Patient-Physician Race Concordance, Physician Decisions, and Patient Outcomes

Han Ye* Junjian Yi†

August 18, 2020

Abstract

Using administrative data from a large, diverse emergency department (ED) in Singapore, we examine the impact of race concordance between patients and physicians on physician decision-making and patient health outcomes. We find that patient-physician race concordance increases consultation time and decreases the probability of inpatient admission and the use of diagnostic testing. Subsequently, race-concordant patients have lower revisit rates after ED discharge. The effect of race concordance is largely driven by patients who had less serious illnesses, and whose diseases had nonspecific symptoms or less clear causes. The results are best explained by the informational and communication mechanism: Racial match between patients and physicians enhances communication and improves the quality of physicians' information. This, in turn, leads to higher quality of care for race-concordant patients.

Keywords: Health care disparities; Racial interactions; Physician decision-making; Patient outcomes

JEL Codes: D83; I14; J15

*Department of Economics, National University of Singapore; email: yehan0413@gmail.com
†Department of Economics, National University of Singapore; email: junjian.yi@gmail.com

I. Introduction

Racial disparities in medical treatment and health outcomes have been documented in the literature for decades (Chandra and Skinner, 2004; Spitzer and Lang, 2020). Racial and ethnic minorities in the US tend to receive lower-quality care than nonminorities, even when their income, insurance status, access, and other factors do not vary (Institute of Medicine, 2003). However, the sources of disparities in clinical encounters are ambiguous. One explanation is that health care providers are simply prejudiced against members of other ethnic groups and treat those patients with less regard than in-group members (Anwar and Fang, 2012; Chandra and Staiger, 2010). Another is that providers treat out-group members differently as a result of information imperfections (Balsa and McGuire, 2001).[1] The broad distinction in causes between prejudice and information corresponds to a broad distinction in policies between rule-based and information-based interventions (Balsa and McGuire, 2003): Rule-based policies require that minorities be treated the same as nonminorities, while information-based policies seek to reduce uncertainty or break stereotypes through information interventions. Identifying which mechanism is at work, therefore, is important for the design of effective policy to address disparities, and is the focus of our paper.

It is difficult to empirically identify the consequences of racial in-group treatment and to distinguish between the various ways disparities can arise based on clinical encounters. First, race information on both patient and physician is required. Most studies have relied exclusively on the patient's race, and have been designed to detect disparities in the quantity and quality of medical care received by minority versus nonminority groups (see, for example, Trivedi et al. (2005)). Such aggregation neglects the race composition of physicians and fails to capture the effect of own-race physicians on patient care. Second,

[1] The literature on labor economics—where racial disparities have been investigated most extensively—posits two major sources of racial disparities: taste-based and statistical discrimination. Becker (1957) introduced the first economic model of discrimination, in which employers' prejudice against interacting with minority workers produces taste-based discrimination. Phelps (1972) and Arrow (1973) introduced the term "statistical discrimination" to describe labor market disparities that result from employers having imperfect information about the skills or behaviors of members of minority groups. An extensive body of studies has discussed and tested these two theories; for a review, see Altonji and Blank (1999); List and Rasul (2011); Lang and Lehmann (2012); and Lang and Spitzer (2020).

even when dyadic data are available, matching between patients and physicians may not be random; for instance, patients are likely to choose physicians of their own race when given a choice (LaVeist and Nuru-Jeter, 2002). If this were the case, the effect of patient-physician race concordance on patient care would be confounded by unobserved patient conditions and physician characteristics.

We use administrative data from a large emergency department (ED) in Singapore, a setting that is well suited to study the effect of patient-physician race concordance on medical treatment and patient outcomes and to explore the mechanisms that underlie such effects. First, the dataset contains comprehensive information for each ED visit, including patient and physician characteristics, clinical decisions, patient outcomes, and timestamps on the patient's path through the ED. Detailed patient visit and physician personnel records allow us to identify race-concordance status between the patient and the treating physician. Second, patients and physicians are almost randomly paired, due to the unexpected nature of emergency care and the predetermined shift schedules of physicians. Third, physicians rarely have pre-existing relationships with their patients; patients and physicians generally meet for the first time in the ED environment. Finally, financial incentives are unlikely to play a role in the ED we study: Physicians are paid a monthly salary with a fixed shift allowance, and patients incur a fixed attendance fee upon registration.

We find that race-concordant patients have lower admission rates and longer consultations than race-discordant patients. Controlling for case characteristics and physician fixed effects, ordinary least squares (OLS) estimates suggest that patient-physician race concordance significantly reduces the probability of inpatient admission by 8.6% and increases consultation length by 2.3%. Race concordance also has a negative though statistically insignificant effect on the use of diagnostic tests. These results remain robust after we address concern about potential nonrandom patient-to-physician assignments using an instrumental-variable (IV) method, in which the instrument for race concordance is the proportion of on-shift physicians who are of the same race as the patient.

We further investigate whether patient-physician race concordance affects patient health outcomes. We find that race-concordant patients have a lower probability of return visits to the ED within 1 week of initial discharge, even though their admission rates are lower than those of race-discordant patients. Specifically, our OLS estimate suggests that race concordance reduces the probability of ED revisits by 3.6%. This suggests that race concordance improves the quality of physicians' disposition decisions, reducing both avoidable hospital admissions and wrongful discharges.

The differential treatment patterns are less consistent with racial prejudice, but can be explained by the informational and communication mechanism. Under the prejudice hypothesis, race-concordant patients could achieve a higher quality of care if providers are prejudiced in favor of racial in-group members. The prejudice theory also predicts that physicians always provide less health care to racial out-group members (Balsa and McGuire, 2001), which contradicts our findings of higher admission rates and increased use of diagnostic tests with race-discordant patients. In contrast, information-based discrimination predicts that out-group members will receive fewer resources in some cases and more in others (Balsa and McGuire, 2001; Spitzer and Lang, 2020). The role of imperfect information in disparities is first discussed in the literature on labor economics, where related disparities have been investigated most extensively. The accuracy of employers' information about individual productivities differs across groups, leading to group wage differentials (Aigner and Cain, 1977; Lundberg and Startz, 1983). Specifically, Lang (1986) stresses that employers may have trouble communicating with members of different ethnic groups because of language differences, where language includes all aspects of verbal and nonverbal communication that transmits information.

The problem of incomplete information and communication is a defining feature of the health care market (Arrow, 1963). Physicians cannot readily observe patients' diseases or severity, but rather can only collect information from symptoms or signals upon encountering a patient. Informational differences lead to differences in physicians' use of medical resources to treat their patients (Phelps, 2000). Information and communication problems may be particularly exacerbated when patient and physician belong to different ethnic groups, as stressed by the theory in Lang (1986). Balsa and McGuire (2001) extend the theory of statistical discrimination based on differences in the quality of information to a clinical context. They consider a physician who has more trouble communicating with minority patients than with members of her own group. The presence of greater uncertainty in interpreting symptoms in minority patients can lead to poorer outcomes for the minority patients, even among fair-minded providers (Balsa and McGuire, 2001).

Our main findings are consistent with the mechanism whereby cultural and language differences impair the quality of information transmission between agents from different groups (Lang, 1986). In the clinical context, physicians have more difficulty interpreting symptoms from and communicating with out-group than in-group patients (Spitzer and Lang, 2020);[2] they collect less (subjective) information from out-group patients and employ more (objective) medical resources (Balsa and McGuire, 2001). This corresponds to our findings that patient-physician race concordance leads to longer consultations and less use of formal medical resources in terms of inpatient admissions and diagnostic tests. Balsa and McGuire's model also suggests that poor communication leads to a bad match between treatment and needs and, in turn, results in poor outcomes. This is consistent with our findings that race-discordant patients have higher revisit rates than race-concordant patients.

We conduct additional analyses to further evaluate the informational interpretation of our findings. First, we find that the effect of race concordance is larger for patients who have less serious illnesses and whose diseases have nonspecific symptoms or less clear causes. These results corroborate Balsa and McGuire's (2001) prediction that differences in patient care would be more pronounced for conditions that require better communication. Second, race concordance is associated with increased specificity of patients' ICD-9 (International Classification of Diseases, Ninth Revision) diagnosis codes, consistent with Balsa and McGuire's prediction that physicians would use vaguer diagnoses for out-group patients.

