

Larger Differences in Physician-to-Patient Ratios among Racial Groups Worsen Outcomes on Preventable Diseases *

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We examine the impact of difference of physician-to-patient ratios on preventable diseases because the unequal distribution of physicians among different racial groups in society will limit patients' choices and may lead to unequal outcomes. We applied a generalized linear model (GLM) with log link and poisson distribution with multiple a California County level data in 2015. Findings show the difference of physician-to-patient ratios among racial groups play a significant role in patient outcomes. We found that the larger inequality measured as the difference of physician-to-patient ratios among racial groups is positively associated with the number of discharged patients. The larger gap of physician-to-patient ratios among racial groups may limit physician choice and worsen the patient outcomes. Thus, health policy makers should incentivize counties to hire more physicians when they have large differences in physician-to-patient ratios among different racial groups.

JEL Classification: I11, I18, J15

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1. INTRODUCTION

In the healthcare systems of most countries around the world, persistent health disparities across different groups have been well documented. Members of racial and ethnic minority populations have markedly worse health outcomes than the majority White population in the U.S.A. (NCHS, 2015; NIH, 2014). There are varying reasons for such disparities. These disparities can be driven indirectly by socio-economic status as well as environmental and occupational exposures (Kingston et al., 2001), and they can also be driven directly by unequal access to needed medical care, preventive services, etc. Among multiple factors, the health care provider is one of the most critical factors affecting patients' health outcomes. In particular, the physician's race in the patient-physician relationship has been postulated as an important factor in the poor quality of health care received by underserved populations. Increasing the racial

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diversity of health professionals has been suggested by the federal government and other groups as a way to address these problems. However, evaluations of the impact of the increase in the numbers of minority physicians have far been inconclusive and limited.

Health care providers play a critical role in driving patients' understanding of health problems and treatment options as well as adherence to treatment plans and preventive services (Armstrong et al., 2007). In particular, patients' preferences for physicians of the same racial or ethnic group has been reported in many studies. For example, Street et al. (2008) found that stronger patient-physician relationships are forged when patients perceive themselves to be similar to their physicians in terms of personal beliefs, values, and communication. This perception of similarity has been shown to be associated with stronger trust, satisfaction, and intention of adherence. Thus, increasing the racial and ethnic diversity of physicians is believed to help underserved populations access to better-quality health care (Alsan et al., 2019; Strumpf, 2011).

However, a large difference in the physician-to-patient ratio across different racial groups in society will limit patients' choices and may lead to unequal outcomes, such as chronic diseases in particular. Health disparities in chronic diseases are widespread among members of racial and ethnic minority populations. More than 75% of health care expenditure is on people with chronic conditions, and every year these types of diseases account for around 70 % of all deaths in the U.S. (National Health Council, 2019). Increasing physician-to-patient ratio across different racial groups could have been one of the methods to decrease the main cause of these health disparities.

A growing number of studies has supported that physician-patient racial concordance will provide underserved patients with increased trust in health care systems, better health care experiences, and stronger adherence to the recommendations of health care providers. However, few studies have examined the impact of racial concordance between patients and physicians on health outcomes. In particular, the way in which the availability of physicians of different racial groups impacts patient health outcomes has yet to be examined. The unequal distribution of physicians among different racial groups in society will worsen minority patients' health outcomes. Instead of focusing on individual physician-patient concordance, we examine the relationship between the distribution of physicians and patients' health outcomes.

2. METHODS

2.1. Data

We used multiple sets of California County level data in 2015: physician-surgeon data, county characteristic data, and quality indicator data. First, the physician-surgeon dataset is a subset of data from the Medical Board of California's Physician Survey of physicians and surgeons. This

dataset includes the number of licensees by the county where they are practicing, as well as their race/ethnicity. Second, the county characteristics dataset provides information on the population, unemployment rate, education, and median income.¹⁾ Finally, the quality indicator dataset provides the number of risk-adjusted observed patients with preventable diseases and their race/ethnicity.²⁾ Preventable diseases include Diabetes Short-term Complications, Perforated Appendix, Diabetes Long-term Complications, COPD or Asthma in Older Adults (Age 40+), Hypertension, Heart Failure, Dehydration, Community-Acquired Pneumonia, Urinary Tract Infection, Angina without Procedure, Uncontrolled Diabetes, Asthma in Younger Adults (Age 18-39), Lower-Extremity Amputation (Diabetes), Prevention Quality Overall Composite, Prevention Quality Acute Composite, and Prevention Quality Chronic Composite. There are 56 counties included, excluding Alpine and Sierra, which did not have patient data provided. The unit of analysis is a county.

