation Rates.** The medical school graduation rate for Caucasian-Americans was 96.99%, for African-Americans 94.09%, and for Latinos 97.20%. The Caucasian-American medical school graduation rate was 99.78% of the same rate for Latinos. The African-American medical school graduation rate was 96.8% of the same rate for Latinos. Of medical residents in all specialties, the representation of Caucasian-Americans was 60.6%, of African-Americans 5.87%, and of Latinos 5.83%. The African-American representation among medical residents in all specialties was 9.69% of the representation of Caucasian-Americans. The Latino representation among medical residents in all specialties was 9.62% of the representation of Caucasian-Americans. However, this study did not provide any information about USMLE scores, medical school performance or residency match rates.

**Discussion**

The results of this study support the hypothesis that Latinos and African-Americans are underrepresented along all points of the pipeline to residency when compared to Caucasian-Americans. The under-representation first begins to appear among high school graduates based on this study. However, it is important to note that not all of the students dropped out at the high school level, but also those who dropped out in middle school, because the calculation only considered who attained a high school education, rather than also considering what level of education was attained for those who did not have a high school degree. Although the high school graduation rates occur at a ratio of 91.55% Caucasian-American: 80.70% African-American: 65.36% Latino, and the college bound
rates occur at a ratio of 51.86% Caucasian-American: 42.32% African-American: 38.48% Latino, the rates of Bachelor's degree attainment occur at a ratio of 75.13% Caucasian-American: 44.04% African-American: 44.62% Latino.

Taking these results into consideration sequentially explains how African-Americans become under-represented, despite initial progress in the high school graduation rate gap, i.e. decreased College bound and Bachelor's degree attainment rates. Furthermore, the low transition frequencies for Latinos for the first three stages in light of the Census projections for the next 50 years indicate that the degree of under-representation of Latino physicians will also further increase. Therefore, closing the achievement gap in high school graduation rates is only the first step in workforce diversification at the pre-College intervention level. Interventions at this level should consider how to also improve the rates of pursuing and obtaining a College education.

Interestingly, the Medical School bound rates indicated that Latinos and African-Americans were more likely to be Pre-Med than Caucasian-Americans, 6.76% Caucasian-American: 10.79% African-American: 11.12% Latino. While it has been argued that application rates to Medical School among Caucasian-American males have decreased due to greater career prospects in other disciplines (Cooper, 2003), there is limited information regarding the higher Pre-Med rates among African-American and Latino college graduates. A contributing factor may be the high rates of drop-out among Latinos and African-Americans up to this point. For the cohort of college graduates may have been distilled down to such a point that those individuals still pursuing education are therefore more likely to be those pursuing professional careers such as medicine. Another contributing factor may be an extrapolation of the data indicating higher rates of serving the underserved among Latino and African-American students to the corresponding ethnic college graduate populations, potentially therefore also showing a greater propensity to pursue a career in medicine in the first instance. However, only further study would answer this question.

Despite the increased Pre-Med rates among Latinos and African-Americans, the disparity persists at the level of representation among those actually taking the MCAT, i.e. 58.4% Caucasian-American: 9.17% African-American: 7.84% Latino. An important consideration is the large gap in Bachelor's degree attainment rates that would limit how
much of an absolute impact increasing the Pre-Med rate would have on workforce diversity. In addition, the disparity also persists at the level of Medical school acceptance rates, 35.64% Caucasian-American: 19.12% African-American: 24.19% Latino. Therefore, intervention should consider how to also improve College performance as well as Medical school acceptance rates, not merely interest in medicine.