Our study is closely related to the literature that examines the role of shared identities in medical care. Most of these studies are based on US samples, and suggest that patient-

[2]The communication problem faced by physicians also includes out-group patients' distrust of physicians and less willingness to communicate (Alsan and Wanamaker, 2018).

physician race concordance is associated with more participatory consultation and greater satisfaction with primary care visits (Cooper-Patrick et al., 1999; LaVeist and Nuru-Jeter, 2002). Evidence on whether race or gender concordance affects physician decisions and patient outcomes is mixed (Balsa et al., 2005; Greenwood et al., 2018; Meghani et al., 2009), perhaps due to methodological or contextual differences, and observational studies face a common challenge of nonrandom matching between patients and physicians. More recently, Alsan et al. (2019) examine the effect of race concordance on the demand for preventive care in African American men using a randomized trial. Their experimental findings suggest that patients assigned to a black doctor increased their demand for preventive services as a result of improved communication within concordant pairs. Our study provides quasi-experimental evidence from the field on the role of race concordance in health care and examines the underlying mechanisms in the context of emergency care in Singapore.

Our findings on the consequences of patient-physician race concordance have major implications for the growing literature on health economics that analyzes variations in medical expenditure and procedure use. It has been well documented that medical practice variations are largely caused by supply-side factors (Cutler et al., 2019; Finkelstein et al., 2016). Physicians' clinical decisions are determined not only by their human capital (Currie and MacLeod, 2017), but also by their surrounding environments (Chan, 2016; Chandra and Staiger, 2007). For instance, financial and liability considerations may motivate physicians to perform unnecessary procedures (Clemens and Gottlieb, 2014; Currie and MacLeod, 2008). Less studied is the impact of patient-physician relationships on physician practices, despite the fact that physicians' decisions are not based solely on clinical documents (Johnson et al., 2016). Interpersonal interactions between patients and physicians are also critical for effective history-taking, physical exams, diagnostic tests, results interpretation, and patients' adherence to treatment. Our study contributes to a deeper understanding of physician practice variability that arises from the clinical encounter.

Our work also contributes to the broader literature on racial interactions. In addition to the large literature on the labor market, the importance of racial interactions has recently been documented in the economics literature on education, law, and finance. For example, assignment to a same-race teacher has been found to generate academic gains for students at different educational stages (Dee, 2004; Fairlie et al., 2014), and a suit in small claims courts is more likely to be settled in the plaintiff's favor if assigned to a judge of the same ethnicity (Shayo and Zussman, 2011). In the credit market, having an in-group loan officer increases credit access and reduces defaults (Fisman et al., 2017), and the officer's prior exposure to religious conflicts leads to lower lending rates and default rates for out-group borrowers (Fisman et al., 2020). Our study contributes to this broader literature by studying racial interactions in health care and substantiating the information and communication mechanism for racial interactions.

The rest of the paper is organized as follows. Section II describes the institutional background and administrative dataset. In Sections III and IV, we estimate the effect of patient-physician race concordance on physician decision-making and patient health outcomes, respectively. In Section V, we examine the heterogeneity of our results by patient and physician characteristics and the effect of race concordance on patient diagnosis granularity. Section VI concludes with a policy discussion.

II. Institutional Setting and Administrative Data

In this section, we describe the institutional background, introduce the administrative data, and define the main variables.

A. Institutional Background

We study a large ED in Singapore with a high frequency of patient visits. Patients with a wide variety of complaints and symptoms self-present or arrive by ambulance. Upon arrival at the ED, patients are assessed by a triage nurse and categorized into one of three severity levels, where level 1 refers to the most severe cases, level 2 to major emergencies, and level 3 to minor emergencies.

Depending on their triage severity level, patients are assigned to one of two treatment areas within the department for consultation with physicians. Patients who have serious illnesses and injuries (severity levels 1 and 2; henceforth severe cases) are usually seen in the acute care area, and patients with mild conditions (severity level 3; henceforth nonsevere cases) in the urgent care section. ED physicians generally work in one of the two areas during a single shift.[3] Their shifts are scheduled at least weeks in advance,[4] and they are expected to cover work during shifts with different start times in both areas. During a shift, physicians cannot control the volume of ED arrivals or the types of patients assigned to them.

The order and priority of emergency treatment is strictly determined by patients' triage severity level and arrival time. A patient scheduling system automatically assigns waiting patients to available physicians. In the acute care area, severity level 1 patients are always picked up before level 2 patients. Within each of the three triage severity levels, patients are sorted by the time of arrival. Physicians generally attend to a new patient from the top of the patient queue, which ensures that for a given severity level, the earliest arrival is always treated first. Other factors like patient race are not of concern in patient-to-physician assignment.

In sum, the pairing of patients and physicians is largely random as a result of the unplanned nature of ED visits, predetermined physician shift schedules, and the exogenous patient assignment system. This institutional feature offers the opportunity to identify the effect of race concordance on physician decision-making in the field. In most health care settings, patients are not randomly assigned to physicians; patients who have a choice of physician are likely to be race concordant (LaVeist and Nuru-Jeter, 2002). Endogenous matching between patient and physician has thus been regarded as a critical challenge in the literature.

Preexisting relationships between patients and physicians are rare in an ED environment. Patients who seek emergency care and the physicians who are on duty to treat

[3]The close proximity of the two treatment areas allows physicians to cross-cover areas during surge periods, when there is an imbalance of patients in the two areas.

[4]Physicians' shift schedules are not publicly available. Patients have no information on which physician will be on shift before their ED visits.

them are generally meeting for the first time. Whether race concordant or not, the only evidence available to the physician is the patient's demographic characteristics, symptoms, and medical history (as imperfectly recalled by the patient) (Groopman, 2008). High patient loads and the emergent nature of patient care require that physicians make quick clinical judgments based on limited information.

Finally, physicians' decisions in the ED we study are not influenced by financial incentives. Government subsidies are provided for every ED patient regardless of nationality, and all patients incur a fixed attendance fee upon registration.[5] Physicians are paid a basic monthly salary with a fixed shift allowance, and are not rewarded for the quality or amount of work performed during the shift.

B. Administrative Data

We obtain administrative data for all patient visits to a large ED in Singapore from January 1, 2011, through December 31, 2012. The hospital information system documents comprehensive records for each visit, including patient characteristics, physician identifier, clinical decisions, patient outcomes, and timestamps for the patient's path through the ED. The information system also provides demographic profiles for each physician in the ED.

Figure A.1 illustrates the patient flow process in the ED. Upon arrival at the ED, patients are registered and seen by a triage nurse who classifies patients in different severity levels on the basis of acuity and resource needs. A scheduling system then determines the assignment of patients to an on-shift physician and the order of consultations based on their triage severity level and arrival time. A few patients leave after the initial consultation, but most undergo some type of diagnostic testing such as lab work or X-rays, or receive treatment by a nurse or physician assistant. When test results are available or the treatment is completed, the patient is reviewed by the same physician before being discharged or hospitalized.

The administrative dataset records real-time patient flow in the ED. The dataset is

[5]In Singapore, emergency services are subsidized by the government at 50%. Patients pay a flat attendance fee of around SGD 120 per visit.

organized by patient visits, with each record corresponding to a single visit. Each record contains detailed timestamps for the patient's complete path through the ED, such as when a patient arrived at the ED, when the patient was seen by a physician, and when the physician made a final decision for patient admission or discharge. For each visit, the physician who carried out patient care is identified by a unique ID. Since the dataset records information on clinical workflow for all visits, we are able to track the universe of physicians' activities in the ED.

Over the 2 years, we observe 264,115 raw patient visits to the ED. We construct real-time patient flow volume and physician shift schedules using all visits.[6] For the purpose of analysis, we restrict the sample to patient visits in which patient-physician race concordance status is well identified.[7] We also exclude visits in which the patient died upon arrival, left before being seen, or self-discharged against medical advice. Finally, we limit our attention to physicians who treat a minimum of 100 patients during the 2-year period. These exclusions restrict the sample to 254,327 patient visits with treatment by 129 physicians.

C. Main Variables and Summary Statistics

Patient-physician Race Concordance. The hospital information system contains information on the race of each patient and physician. Individuals are grouped into four main ethnic groups in Singapore: Chinese, Malay, Indian, and other ethnicities. Panel A of Table 1 presents the ethnicity compositions of the patient and physician population. Chinese represent the majority of patients (54.9%) and physicians (72.9%). Malays and Indians constitute 20.2% (3.1%) and 16.4% (17.1%) of patients (physicians), respectively. Chinese are underrepresented in the patient sample and Malays are underrepresented

[6]Following the procedure of Brachet et al. (2012), we construct physicians' shifts based on their periods of inactivity, which is identified by their absence from the administrative data. Sorting data first by physician ID, then by the date and time during which physicians were involved in each patient visit, we define the beginning of a new shift when 6 or more hours have elapsed between consecutive observations of the same physician. Our results remain robust if we use 4-hour and 5-hour cutoffs to define new shifts.