2.2. Empirical Model

We applied a generalized linear model (GLM) with log link and Poisson distribution to examine the effect of the distribution of physicians to patients among racial groups on outcomes, measured as the number discharged patients. To select the model, the quasi-likelihood was applied under the independence model criterion with the smallest independence model criterion among various variance structures (Cui, 2002). Therefore, the empirical model can be expressed as follows:

$$Y = \beta_D D + \theta_{Ph} Ph + \theta_{PT} PT + \theta_{Pop} Pop + \theta_{Une} Unemp + \theta_{Inc} Inc + \theta_C C + \varepsilon. \quad (1)$$

Y represents risk-adjusted numbers of targeted patients (for each preventable disease) per 100,000 people by age, sex, and case mix. D represents the difference in the physician-to-patient ratio among races between the minimum and maximum physician-to-patient ratios among races. Thus, larger D values represent larger physician provision inequality among races. Ph represents the number of physician and surgeons in the county, Pt is the number of total patients, Pop is the population, $Unemp$ is unemployment, INC is median income, C is education measured by the percentage of people with a college education, and ε is an error term. The unit of analysis is a

1) Each dataset was collected from State of California websites.

2) Information on preventable diseases is reported in Table 3.

county. All analyses were conducted using Stata Statistical Software 17 (Stata Corp, College Station, TX, USA).

3. RESULTS

Table 1 lists the numbers of physician-surgeons and patients as well as the ratios of physicians to patients. White physician-surgeons make up the largest group, followed by Asian physicians. White patients also make up the largest patient group, while Black patients make up the smallest patient group.

The physician-to-patient ratio was calculated to divide physicians by the number of patients of the same race. The Asian physician-to-patient ratio is the largest (0.088), while the Hispanic physician-to-patient ratio is the smallest (0.004). These ratios can be interpreted to mean that each Asian physician takes care of almost 12 Asian patients, whereas each Hispanic physician takes care of almost 250 Hispanic patients. Thus, there are large differences in the physician-to-patient ratios among racial groups (Kim and Lee, 2021).

Finally, the difference measures the varying physician-to-patient ratios among different racial groups. A number of measures can be used to track distribution (variability), such as range, interquartile range, and standard deviation. We adopted range because it is based solely on the

Table 1 Number of Physicians and Patients per County

Variables	Races/Ethnicity	Mean	Std. Dev.	Min	Max
<i>Physician (A)</i>	Asian	315	621	1	3,521
	Black	44	111	0	703
	Hispanic	80	172	1	1,046
	White	689	1,269	6	7,404
<i>Patients (B)</i>	Asian	9,089	19,699	15	112,070
	Black	8,226	22,544	0	140,872
	Hispanic	29,856	69,003	152	433,362
	White	43,021	66,841	496	381,751
<i>Physician per Patients (A/B)</i>	Asian	0.088	0.122	0.011	0.625
	Black	0.014	0.018	0.003	0.103
	Hispanic	0.004	0.004	0.000	0.020
	White	0.017	0.012	0.001	0.061
Difference (maximum distance between physician per patient among races)		0.085	0.121	0.010	0.605

two most extreme values, which represent inequality in our model.³⁾ Thus, the range was calculated by subtracting the smallest value from the largest value of the physician-to-patient ratio among racial groups. A larger difference means a larger difference in the physician-to-patient ratio among racial groups, and it represents a larger inequality in physician-to-patient provision in the county.⁴⁾

Table 2 presents the descriptive statistics of the other independent variables. The average number of physicians in each county is 1,245. The average number of patients in and the average population of each county are 94,986 and 527,434, respectively. The average median income is 72,678, the average unemployment ratio is 7.3, and the average percentage of the population that is college educated is 29.7%.

Table 2 Descriptive Statistics of Independent Variables

Variable	Mean	Std. Dev.	Min	Max
<i>Physicians (Ph)</i>	1,245	2,412	8	14,148
<i>Total Patients (PT)</i>	94,986	185,987	710	1,127,859
<i>Populations (Pop)</i>	527,434	941,460	10,444	5,622,301
<i>Median income (INC)</i>	72,678	22,160	45,086	125,933
<i>Unemployment (Unemp)</i>	7.3%	3.6%	3.4%	24.5%
<i>College education (C)</i>	29.7%	12.5%	13.5%	58.8%

Table 3 provides information on preventable diseases. Preventable disease information is presented as a risk-adjusted rate per 100,000 population by age, sex, and case mix; case mix is the average relative diagnosis relative group (DRG) weight of a hospital's discharges of inpatient, calculated by summing the Medicare Severity-DRG (MS-DRG) weight for each discharge, dividing the total by the number of discharges, and controlling for disease-related risk. For example, a value of 188 for heart failure represents the average number of heart failure-discharged patients per 100,000 population adjusted by age, sex, and case mix.