Although differences in MCAT scores between the groups can explain differences in acceptance rates, it is interesting that Medical School graduation rates, despite the differences in MCAT scores for admitted Medical students, were virtually identical, 96.99% Caucasian-American: 94.09% African-American: 97.20% Latino. Despite closing the gap in Medical School graduation rates, representation among Medical graduates was 63.97% Caucasian-American: 6.54% African-American: 6.36% Latino. Again, an important consideration is the large gap in the absolute number of Pre-Meds and Medical School acceptance rates that would limit how much of an absolute impact closing the Medical School graduation rate has had on workforce diversity. These data indicate that the ability of Medical Schools to diversify the physician workforce is therefore limited by how many Latino and African-American students are graduating from College and applying for admission. Therefore, it would be compelling for Medical Schools to engage interventions to improve these limiting factors by improving the outcomes at each of the previous stages.

Such data place into perspective how much of an impact the apparent closing of the Pre-Med gap alone has on eliminating disparities, indicating therefore that increasing Pre-Med rates is only one part of College level intervention. Furthermore, such data indicate that the proper role of MCAT scores in Medical School admissions should be further examined, as also argued in further depth by Cooper (Cooper 2003). While this study indicates that MCAT scores do not seem to reliably predict Medical school graduation rates, there may be other measures of Medical school performance that MCAT scores reliably predict. Further study would answer this question.

In addition to providing a glimpse of the pipeline for these three groups, this study proposes two mechanisms for evaluating the outcomes of efforts to increase physician workforce diversity. However, underlying both mechanisms is the perhaps too obvious consideration of time, i.e. the span of time from kindergarten to matching for residency along a traditional route is at least 20 years, thus creating varying time lags between
intervening and producing an outcome. The first method is a flow- or transition frequency-based approach where the degree of disparity reduction is measured by the reduction in the transition frequency curve gaps, as illustrated in Figure 1. Furthermore, how the transition frequency curves change over the years can provide information about how the ethnic composition of the physician workforce will change. For example, to measure the impact of an intervention for high school seniors, data would have to be collected by following the cohort for at least eight years. However, this method alone is inadequate without also considering the absolute numbers of individuals progressing through the pipeline because eliminating the disparity in transition frequencies would provide an elusive gain if the absolute numbers do not significantly meet the demand.

The second method, therefore, is a volume- or cohort-based approach where the degree of disparity reduction is measured by two parameters: first, by considering what absolute volume or cohort size actually progresses beyond a particular stage of transition, and second, by considering how the volume or cohort representation of an ethnic group among all groups who progress beyond a particular stage of transition compares to its representation in the total population. Focusing solely on transition frequencies understates the dramatic extent of the disparity of representation among these three ethnic groups in the physician workforce. However, focusing solely on absolute numbers, because of the extent of the current disparity, has the potential to mask any gains being made to improve the current situation. The graphic proportions at the level of high school seniors provides a control, establishing an idea of what the demographic representations of the ethnic groups are at the very beginning. Therefore, as the cohorts progress through their respective pipelines, the graphic changes in representation after each stage of transition are thus illustrated. The volume- or cohort-based approach is illustrated in figures 2 and 3.

The first recommendation of this study is for initiatives to improve workforce diversity to target all six stages of the pipeline. Second, the effectiveness of such initiatives should be evaluated by the degree to which they eliminate the gaps between the transition frequency curves as illustrated in figure 1. Third, the effectiveness of such initiatives should be evaluated by the degree to which they actually increase the absolute volume of flow through the pipelines, i.e. the degree to which the pipelines in figures 2 and 3 maintain
their proportions as the cohorts progress through each stage. Fourth, it is important to correlate interventions with their corresponding outcomes at the end of the pipeline over the 20 year span discussed above, rather than prematurely correlating interventions with mismatched outcomes. Fifth, further research is recommended to understand why these disparities continue to persist, whether they are controlled for socioeconomic status, gender, geography and other factors such as grade point average, SAT score, medical school performance and USMLE scores.