[7]We exclude visits in which either the patient's or the physician's race is missing. We also exclude visits in which the patient's and the physician's races are both coded as unspecified "others," since we cannot tell whether they are of the same race.

in the physician sample, relative to the population in Singapore (Chinese 74.3%, Malay 13.4%, Indian 9%, Other 3.2%).[8]

The main independent variable of interest is the status of race concordance between patients and their treating physicians. We stratify patient-physician pairs into race-concordant and race-discordant relationships. A race-concordant patient refers to a patient being seen by a physician of the same race, while a race-discordant patient refers to the patient being treated by a physician of another race group. The last row in Panel A shows that 40.5% of patients treated in the ED were race concordant.

Physician Decisions. Physicians in the ED provide immediate evaluation, care, and stabilization to patients, and at the same time act as gatekeepers to inpatient specialist units. We use three measures for physician decisions: (i) inpatient admission, (ii) order of advanced diagnostic imaging, and (iii) patient length of consultation. Panel B of Table 1 presents the summary statistics for these decision variables.

Patient disposition is the primary product of ED care and a matter of discretion for physicians (Chan, 2018). After completion of diagnosis and treatment, the physician may discharge a patient to home or refer him or her to a primary care center for follow-up treatment. If a patient has a serious condition that renders outpatient discharge dangerous, the physician will admit the patient for inpatient treatment. The decision to admit the patient does not necessarily mean the end of ED care, as inter-unit handoffs from the ED to inpatient care require coordination between different parties. Patients awaiting inpatient admission may have to remain in the ED for at least several hours. We focus on the decision to admit the patient for inpatient care as a main outcome measure, which accounts for 21.4% of sample visits.

We also examine physicians' input for diagnostic testing and consultation time. Formal diagnostic tests are an effective way for physicians to gather information on patients' clinical conditions. However, the ease of obtaining high-resolution images for analysis comes at a price: The use of advanced diagnostic imaging (i.e., CT or MRI scans) is one

[8] Singapore demographic profile 2018, https://www.indexmundi.com/singapore/demographics_profile.html.

of the fastest growing categories of medical expenditure in the US, and the ED is one of the largest venues for imaging use (Mills et al., 2015). As many as 20% to 50% of high-tech imaging procedures are medically unnecessary.[9] We measure whether a patient received any advanced diagnostic imaging in the ED, which accounts for 5.7% of patient visits in our analytic sample.

Time with the patient is another important input in the production of information. Careful history-taking and physical examinations enhance patient-physician interactions and often provide information that cannot be gained by advanced diagnostic technologies (Reilly, 2003). We measure patient length of consultation as the minutes elapsed from the start to the end of the patient's consultation with the specific physician.[10] As shown in Panel B of Table 1, on average, a patient stayed for approximately 1 hour in the ED.

Patient Outcomes. We focus on two measures of patient health outcomes: ED revisits and mortality.[11] ED revisits measure whether a patient revisited the same ED within 1 week after being discharged.[12] ED mortality indicates whether a patient died in the ED after being assigned to a physician. Panel C of Table 1 reports the summary statistics for these two variables. The 7-day revisit rate is 10.1% and the ED mortality rate is 0.3%.

Patient Characteristics. We observe much of the information available to the physician at the time of seeing the patient, including the patient's gender, age, race, and triage severity level. Panel D of Table 1 reports summary statistics for patient characteristics. In our data, 64.9% of patients who visited the ED during the sample period were men. The average age of patients was around 40 years. Overall, 71% of patient visits were minor emergency cases, 4.1% were level 1 cases, and 24.9% were level 2.

We also have diagnostic information for each patient. This information is only in-

[9]U.S. Food and Drug Administration, "Initiative to Reduce Unnecessary Radiation Exposure from Medical Imaging." Available at: https://www.fda.gov/radiation-emitting-products/radiation-safety/initiative-reduce-unnecessary-radiation-exposure-medical-imaging.

[10]This time duration includes the time for history-taking, initial examination, formal tasks, and review of test results, but excludes waiting times for initial consultation and admission to an inpatient ward.

[11]Since our data are confined to what happens within the specific ED, we are only able to use these two variables to measure patient health outcomes.

[12]We identify multiple visits for the same patient using comprehensive patient information that includes gender, race, birthdate, and home address.

completely known by physicians prior to consultation via the patient's "chief complaint." Formal diagnostic judgments are made after physicians interact with patients or review their test results. We codify the diagnostic information into 19 broad categories based on ICD-9 diagnosis codes.[13]

Patient arrivals at the ED are not smooth; we observe considerable fluctuations in ED occupancy over time. For example, Sundays and Mondays were the busiest days, and 10 am to 3 pm and 8 pm to 11 pm were the two peak periods within a day. The total number of patient visits increased over the 2 years, and ED patient volumes varied across months. We include a set of time fixed effects—hour of day, day of week, and month-year interactions—in our regression analysis to account for time variations.

III. Impacts of Race Concordance on Physician Decisions

In this section, we estimate the effect of patient-physician race concordance on physician decisions, controlling for patient demographics, triage severity levels, diagnostic categories, time fixed effects, and physician fixed effects. We also conduct IV estimations to further address concern regarding potential nonrandom patient-to-physician assignments.

A. Regression Specification

Our empirical strategy compares physician decision making when treating race-concordant patients with that when treating race-discordant patients. We start from a linear model in which we assume that race matching between patients and physicians is random conditional on observable patient and physician characteristics. The main econometric model

[13] Diseases are classified into 19 broad categories: infectious and parasitic diseases, neoplasms, endocrine-nutritional-metabolic diseases, diseases of the blood, mental disorders, diseases of the nervous and sense system, diseases of the circulatory system, diseases of the respiratory system, diseases of the digestive system, diseases of the genitourinary system, complications of pregnancy and childbirth, diseases of the skin and subcutaneous tissue, diseases of the musculoskeletal system, congenital anomalies, disorders originating in the perinatal period, signs-symptoms, injury-poisoning, external causes of injury, and supplementary classification.

of physician decisions at the patient-visit level is given by

$$y_{ijt} = \beta_0 + \beta_1 RaceConcordance_{ij} + X_{it}\gamma + \nu_j + \epsilon_{ijt}, \quad (1)$$

where decision y_{ijt} is indexed for patient i treated by physician j starting consultation at time t. For disposition decisions, y_{ijt} is a dummy variable that equals one if patient i is admitted to inpatient care and zero otherwise; for the ordering of diagnostic tests, y_{ijt} is a dummy variable that equals one if patient i receives any advanced diagnostic imaging and zero otherwise; for consultation length, y_{ijt} takes log transformation. We fit linear models for all outcomes and conduct additional probit and logit regressions for the binary variables of inpatient admission and test ordering. Our interested independent variable, $RaceConcordance_{ij}$, indicates whether patient i and physician j are of the same race. Its coefficient β_1 captures the difference between physicians' decisions when treating race-concordant patients relative to treating race-discordant patients.

We condition the regression on a set of case characteristics X_{it} and physician fixed effects ν_j. Case characteristics include patient race, gender, age, triage severity, diagnostic categories, and time fixed effects. Time fixed effects include hour of day, day of week, and month-year interactions. Physician fixed effects ν_j captures the effect of physician race, as well as all other time-invariant physician heterogeneities. That is, we study within-physician variations in medical decisions rather than across physician variations. This is important, because physicians may differ inherently in terms of practice style and decision criteria. Finally, the error term, ϵ_{ijt}, captures measurement errors. We cluster standard errors at the physician level throughout.

B. Main Results

Table 2 presents linear estimation results from versions of Equation (1) with varying sets of control variables.[14] The dependent variable in Panel A is the decision to admit the patient for inpatient care. The coefficient on race concordance is negative and statisti-

[14]To save space, we only report estimates for the main coefficient, i.e., β_1. Estimates for coefficients on other control variables have expected signs and magnitudes. Full results are available upon request.

cally significant in column (1), where we control only for racial backgrounds of the patient and treating physician. The negative estimate indicates that on average, race-concordant patients have lower admission rates than race-discordant patients. The negative estimate persists in column (2), where we control for various case characteristics including patient demographics, triage severity, diagnostic category, and time fixed effects. Column (3) shows that the result remains essentially unchanged when we further control for physician fixed effects. In the full model (column (3)), the coefficient estimate is -0.0184 (standard error 0.0025). Race-concordant patients are 1.84 percentage points less likely to be admitted to hospital compared with race-discordant counterparts, which translates into an 8.6% reduction given the sample mean admission rate of 21.4%. Table A.1 reports marginal effects from probit and logit models. The results remain statistically significant and have similar economic magnitudes as the OLS estimates. Henceforth, we only discuss OLS estimates.