Table 4 lists the regression results of preventable diseases. For all preventable chronic conditions except Hypertension, Lower-Extremity Amputation, and Perforated Appendix, the differences in the physician-to-patient ratios among races are positively associated with the risk-adjusted targeted number of patients. This means that a larger difference in the ratio of physicians to patients among races is positively associated with patient visits.

3) The results obtained with the other two measures (interquartile range, and standard deviation) showed similar regression results.

4) Interpretation of difference should be cautious. For example, if all the races in the county have low physician-to-patient ratios, then their difference would be small, and it would say that this county has high racial concordance. In this case, racial concordance might be high, but the county still suffers from low physician-to-patient ratio.

Generally, the more total patients, less population and less college education is positively associated with the number of discharged patients. In addition, the more total patients there are, the more unemployment is negatively associated with the number of patients.

Table 3 Preventable Disease

Preventable Disease	Mean	Std. Dev.	Min	Max
Angina without Procedure	70	32	0	150
Asthma in Younger Adults (Age 18-39)	38	7	26	54
COPD or Asthma in Older Adults (Age 4..	96	42	11	242
Community-Acquired Pneumonia	285	114	41	557
Dehydration	26	16	6	94
Diabetes Long-term Complications	294	95	41	541
Diabetes Short-term Complications	92	35	39	180
Heart Failure	188	79	65	417
Hypertension	120	42	58	234
Lower-Extremity Amputation (Diabetes)	14	10	0	58
Perforated Appendix	6	5	0	30
Prevention Quality Acute Composite	24	13	0	69
Prevention Quality Chronic Composite	17	9	0	45
Prevention Quality Overall Composite	1,099	380	251	2114
Uncontrolled Diabetes	400	141	171	795
Urinary Tract Infection	699	249	85	1319

4. DISCUSSION

In contrast to previous studies that examined individual doctor-patient racial matching and its impact on outcomes, this study is more focused on the effect on preventable diseases of differences in physician-to-patient ratios across racial groups. The results presented here indicate that equally distributed physician-to-patient ratios across different racial groups can give patients more choices of racially-matching physicians. By contrast, patients who cannot easily find physicians of the same race within their neighborhood are likely to be treated in race-discordant relationships.

These findings show that differences in physician-to-patient ratios among different racial groups play a significant role in patient outcomes. Specifically, we found that a larger inequality, measured as larger differences in physician-to-patient ratios among different racial groups, is positively associated with the number of discharged patients. Larger gaps in physician-to-patient ratios among different racial groups may limit physician choice for racial minorities and worsen their health outcomes. This finding corroborates the findings of previous research indicating that minority patients are less likely to postpone seeking care and will receive needed health care more

often when they are in a racially-concordant physician-patient relationship (Leveist and Nuru-Jeter, 2002).

This study helps elucidate the impact of the availability of a racial relationship on patients with chronic diseases. Chronic diseases are primary causes of death and disability (Bauer et al., 2014; Lee, 2015), but they are often preventable through improvements in diet and physical activity as well as early detection and appropriate treatment. Accordingly, racial concordance may have a noticeable effect in preventing and treating chronic diseases. The findings of this study indicate that access to care may be influenced by the availability of physicians of the same race as the patients. While the direct reasons that patients prefer physicians of the same race are outside the scope of this study, patients in race-discordant physician-patient relationships might miss opportunities to prevent, detect, and treat their disease conditions. This finding supports the importance of having diverse physicians to promote collaboration between health service providers and patients, allowing patients' active participation in their own care and better adhere to their treatment and outcomes (Strumpf et al., 2011; Kingston and Nickens, 2001).

5. CONCLUSION

We found that larger differences in physician-to-patient ratios among different racial groups result in worse health outcomes. The findings support the idea that increasing racial diversity among physicians will lead to better health outcomes by giving patients more opportunities to find racial concordance relationships, and accordingly, have better health care experiences.

This study has some limitations. First, we used cross-sectional data in this study. Thus, we could not control variables such as county fixed variables, which may lead to omitted variable bias. Second, we could not observe individual physician-patient matching concordance. However, we assume that increased physician provision to patients leads to increased physician-patient matching.

This study calls for health policy makers to make efforts to achieve more equal distributions of physicians to patients, which will in turn improve the health outcomes of patients who are members of underserved populations. Thus, health policy makers should incentivize counties to hire more physicians when they have large differences in physician-to-patient ratios among different racial groups.