Finally, it is important not to rely solely on physician workforce diversification to eliminate these disparities in health care because the 20 year lag between interventions and outcomes, the existence of disparities today and the projections of greater disparities in the future, indicate that doing so would not satisfy this great need in a timely fashion. Because of the current disparities in health care and the projected exacerbations in these disparities, it is recommended that further research be conducted, prospectively and using qualitative methods, to more precisely characterize the various disparities as well as to further evaluate proposed interventions. It is recommended that best models of practice guidelines and reform of the health care system be pursued accordingly along with such research. It is also recommended to pursue the further development of medical curricula that would complement these efforts, in order to educate all future physicians on how to provide the best care for all patients, regardless of any sociologically constructed divisions.

Tables

<table>
<thead>
<tr>
<th>Table 1: Latino SAT Data from the College Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Mexican American</td>
</tr>
<tr>
<td>Puerto Rican</td>
</tr>
<tr>
<td>Latin American</td>
</tr>
<tr>
<td>Total Latino</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Stage 1, High School Graduation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Students Taking the 2004 SAT</td>
<td>High School Graduates in 2004</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Caucasian-American</td>
<td>719753</td>
<td>1388000</td>
</tr>
<tr>
<td>African-American</td>
<td>137953</td>
<td>326000</td>
</tr>
<tr>
<td>Latino</td>
<td>122380</td>
<td>318000</td>
</tr>
</tbody>
</table>

Table 3: Stage 2, College Bound Rate

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>20 – 24 year olds with a Bachelor’s Degree in 2004</th>
<th>Students Taking 2000 SAT</th>
<th>Rate of Bachelor’s Degree Attainment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian-American</td>
<td>1605000</td>
<td>712105</td>
<td>75.13%</td>
</tr>
<tr>
<td>African-American</td>
<td>158000</td>
<td>119591</td>
<td>44.04%</td>
</tr>
<tr>
<td>Latino</td>
<td>131000</td>
<td>97872</td>
<td>44.62%</td>
</tr>
</tbody>
</table>

Table 4: Stage 3, Bachelor’s Degree Attainment Rate
Table 5: Stage 4, Medical School Bound Rate

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Students Taking the 2004 MCAT</th>
<th>20 - 24 year olds with a Bachelor’s Degree in 2004</th>
<th>Percentage of All Students Taking the 2004 MCAT</th>
<th>Medical School Bound Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian-American</td>
<td>36186</td>
<td>1605000</td>
<td>58.4%</td>
<td>6.76%</td>
</tr>
<tr>
<td>African-American</td>
<td>5681</td>
<td>158000</td>
<td>9.17%</td>
<td>10.79%</td>
</tr>
<tr>
<td>Latino</td>
<td>4857</td>
<td>131000</td>
<td>7.84%</td>
<td>11.12%</td>
</tr>
</tbody>
</table>

Table 6: Stage 5, Medical School Acceptance Rate

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>First Year Medical Students in 2004</th>
<th>Number of Students Taking 2004 MCAT</th>
<th>Medical School Acceptance Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian-American</td>
<td>10343</td>
<td>36186</td>
<td>35.64%</td>
</tr>
<tr>
<td>African-American</td>
<td>1086</td>
<td>5681</td>
<td>19.12%</td>
</tr>
<tr>
<td>Latino</td>
<td>1175</td>
<td>4857</td>
<td>24.19%</td>
</tr>
</tbody>
</table>

Table 7: Stage 6, Representation among Medical Graduates

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>2004 Medical School Graduates</th>
<th>2004 Total Medical School Graduates</th>
<th>Representation among Medical School Graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian-American</td>
<td>10120</td>
<td>15821</td>
<td>63.97%</td>
</tr>
<tr>
<td>African-American</td>
<td>1034</td>
<td>15821</td>
<td>6.54%</td>
</tr>
<tr>
<td>Latino</td>
<td>1007</td>
<td>15821</td>
<td>6.36%</td>
</tr>
</tbody>
</table>