Panel B examines the effect of race concordance on the ordering of advanced diagnostic imaging tests. Estimates under different specifications through columns (1) to (3) remain negative, with coefficients ranging from -0.0050 to -0.0057. This suggests that race-concordant patients are less likely to receive advanced diagnostic imaging compared with race-discordant patients, though the difference is not statistically significant. The results are robust to alternative measures of task ordering, including the use of laboratory tests, the use of medical imaging, and the total number of medical procedures performed on the patient (Table A.2).[15] Race concordance between patients and physicians has some negative but statistically insignificant effects on physicians' ordering of formal medical tasks.

Panel C shows that race-concordant patients have longer consultations than race-discordant patients. Models with different control variables estimate statistically significant and positive coefficients on race concordance. The estimated effect of race concordance ranges from 0.0229 to 0.0431 under different specifications. The full model (column

[15] Laboratory test utilization measures whether the patient undergoes any laboratory tests such as blood and urine tests. Imaging utilization indicates whether the patient receives any form of diagnostic imaging, including X-ray, ultrasound, CT, and MRI scans. The number of medical procedures counts the total number of diagnostic tests and treatments performed on the patient.

(3)) suggests that consultations are 2.3% longer for race-concordant patients than for race-discordant patients.

These results suggest that race concordance plays a significant role in physician decision-making. Patient-physician race concordance increases patient consultation time and decreases the probability of inpatient admissions and the use of diagnostic tests.

C. Consideration of Nonrandom Patient Assignment

Although the ED provides a context in which race is less of concern in patient-to-physician assignments, the challenge to causal inference based on OLS estimates remains. For example, ED staff, such as triage nurses, may observe patients' language ability and assign low-English-proficiency patients to physicians who can understand patients' non-English mother tongues. If this were the case, patients with limited English proficiency may have been more likely to be treated by physicians of their own race. Our OLS estimates would be biased if language proficiency, which is unobserved by researchers, correlates with physician decision making.

We address this concern using an IV method. Our instrument for race concordance is the proportion of on-shift physicians who shared the same race with the index patient at the time of the patient's arrival. This proportion strongly predicts the probability of the index patient's being treated by a same-race physician, but is orthogonal to unobservable case characteristics due to the unexpected nature of patient arrivals and predetermined physicians' shift schedules.[16] Panel A of Table 3 reports first-stage results, showing a strong positive correlation between the proportion of a patient's same-race physicians and the patient's race-concordance status. The coefficients are around 0.78, with t-statistics around 11, suggesting that the weak instrument problem is not a serious concern in our study.

Panel B shows that the signs of IV estimates are consistent with OLS estimates. Column (1) suggests that race-concordant patients are 1.39 percentage points less likely to be

[16] As discussed in Section II, information on physician work schedules is publicly unavailable. Patients are not likely to schedule their ED visits to meet physicians of a specific race; their arrival times are supposed to be orthogonal to the race composition of on-shift physicians.

admitted, which translates into a 6.5% reduction in the probability of inpatient admission. In column (2), race concordance exhibits a negative but statistically insignificant effect on the ordering of advanced diagnostic imaging. Column (3) shows that race concordance is associated with a 7.8% increase in length of consultation, which is statistically significant and larger than the OLS estimate. Results of the Hausman test show that differences between OLS and IV estimates are statistically significant at the 1% level for consultation length, but statistically insignificant for the other two decision measures.

A potential explanation for the difference between OLS and IV estimates for length of consultation is that, as described above, ED staff—such as triage nurses—may observe a patient's English proficiency and communication skills during the patient's registration, and assign patients with limited English proficiency or poor communication skills to physicians of their own race. These patients, on average, are less talkative and have shorter consultation time compared with others, which biases downward the OLS estimate of the positive race-concordance effect on length of consultation. Apart from the differences in consultation time, language proficiency and communication skills do not correlate with patients' unobservable health conditions. Thus, we do not observe significant differences between OLS and IV estimates of the race-concordance effect on admission decisions and test ordering.

We conduct another analysis on a restricted patient sample to address concern regarding potential nonrandom pairing of patients and physicians. This study sample includes only patients who arrive when the share of their own-race physicians is either zero or one. In both circumstances, ED staff has no discretion in manipulating the patient's race-concordance status. A patient will be race-concordant with certainty if all on-shift physicians share the same race as the patient, and race-discordant with certainty if all on-shift physicians are of other race groups. The results for this restricted sample, shown in Table A.3, are qualitatively similar to those obtained for the whole sample.

The two sets of analyses suggest that the observed differences in physician decisions could be interpreted as a causal relationship. The ED is an environment with particularly low information, which physicians collect through interviews or tests. Because of the potential communication problem in race-discordant pairs, a physician may use less of her own time to collect information but utilize more diagnostic testing and inpatient admissions.

IV. Impacts of Race Concordance on Patient Outcomes

The previous section demonstrates that patient-physician race concordance affects physician decision-making. In this section, we examine the impact of race concordance on patient health outcomes. As discussed in Section II, we focus on two patient outcomes: whether a patient revisited the same ED within 1 week after ED discharge and whether the patient died in the ED after arrival.

We conduct regression analyses that control for a full set of case characteristics and physician fixed effects. The regression specification is similar to Equation (1), but uses different dependent variables. For ED revisits, we focus on the sample of discharged patients; the outcome variable is a dummy variable that equals one if the patient revisited the ED within 1 week after ED discharge and zero otherwise. For mortality, the outcome variable is a dummy variable that equals one if the patient died in the ED after arrival and zero otherwise.

Table 4 reports the estimation results. Panel A of column (1) presents the OLS estimate of the race-concordance effect on ED revisits. The estimated coefficient on race concordance is negative and statistically significant at the 10% level. The coefficient estimate of -0.0036 (standard error 0.0021) implies that race-concordant patients are 0.36 percentage points less likely to revisit the ED within 1 week after ED discharge. This represents a 3.6% reduction given the sample mean revisit rate of 10.1%.

We also conduct IV estimation using the proportion of same-race physicians as the instrument, as in Section III.C. Panel C of column (1) shows that the IV estimate remains negative and statistically significant. The magnitude of the IV estimate is larger than that of the OLS estimate (point estimates, -0.0085 versus -0.0036). The difference, however, is statistically insignificant, with the p value of the Hausman test being around 0.275.

Column (2) reports the estimates of the effect of race concordance on mortality in the ED. Both OLS and IV estimates are negative, but also small in magnitude and statistically insignificant. The estimates imply that patient-physician race concordance has little effect on the probability of death in the ED. This result is in line with predictions from the informational channel: For patients with acute life-threatening emergencies, physicians barely have time to communicate or interact with patients, and instead must begin treatment immediately. Race concordance between patients and physicians thus has little impact on these patients' treatments or health outcomes.

Taken together, our results suggest that patient-physician race concordance may improve the quality of physician decision-making. Race-concordant patients have a lower probability of ED revisits after being discharged, despite their lower probability of inpatient admission. These results imply that physicians make more accurate disposition decisions for their race-concordant patients, which reduce both wrongful ED discharges and avoidable inpatient admissions.

V. Heterogeneity and Diagnosis Granularity

We have already shown that patient-physician race concordance affects physician decision-making and patient health outcomes. In this section, we investigate whether the effect is heterogeneous with respect to case severity, diagnostic category, and physician experience. We also explore the effect of race concordance on the granularity of patients' diagnosis codes. The results of these analyses are broadly consistent with the informational and communication channel: Communication problems in the clinical encounter result in disparities in the use of healthcare resources between race concordant and discordant patients.

A. Heterogeneity by Emergency Severity

Patients with different triage severity levels are assigned to physicians. Severe cases should be attended to without delay in the acute care area. Nonsevere cases with mild conditions are treated in the urgent care section. We examine how the effect of race concordance varies across severe versus nonsevere cases. We add to our baseline regression the interaction term between race concordance and an indicator of severe cases.

Table 5 reports the estimation results. Estimates in the first row (β_1) reflect the role of race concordance in nonsevere cases. Columns (1) to (3) report results on physician decision-making. For nonsevere cases, race concordance is associated with fewer inpatient admissions, lower rates of advanced diagnostic imaging, and longer consultation time. All of these effects are statistically significant at the 1% level. Column (4) shows that nonsevere cases have a lower probability of return visits after ED discharge, which is statistically significant at the 10% level. Finally, column (5) shows that race concordance has no effect on mortality in the ED for nonsevere cases.