Conflicts of Interest “The authors declare no conflict of interest.” “The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results”.

Table 4 GLM Regression Results-Preventable Disease

riskadjrate_icd9	Angina without Procedure	Asthma in Younger Adults (Age 18-39)	COPD or Asthma in Older Adults (Age 40+)..	Community-Acquired Pneumonia	Dehydration	Diabetes Long-term Complications	Diabetes Short-term Complications	Heart Failure
	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)
<i>Difference</i>	3.038** (0.930)	2.537** (0.920)	0.401* (0.200)	0.498* (0.230)	1.160*** (0.330)	0.674* (0.330)	0.983** (0.380)	1.224*** (0.190)
<i>Total Physician</i>	-0.091 (0.240)	0.097 (0.280)	-0.052 (0.050)	0.056 (0.060)	0.047 (0.090)	0.063 (0.090)	0.190 (0.100)	0.064 (0.050)
<i>Total Patient</i>	1.151*** (0.200)	0.556* (0.260)	0.328*** (0.040)	0.064 (0.050)	0.328*** (0.070)	0.405*** (0.070)	0.279*** (0.080)	0.421*** (0.040)
<i>Population</i>	-0.958** (0.300)	-0.665** (0.240)	-0.241*** (0.070)	(0.134) (0.080)	-0.231* (0.110)	-0.244* (0.110)	-0.468*** (0.130)	-0.432*** (0.060)
<i>Unemployment</i>	(0.049) (0.030)	-0.059* (0.030)	-0.022*** (0.010)	(0.010) (0.010)	-0.034** (0.010)	-0.021* (0.010)	-0.047*** (0.010)	-0.025*** (0.010)
<i>Median Income</i>	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	-0.000*** 0.000	0.000 0.000
<i>College Education Percent</i>	-1.485 (1.020)	-1.658- (0.910)	-1.896*** (0.220)	-2.398*** (0.260)	-2.158*** (0.380)	-2.899*** (0.380)	-2.408*** (0.430)	-1.952*** (0.210)
<i>Constant</i>	3.566 (1.890)	5.426** (1.770)	6.217*** (0.410)	6.725*** (0.510)	5.187*** (0.720)	4.552*** (0.710)	7.623*** (0.830)	6.805*** (0.400)

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4 GLM Regression Results-Preventable Disease(continuous)

Risk Adjusted	Hypertension	Lower-Extremity Amputation (Diabetes)	Perforated Appendix	Prevention Quality Acute Composite	Prevention Quality Chronic Composite	Prevention Quality Overall Composite	Uncontrolled Diabetes	Urinary Tract Infection
	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)	Coef. (S.D.)
<i>Difference</i>	0.850 (0.640)	- 1.290 (0.780)	0.315 (0.550)	0.713*** (0.160)	0.963*** (0.120)	0.894*** (0.100)	2.688* (1.320)	0.651* (0.290)
<i>Total Physician</i>	0.322 (0.180)	0.041 (0.210)	0.124 (0.120)	0.010 (0.040)	0.027 (0.030)	0.022 (0.030)	0.183 (0.350)	0.002 (0.080)
<i>Total Patient</i>	0.345* (0.140)	0.329* (0.160)	0.079 (0.110)	0.134*** (0.030)	0.397*** (0.030)	0.298*** (0.020)	0.870** (0.290)	0.097 (0.060)
<i>Population</i>	- 0.484* (0.220)	0.334 (0.270)	- 0.266* (0.110)	- 0.111* (0.050)	- 0.355*** (0.040)	- 0.263*** (0.030)	- 0.920* (0.450)	0.011 (0.100)
<i>Unemployment</i>	0.012 (0.020)	0.052* (0.030)	0.014 (0.020)	- 0.017*** (0.010)	- 0.024*** (0.000)	- 0.022*** (0.000)	- 0.064 (0.040)	-0.012 (0.010)
<i>Median income</i>	- 0.000*** (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	- 0.000** (0.000)	- 0.000** (0.000)	- 0.000** (0.000)	0.000 (0.000)
<i>College education percent</i>	- 1.301 (0.730)	- 2.091* (0.910)	- 0.182 (0.580)	- 2.355*** (0.180)	- 2.080*** (0.140)	- 2.195*** (0.110)	- 1.581 (1.480)	- 2.472*** (0.330)
<i>Constant</i>	5.076*** (1.400)	3.611* (1.750)	3.776*** (0.540)	6.715*** (0.350)	7.423*** (0.260)	7.824*** (0.210)	5.023 (2.810)	4.510*** (0.640)

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

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