Table 8: Stage 6, Medical School Graduation Rate

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>2004 Medical School Graduates</th>
<th>2000 First Year Medical Students</th>
<th>Medical School Graduation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian-American</td>
<td>10120</td>
<td>10424</td>
<td>96.99%</td>
</tr>
<tr>
<td>African-American</td>
<td>1034</td>
<td>1099</td>
<td>94.09%</td>
</tr>
<tr>
<td>Latino</td>
<td>1007</td>
<td>1036</td>
<td>97.20%</td>
</tr>
</tbody>
</table>

Table 9: Stage 6, Representation among Residents in All Specialties

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>2003 Residents in All Specialties</th>
<th>2003 All Residents of All Ethnicities</th>
<th>Representation among Residents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian-American</td>
<td>4092</td>
<td>67524</td>
<td>60.60%</td>
</tr>
<tr>
<td>African-American</td>
<td>3967</td>
<td>67524</td>
<td>5.87%</td>
</tr>
<tr>
<td>Latino</td>
<td>3935</td>
<td>67524</td>
<td>5.83%</td>
</tr>
</tbody>
</table>
Table 10: Medical Student Representation and Mean MCAT Scores

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Representation Among All 2004 Medical Students</th>
<th>2004 First Year Medical Student Mean MCAT Score</th>
<th>Mean Score Among All Who Took the 2004 MCAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian-American</td>
<td>51%</td>
<td>30.5</td>
<td>25.4</td>
</tr>
<tr>
<td>African-American</td>
<td>2.40%</td>
<td>25.3</td>
<td>18.7</td>
</tr>
<tr>
<td>Latino</td>
<td>3.30%</td>
<td>Grand Mean 27.16</td>
<td>21</td>
</tr>
<tr>
<td>For All Ethnicities</td>
<td>29.9</td>
<td>25.4</td>
<td></td>
</tr>
</tbody>
</table>

Figures

Figure 1: The Flow or Transition Frequency Approach
This figure depicts the transition frequencies for each of the six stages along the respective pipelines for Latinos, African-Americans and Caucasian-Americans. One means of measuring the outcomes of efforts to diversify the physician workforce is to consider the degree to which the gaps between the three curves have been eliminated. When all three curves are transposable, then there will be no disparity by this measure. Furthermore, the effectiveness of an intervention at a particular stage can be measured by the degree to which it closes the gap at that same stage.

Figures 2 & 3: Pre-College/College Intervention in the Pipeline by Ethnicity, The Volume or Cohort Approach
These figures depict the respective pipelines for Latinos, African-Americans and Caucasian-Americans. The proportional width of the three pipelines at the level of high school seniors provides an initial perspective on how these ethnicities are represented proportionally in the general population. However, as the cohorts of students track through the six stages of transition to reach the end point of medical residency, the width of the individual pipelines changes, and the relative widths of the individual pipelines change, in stark contrast to such proportions at the high school senior level. When all three pipelines maintain their relative widths proportionally as the cohorts proceed across the six stages of transition, then there will be no disparity by this measure. Furthermore, the effectiveness of an intervention at a particular stage can be measured by the degree to which it affects the width of the pipeline downstream as the cohorts subject to that intervention progress across the pipeline over an appropriate period of time.
Figure 1: The Flow or Transition Frequency Approach

Stage 1 High School Graduation Rate
Stage 2 College Bound Rate
Stage 3 Bachelor's Degree Attainment Rate
Stage 4 Medical School Bound Rate
Stage 5 Medical School Acceptance Rate
Stage 6 Medical School Graduation Rate
Figure 2: Pre-College/College Intervention in the Pipeline by Ethnicity, Stages 1 - 3, The Volume or Cohort Approach

Stage 1 High School Graduation Rate  Stage 2 College Bound Rate  Stage 3 Bachelor’s Degree Attainment Rate
Figure 3: Pre-Med/Med Intervention in the Pipeline by Ethnicity, Stages 4 - 6, The Flow or Cohort Approach
References