In the second row, coefficients on the interaction term (β_2) capture differences in the race-concordance effect between severe and nonsevere cases. The coefficients, with only one exception, have an opposite sign compared with those on race concordance.[17] In each column, the sum of coefficients in the first and second rows ($\beta_1 + \beta_2$) measures the role of race concordance for severe cases. P values reported in the third row indicate that none of these effects are statistically significant at the 10% level. The results suggest that race concordance has little impact on physician decisions and patient health outcomes for severe cases.

As in Section III, we also conduct analyses on alternative measures of task ordering. Table A.4 reports the estimation results. We find that race concordance reduces the use of laboratory tests, the use of medical imaging, and the total number of medical procedures for nonsevere cases. Consistent with the findings in Table 5, the tasks performed in the care of severe cases are less affected by the status of patient-physician race concordance.

[17] For death in the ED, coefficients have a negative sign in both the first and second rows. The two coefficients are both small in magnitude and statistically insignificant.

The fact that race concordance plays a larger role for patients with lower severity levels is presumably due to the increased patient-physician interactions in nonsevere cases. For severe emergency patients who need immediate surgery or treatment, interactions between physicians and patients tend to be limited. Physicians have to begin treatment immediately. As a result, the status of race concordance does not matter much for severe cases. On the other hand, for nonsevere cases, physicians tend to have more time and engage in more interactions with patients before making a clinical decision. This allows for more detailed history-taking and closer physical examinations.

B. Heterogeneity by Clinical Diagnoses

We next examine whether the effect of race concordance varies with patients' clinical conditions. Specifically, we focus on four common conditions: (i) intestinal infections, (ii) diseases of the respiratory system, (iii) superficial injury, and (iv) external causes of injury. These clinical circumstances differ widely in terms of the obviousness of symptoms or diagnoses, and require different levels of information collection during the patient-physician encounter. We estimate Equation (1) separately for patients diagnosed with the four conditions.

Table 6 reports estimates of β_1 for each of the four diagnostic groups. Panel A and Panel B suggest that race concordance has statistically significant effects for patients who are diagnosed with intestinal infections or respiratory system diseases. Consistent with our baseline results, race concordance is associated with lower admission rates, longer consultation time, and lower revisit rates in the two subsamples. In contrast, estimates in Panels C and D are small in magnitude and lack statistical significance. Race concordance has little impact for patients who visited the ED because of a superficial injury or external causes of injury.

The differences in race-concordance effects across conditions may be caused by differences in clinical uncertainty. For a superficial injury, physicians could observe directly the location of the injury and apply standard procedures to prevent infection. For external causes of injury, physicians know the explicit causes of patients' injuries. In both circumstances, physicians usually face less uncertainty in choosing medical procedures. In contrast, since symptoms or causes tend to be less obvious for intestinal infections and respiratory system diseases, physicians face more uncertainty in determining patient diagnoses and choosing appropriate treatments, and thus are likely to rely more on interactions with patients for clinical information. This results in a larger effect of race concordance for cases with less clear causes or less obvious symptoms.

C. Heterogeneity by Physician Experience

We now turn to evaluating how the effect of race concordance differs by physicians' experience. This analysis may inform us regarding whether the race-concordance effect requires time to develop, or if its importance diminishes over time. We define a physician as more experienced if she has more than the median experience in the sample (8 years).[18] Table 7 presents results from a specification that includes the indicator of experienced physician and its interaction with race-concordance status.

We find qualitatively similar coefficients on race concordance (β_1) compared with our baseline results. This suggests that the effect of race concordance is seen for less experienced physicians. We also observe that in columns (1) to (4), coefficients on the interaction term (β_2) have the same sign as those on race concordance (β_1). Race concordance reduces the probability of inpatient admission and the probability of ED revisits after discharge to a significantly larger extent for experienced physicians than for less experienced physicians. In column (5), for ED mortality, β_1 and β_2 have opposite signs. The two coefficients are both small in magnitude and statistically insignificant.

The observed patterns suggest that physicians are "endowed" with an advantage in communicating with and getting information from their race-concordant patients. Physicians, experienced or not, tend to increase consultation time and decrease the use of formal medical resources for race-concordant patients compared with race-discordant patients. Moreover, the advantage of evaluating race-concordant patients is larger for experienced physicians than for less experienced physicians. This result does not necessarily rule out

[18]Physician experience is defined as the number of years since a physician obtained his or her first degree to practice medicine.

the possibility that a particular physician may learn over time about the health beliefs, language, and communication habits of a certain ethnic group as she increases her experiences and interactions with that group.[19] Indeed, a cohort of experienced physicians may differ from a cohort of less experienced physicians. In columns (1) and (2) of Table 7, coefficients on the indicator of experienced physician and its interaction with race concordance are both negative, suggesting that experienced physicians admit fewer patients for inpatient care and order fewer diagnostic tests than less experienced physicians. It is likely that experienced physicians rely less on technology and more on history-taking and physical diagnostic skills compared with their younger colleagues;[20] they gather more information from interactions with patients, especially with their race-concordant patients.

D. Race Concordance on Diagnosis Granularity

We conclude our analysis by comparing the granularity of diagnoses recorded for race-concordant and discordant patients. Balsa and McGuire (2001) suggest that the granularity of the physician's diagnosis can be measured by the length of ICD-9 diagnosis codes assigned to patients. Their model of information-based disparities predicts that physicians record fewer and vaguer diagnoses for out-group patients.

The basic ICD-9 diagnosis code structure is three digits, but some codes are more specific with a fourth and sometimes a fifth digit subdivision.[21] The extra digits provide greater detail about the diagnosis. In our data, nearly one-half of patient diagnoses are assigned four- or five-digit ICD-9 codes.[22] We define a detailed diagnosis as a dummy variable that equals one if the ICD-9 code has four or five digits, and zero otherwise.

Table 8 reports the estimate of the effect of race concordance on the use of detailed diagnosis codes. The estimate on race concordance is positive and statistically significant

[19]Each physician in our sample is observed for at most 2 years in the particular ED. It is difficult to track the dynamics of the effect of race concordance over a physician's career using our data.

[20]For example, Ivtzan (2019) states that "young doctors, accustomed to working with technology, may rely more on data from laboratory tests than the story told by the patient believing that this is more efficient and accurate."

[21]For example, the ICD-9 code 274 is "Gout"; the ICD-9 code with an extra digit 274.0 is "Gouty arthropathy"; and the code with two extra digits 274.01 is "Acute gouty arthropathy."

[22]This number is different from that in the US, where ICD-9 diagnosis codes are used for claims reimbursement and should provide sufficient clinical specificity (at least 4 digits).

at the 10% level. Race-concordant patients are 0.58 percentage points more likely to be assigned a detailed diagnosis than race-discordant patients, which represents a 1.3% increase relative to the detailed diagnosis rate of 43.7%. This result is consistent with Balsa and McGuire's (2001) prediction that physicians would use vaguer diagnoses for patients of other ethnic groups as a result of information insufficiency and communication problems.

VI. Conclusion

In this paper, we examine the effect of patient-physician race concordance on physician decision-making and patient health outcomes in an ED setting. We find that patient-physician race concordance increases consultation time and decreases the probability of inpatient admission and use of diagnostic testing. Subsequently, race-concordant patients have lower revisit rates after ED discharge. The effect is larger for patients who have less serious illnesses, and whose diseases have nonspecific symptoms or less clear causes. Finally, race concordance also has a positive effect on the granularity of patients' diagnosis codes.

Our findings are best explained by the informational and communication mechanism. Physicians in the ED are provided with only limited information on patients' conditions. As a result, they must collect information for diagnoses and treatments from interviews or tests and make rapid judgments within tight time constraints. A shared race between patients and physicians may facilitate more effective communication. Physicians obtain more accurate information from their race-concordant patients, which leads to less use of formal medical resources and better treatment outcomes. Alternative mechanisms, such as racial prejudice, are less consistent with our findings.

Our results suggest that demographic matches between patients and physicians contribute to better quality of care. A direct implication for an effective health care system is to increase racial diversity in the physician workforce. More broadly, information-based policies that reduce medical uncertainty would be beneficial (Balsa and McGuire, 2003).

For example, medical schools could emphasize cultural competency in education; hospitals facilitate better patient-physician communication through training and interpreter services.

References

Aigner, Dennis J. and Glen G. Cain, "Statistical Theories of Discrimination in Labor Markets," *Industrial and Labor Relations Review*, 1977, *30* (2), 175–187.

Alsan, Marcella and Marianne Wanamaker, "Tuskegee and the Health of Black Men," *Quarterly Journal of Economics*, 2018, *133* (1), 407–455.

__ , Owen Garrick, and Grant Graziani, "Does Diversity Matter for Health? Experimental Evidence from Oakland," *American Economic Review*, 2019, *109* (12), 4071–4111.

Altonji, Joseph G. and Rebecca M. Blank, "Race and Gender in the Labor Market," *Handbook of Labor Economics*, 1999, *3*, 3143–3259.

Anwar, Shamena and Hanming Fang, "Testing for the Role of Prejudice in Emergency Departments Using Bounceback Rates," *The B.E. Journal of Economic Analysis & Policy*, 2012, *13* (3), 1–49.

Arrow, Kenneth J., "Uncertainty and the Welfare Economics of Medical Care," *American Economic Review*, 1963, *53*, 941–973.

__ , "The Theory of Discrimination," in Orley Ashenfelter and Albert Rees, eds., *Discrimination in Labor Markets*, Princeton, NJ: Princeton University Press, 1973.

Balsa, Ana I. and Thomas G. McGuire, "Statistical Discrimination in Health Care," *Journal of Health Economics*, 2001, *20* (6), 881–907.

__ and __ , "Prejudice, Clinical Uncertainty and Stereotyping as Sources of Health Disparities," *Journal of Health Economics*, 2003, *22* (1), 89–116.

__ , __ , and Lisa S. Meredith, "Testing for Statistical Discrimination in Health Care," *Health Services Research*, 2005, *40* (1), 227–252.

Becker, Gary S., *The Economics of Discrimination*, Chicago & London: University of Chicago Press, 1957.

Brachet, Tanguy, Guy David, and Andrea M. Drechsler, "The Effect of Shift Structure on Performance," *American Economic Journal: Applied Economics*, 2012, *4* (2), 219–46.

Chan, David C., "Teamwork and Moral Hazard: Evidence from the Emergency Department," *Journal of Political Economy*, 2016, *124* (3), 734–770.

— , "The Efficiency of Slacking Off: Evidence from the Emergency Department," *Econometrica*, 2018, *86* (3), 997–1030.

Chandra, Amitabh and Douglas O. Staiger, "Productivity Spillovers in Health Care: Evidence from the Treatment of Heart Attacks," *Journal of Political Economy*, 2007, *115* (1), 103–140.

— **and** — , "Identifying Provider Prejudice in Healthcare," *NBER Working Paper No.w16382*, 2010.

— **and Jonathan Skinner**, "Geography and Racial Health Disparities," in Rodolfo A Bulatao Norman B Anderson and Barney Cohen, eds., *Critical Perspectives on Racial and Ethnic Differences in Health in Late Life*, Washington (DC): National Academies Press (US), 2004.

Clemens, Jeffrey and Joshua D Gottlieb, "Do Physicians' Financial Incentives Affect Medical Treatment and Patient Health?," *American Economic Review*, 2014, *104* (4), 1320–49.

Cooper-Patrick, Lisa, Joseph J. Gallo, Junius J. Gonzales, Hong Thi Vu, Neil R. Powe, Christine Nelson, and Daniel E. Ford, "Race, Gender, and Partnership in the Patient-Physician Relationship," *JAMA*, 1999, *282* (6), 583–589.

Currie, Janet and W. Bentley MacLeod, "First Do No Harm? Tort Reform and Birth Outcomes," *Quarterly Journal of Economics*, 2008, *123* (2), 795–830.

— **and** — , "Diagnosing Expertise: Human Capital, Decision Making, and Performance among Physicians," *Journal of Labor Economics*, 2017, *35* (1), 1–43.

Cutler, David, Jonathan S. Skinner, Ariel Dora Stern, and David Wennberg, "Physician Beliefs and Patient Preferences: A New Look at Regional Variation in Health Care Spending," *American Economic Journal: Economic Policy*, February 2019, *11* (1), 192–221.

Dee, Thomas S., "Teachers, Race, and Student Achievement in a Randomized Experiment," *Review of Economics and Statistics*, 2004, *86* (1), 195–210.

Fairlie, Robert W., Florian Hoffmann, and Philip Oreopoulos, "A Community College Instructor Like Me: Race and Ethnicity Interactions in the Classroom," *American Economic Review*, 2014, *104* (8), 2567–91.

Finkelstein, Amy, Matthew Gentzkow, and Heidi Williams, "Sources of Geographic Variation in Health Care: Evidence from Patient Migration," *Quarterly Journal of Economics*, 2016, *131* (4), 1681–1726.

Fisman, Raymond, Arkodipta Sarkar, Janis Skrastins, and Vikrant Vig, "Experience of Communal Conflicts and Inter-group Lending," *Journal of Political Economy*, 2020, *forthcoming.*

— , **Daniel Paravisini, and Vikrant Vig**, "Cultural Proximity and Loan Outcomes," *American Economic Review*, 2017, *107* (2), 457–92.

Greenwood, Brad N., Seth Carnahan, and Laura Huang, "Patient–Physician Gender Concordance and Increased Mortality among Female Heart Attack Patients," *Proceedings of the National Academy of Sciences*, 2018, *115* (34), 8569–8574.

Groopman, Jerome, *How Doctors Think*, Boston, Massachusetts: Houghton Mifflin Harcourt, 2008.

Institute of Medicine, *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*, Washington, DC: The National Academies Press, 2003.

Ivtzan, Itai, *Handbook of Mindfulness-based Programmes: Mindfulness Interventions from Education to Health and Therapy*, Routledge, 2019.

Johnson, Erin, M. Marit Rehavi, David C. Chan, and Daniela Carusi, "A Doctor Will See You Now: Physician-Patient Relationships and Clinical Decisions," *NBER Working Paper No.w22666*, 2016.

Lang, Kevin, "A Language Theory of Discrimination," *Quarterly Journal of Economics*, 1986, *101* (2), 363–382.

— **and Jee-Yeon K Lehmann**, "Racial Discrimination in the Labor Market: Theory and Empirics," *Journal of Economic Literature*, 2012, *50* (4), 959–1006.

— **and Kahn-Lang Ariella Spitzer**, "Race Discrimination: An Economic Perspective," *Journal of Economic Perspectives*, May 2020, *34* (2), 68–89.

LaVeist, Thomas A. and Amani Nuru-Jeter, "Is Doctor-Patient Race Concordance Associated with Greater Satisfaction with Care?," *Journal of Health and Social Behavior*, 2002, *43* (3), 296–306.

List, John and Imran Rasul, "Field Experiments in Labor Economics," *Handbook of Labor Economics*, 2011, *4*, 103–228.

Lundberg, Shelly J. and Richard Startz, "Private Discrimination and Social Intervention in Competitive Labor Market," *American Economic Review*, 1983, *73* (3), 340–347.

Meghani, Salimah H., Jacqueline M. Brooks, Trina Gipson-Jones, Roberta Waite, Lisa Whitfield-Harris, and Janet A. Deatrick, "Patient–provider Race-concordance: Does It Matter in Improving Minority Patients' Health Outcomes?," *Ethnicity & Health*, 2009, *14* (1), 107–130.

Mills, Angela M., Ali S. Raja, and Jennifer R. Marin, "Optimizing Diagnostic Imaging in the Emergency Department," *Academic Emergency Medicine*, 2015, *22* (5), 625–631.

Phelps, Charles E., "Information Diffusion and Best Practice Adoption," *Handbook of Health Economics*, 2000, *1*, 223–264.

Phelps, Edmund S., "The Statistical Theory of Racism and Sexism," *American Economic Review*, 1972, *62* (4), 659–661.

Reilly, Brendan M., "Physical Examination in the Care of Medical Inpatients: An Observational Study," *The Lancet*, 2003, *362* (9390), 1100–1105.

Shayo, Moses and Asaf Zussman, "Judicial Ingroup Bias in the Shadow of Terrorism," *Quarterly Journal of Economics*, 2011, *126* (3), 1447–1484.

Spitzer, Ariella Kahn-Lang and Kevin Lang, "How Discrimination and Bias Shapes Outcomes," *In The Future of Children "How Cultural Factors Shape Economic Outcomes,"*, 2020, *30* (1), 165–186.

Trivedi, Amal N., Alan M. Zaslavsky, Eric .C Schneider, and John Z. Ayanian, "Trends in the Quality of Care and Racial Disparities in Medicare Managed Care," *New England Journal of Medicine*, 2005, *353* (7), 692–700.

Tables and Figures

TABLE 1 Summary Statistics

Variable	Observations	Mean	SD
Panel A: Patient and physician composition, by ethnic group			
Patients' ethnic groups			
Chinese	254,327	0.549	0.498
Malay	254,327	0.202	0.402
Indian	254,327	0.164	0.370
Others	254,327	0.085	0.278
Physicians' ethnic groups			
Chinese	129	0.729	0.446
Malay	129	0.031	0.174
Indian	129	0.171	0.378
Others	129	0.070	0.256
Patient-physician race concordance[a]	254,327	0.405	0.491
Panel B: Physician decisions[b]			
Inpatient admission	254,327	0.214	0.410
Advanced diagnostic imaging	213,795	0.057	0.231
Length of stay, minutes	254,327	63.863	74.697
Panel C: Patient health outcomes[c]			
7-day revisit after ED discharge	199,177	0.101	0.302
Death in the ED	254,327	0.003	0.051
Panel D: Patient characteristics[d]			
Male	254,327	0.649	0.477
Age	254,327	39.655	20.603
Triage severity level			
1	254,327	0.041	0.199
2	254,327	0.249	0.432
3	254,327	0.710	0.454

Note: This table presents the ethnicity composition of patient and physician populations, and summarizes patient-physician concordance, physician decisions, patient health outcomes, and patient characteristics for the analytic sample.

[a] Race concordance is a dummy variable that measures whether the patient is treated by a physician of the same ethnic group.

[b] Inpatient admission is a dummy variable that measures whether the patient is admitted for inpatient treatment. Advanced diagnostic imaging is a dummy variable that measures whether the patient receives any CT or MRI scan. Length of consultation measures the minutes elapsed from the start to the end of the patient's consultation. Because information on task orders is only available for a subset of patient visits, observations are fewer for diagnostic tests than for the other two decision measures.

[c] 7-day revisit is a dummy variable indicating whether the patient revisits the same ED within 7 days after being discharged. Death in the ED is a dummy variable that measures whether the patient died in the ED after arrival.

[d] Unlisted variables include patient diagnostic categories and time categories.

TABLE 2 Race Concordance on Physician Decisions

	(1)	(2)	(3)
Dependent variable:	**A. Inpatient admission**		
Race Concordance	-0.0172***	-0.0180***	-0.0184***
	(0.0050)	(0.0024)	(0.0025)
Observations	254,327	254,327	254,327
R-squared	0.010	0.386	0.391
Sample mean outcome	0.214	0.214	0.214
	B. Advanced diagnostic imaging		
Race Concordance	-0.0057	-0.0050	-0.0051
	(0.0047)	(0.0041)	(0.0042)
Observations	213,795	213,795	213,795
R-squared	0.003	0.121	0.123
Sample mean outcome	0.057	0.057	0.057
	C. Log length of stay		
Race Concordance	0.0431***	0.0253**	0.0229**
	(0.0135)	(0.0115)	(0.0115)
Observations	254,327	254,327	254,327
R-squared	0.034	0.264	0.339
Sample mean outcome	3.482	3.482	3.482
Case characteristics	Race	All	All
Physician characteristics	Race	Race	FE

Note: This table presents OLS estimates from versions of Equation (1) with varying sets of control variables. Dependent variables are a dummy variable that equals one if the patient is admitted for inpatient care and zero otherwise (Panel A), a dummy variable that equals one if the patient receives any advanced diagnostic imaging and zero otherwise (Panel B), and patient length of consultation in logarithmic form (Panel C). Race concordance is a dummy variable that equals one if the patient and the physician are of the same race and zero otherwise. Column (1) in each panel controls for the patient's and the physician's race group. Column (2) controls for the physician's race and a full set of case characteristics, including patient race, age, gender, triage severity, diagnostic category, and time fixed effects (hour of day, day of week, and month-year interactions). Column (3) controls for physician fixed effects and the full set of case characteristics. Standard errors reported in parentheses are clustered at the physician level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

TABLE 3 Race Concordance on Physician Decisions: IV Estimates

	(1)	(2)	(3)
Panel A: First stage results			
Dependent variable:	Patient-physician race concordance		
% same-race physician	0.782***	0.788***	0.782***
	(0.0721)	(0.0716)	(0.0721)
R-squared	0.626	0.618	0.626
Sample mean outcome	0.405	0.404	0.405
Panel B: Second stage results	Inpatient admission	Advanced diagnostic imaging	Log length of consultation
RaceConcordance	-0.0139***	-0.0018	0.0781***
	(0.0045)	(0.0048)	(0.0174)
R-squared	0.391	0.123	0.339
Sample mean outcome	0.214	0.057	3.482
p-value of Hausman test	0.2676	0.3501	0.0004
Case characteristics	All	All	All
Physician characteristics	FE	FE	FE
Observations	254,327	213,795	254,327

Note: This table presents IV estimation results for the effect of race concordance on physician decisions. The instrumental variable for race concordance is the proportion of on-shift physicians who shared the same race with the index patient at the time of the patient's arrival. Panel A shows the first-stage relationship between the instrument and the index patient's race-concordance status. Panel B shows second-stage results, i.e., the IV estimates of the race-concordance effect on physician decisions. Outcome variables listed at the top of Panel B are the same as those in Table 2. All columns in each panel control for a full set of case characteristics and physician fixed effects. Standard errors reported in parentheses are clustered at the physician level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

TABLE 4 Race Concordance on Patient Outcomes

	(1)	(2)
Panel A: OLS estimates	7-day revisit	Death in the ED
Race Concordance	-0.0036*	-0.0001
	(0.0021)	(0.0003)
R-squared	0.019	0.068
Sample mean outcome	0.101	0.003
Panel B: First stage results	Patient-physician race concordance	
% same-race physician	0.789***	0.782***
	(0.0758)	(0.0721)
R-squared	0.640	0.626
Sample mean outcome	0.409	0.405
Panel C: Second stage results	7-day revisit	Death in the ED
Race Concordance	-0.0085*	-0.0003
	(0.0050)	(0.0006)
R-squared	0.019	0.068
Sample mean outcome	0.101	0.003
p-value of Hausman test	0.2745	0.7319
Case characteristics	All	All
Physician characteristics	FE	FE
Observations	199,177	254,327

Note: This table reports estimates for the effect of race concordance on patient outcomes. Panel A reports OLS estimates. Panel B and Panel C report first- and second-stage results from the IV estimation, respectively. The instrumental variable for race concordance is the proportion of on-shift physicians who shared the same race with the index patient at the time of the patient's arrival. Outcome variables are listed at the top of each panel. *7-day revisit* is a dummy variable measuring whether the patient revisited the ED within 7 days after being discharged. *Death in the ED* is dummy variable measuring whether the patient died in the ED after arrival. All columns control for a full set of case characteristics and physician fixed effects. Standard errors reported in parentheses are clustered at the physician level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

TABLE 5 Heterogeneous Analysis: Patient Severity

Dependent variable:	(1) Inpatient admission	(2) Advanced diagnostic imaging	(3) Log length of consultation	(4) 7-day revisit	(5) Death in the ED
β_1: Race Concordance	-0.0258***	-0.0097***	0.0436***	-0.0045*	-0.0000
	(0.0023)	(0.0033)	(0.0139)	(0.0023)	(0.0002)
β_2: Race Concordance	0.0243***	0.0131**	-0.0677***	0.0053	-0.0004
$\times$ Severe case	(0.0080)	(0.0054)	(0.0236)	(0.0036)	(0.0006)
P value: $\beta_1 + \beta_2 = 0$	0.8532	0.6561	0.2802	0.8093	0.5003
Observations	254,327	213,795	254,327	199,177	254,327
R-squared	0.391	0.124	0.340	0.019	0.068
Sample mean outcome	0.214	0.057	3.482	0.101	0.003

Note: This table examines the heterogeneous effects of race concordance with respect to patient severity levels. Outcome variables are the same as those in Table 2 and Table 4. *Severe Case* is a dummy variable that measures whether the index patient is triaged as a severe case (severity levels 1 and 2). All columns control for a full set of case characteristics and physician fixed effects. Standard errors reported in parentheses are clustered at the physician level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

TABLE 6 Heterogeneous Analysis: Diagnostic Category

	(1)	(2)	(3)	(4)	(5)
Dependent variable:	Inpatient admission	Advanced diagnostic imaging	Log length of consultation	7-day revisit	Death in the ED
Panel A. Intestinal infection					
Race Concordance	-0.0168***	-0.0001	0.0338	-0.0164*	/
	(0.0051)	(0.0023)	(0.0215)	(0.0093)	
Observations	17,024	10,222	17,024	15,813	
Sample mean outcome	0.071	0.004	3.017	0.111	
Panel B. Diseases of the respiratory system					
Race Concordance	-0.0231***	-0.0009	0.0395**	-0.0152***	0.0000
	(0.0052)	(0.0017)	(0.0191)	(0.0041)	(0.0004)
Observations	44,456	28,774	44,456	37,461	44,456
Sample mean outcome	0.157	0.007	3.148	0.119	0.001
Panel C. Superficial injury					
Race Concordance	-0.0064	0.0009	-0.0141	0.0045	/
	(0.0044)	(0.0029)	(0.0236)	(0.0093)	
Observations	13,475	12,273	13,475	13,191	
Sample mean outcome	0.021	0.012	3.476	0.083	
Panel D. External causes of injury					
Race Concordance	0.0026	0.0150	-0.0092	-0.0015	-0.0009
	(0.0121)	(0.0132)	(0.0328)	(0.0108)	(0.0013)
Observations	6,312	5,640	6,312	5,317	6,312
Sample mean outcome	0.156	0.115	3.574	0.087	0.002

Note: This table examines the heterogeneous effects of race concordance with respect to diagnostic categories. Observations are restricted to patients diagnosed with intestinal infections (Panel A), diseases of the respiratory system (Panel B), superficial injury (Panel C), and external causes of injury (Panel D). Outcome variables are the same as those in Table 2 and Table 4. Results in column (5) of Panel A and Panel B are missing because no patient died in the two subgroups. All columns control for a full set of case characteristics and physician fixed effects. Standard errors reported in parentheses are clustered at the physician level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

TABLE 7 Heterogeneous Analysis: Physician Experience

Dependent variable:	(1) Inpatient admission	(2) Advanced diagnostic imaging	(3) Log length of consultation	(4) 7-day revisit	(5) Death in the ED
β_1: Race Concordance	-0.0157***	-0.0032	0.0206*	-0.0013	-0.0003
	(0.0026)	(0.0034)	(0.0107)	(0.0025)	(0.0003)
β_2: Race Concordance	-0.0056*	-0.0039	0.0049	-0.0048*	0.0004
× Experienced physician	(0.0031)	(0.0032)	(0.0154)	(0.0029)	(0.0003)
Experienced physician	-0.0094	-0.0166***	-0.0716	0.0023	-0.0019**
	(0.0068)	(0.0029)	(0.0798)	(0.0040)	(0.0008)
P value: $\beta_1 + \beta_2 = 0$	0.0000	0.1639	0.1211	0.0130	0.8312
Observations	254,327	213,795	254,327	199,177	254,327
R-squared	0.391	0.123	0.339	0.019	0.068
Sample mean outcome	0.214	0.057	3.482	0.101	0.003

Note: This table examines the heterogeneous effects of race concordance with respect to physician experience. Outcome variables are the same as those in Table 2 and Table 4. *Experienced physician* is a dummy variable indicating whether the physician, at the time of the patient's visit, had more than the median experience in the sample (8 years). All columns control for a full set of case characteristics and physician fixed effects. Standard errors reported in parentheses are clustered at the physician level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

TABLE 8 Race Concordance on Diagnosis Granularity

Dependent variable:	Detailed diagnosis
Race Concordance	0.0058*
	(0.0033)
Case characteristics	All
Physician characteristics	FE
Observations	254,327
R-squared	0.262
Sample mean outcome	0.437

Note: This table examines the effect of race concordance on the granularity of patient diagnosis. The dependent variable, *detailed diagnosis*, is a dummy variable that equals one if the patient's ICD-9 diagnosis code has four or five digits, and zero otherwise. We control for a full set of case characteristics and physician fixed effects. Standard errors reported in parentheses are clustered at the physician level. * indicates significance at the 10% level.

Appendix

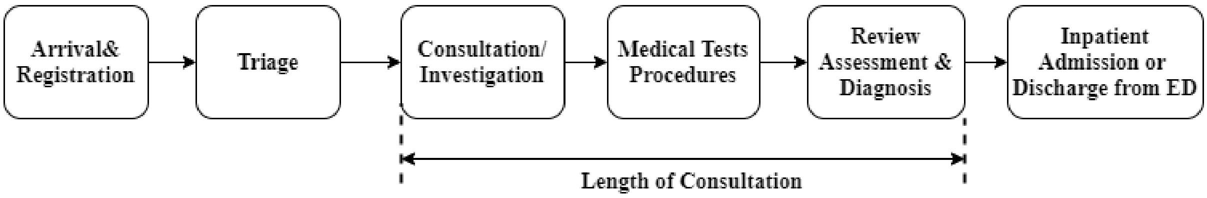

FIGURE A.1
Patient Flow in the Emergency Department

Note: This figure depicts the general patient flow in the ED, starting with patient arrival and ending with the patient's admission to the hospital or discharge from the ED. Patient length of consultation is measured from the start time of the patient's consultation to the end of the consultation. Case end is not necessarily the same as consultation end. For example, a patient's consultation ends but the patient is still waiting to be admitted; the case does not end until the patient is admitted.

TABLE A.1 Marginal Effects from Probit and Logit Regressions

Dependent variable:	(1) Inpatient admission	(2) Advanced diagnostic imaging	(3) 7-day revisit	(4) Death in the ED
Panel A: Probit estimation				
Race Concordance	-0.0161***	-0.0026	-0.0033*	-0.0010
	(0.0018)	(0.0023)	(0.0020)	(0.0012)
Panel B: Logit estimation				
Race Concordance	-0.0150***	-0.0022	-0.0035*	-0.0008
	(0.0017)	(0.0022)	(0.0019)	(0.0012)
Case characteristics	All	All	All	All
Physician characteristics	FE	FE	FE	FE
Sample mean outcome	0.405	0.404	0.101	0.010
Observations	254327	213795	199,168	63,960

Note: This table re-estimates the baseline results for binary outcome variables. Panel A and Panel B present average marginal effects from the probit and logit models, respectively. Dependent variables are defined in Table 2 and Table 4. All columns control for a full set of case characteristics and physician fixed effects. Standard errors reported in parentheses are clustered at the physician level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

TABLE A.2 Alternative Measures of Medical Tasks

	(1)	(2)	(3)
Dependent variable:	Laboratory test utilization	Imaging utilization	Number of medical procedures
RaceConcordance	-0.0043	-0.0025	-0.0074
	(0.0032)	(0.0040)	(0.0286)
Case characteristics	All	All	All
Physician characteristics	FE	FE	FE
Observations	213,795	213,795	213,795
R-squared	0.378	0.216	0.552
Sample mean outcome	0.618	0.607	4.282

Note: This table presents linear estimation results for alternative measures of task orders. *Laboratory test utilization* is a dummy variable that measures whether the patient undergoes any lab test. *Imaging utilization* is a dummy variable that measures whether the patient receives any form of diagnostic imaging, including X-rays, ultrasound, CT, and MRI scans. *Number of medical procedures* counts the total number of diagnostic tests and treatments performed on the patient. All columns control for a full set of case characteristics and physician fixed effects. Standard errors reported in parentheses are clustered at the physician level.

TABLE A.3 Deterministic Race-Concordance Status

	(1)	(2)	(3)	(4)	(5)
Dependent variable:	Inpatient admission	Advanced diagnostic imaging	Log length of consultation	7-day revisit	Death in the ED
Race Concordance	-0.0205***	0.0038	0.0718***	-0.0159**	0.0011
	(0.0066)	(0.0044)	(0.0259)	(0.0079)	(0.0011)
Case characteristics	All	All	All	All	All
Physician characteristics	FE	FE	FE	FE	FE
Observations	100,347	83,025	100,347	81,669	100,347
R-squared	0.354	0.111	0.337	0.020	0.072
Sample mean outcome	0.184	0.045	3.357	0.098	0.002

Note: This table presents OLS estimates from Equation (1). The analytic sample is restricted to patients who arrive when the share of their own-race physicians is either zero or one. Outcome variables are the same as those in Table 2 and Table 4. All columns control for a full set of case characteristics and physician fixed effects. Standard errors reported in parentheses are clustered at the physician level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

TABLE A.4 Alternative Measures of Medical Tasks: Heterogeneity by Patient Severity

	(1)	(2)	(3)
Dependent variable:	Laboratory test utilization	Imaging utilization	Number of medical procedures
β_1: Race Concordance	-0.0107***	-0.0047	-0.0679**
	(0.0040)	(0.0050)	(0.0275)
β_2: Race Concordance	0.0181***	0.0063	0.1699**
$\times$ Severe case	(0.0057)	(0.0084)	(0.0691)
P value: $\beta_1 + \beta_2 = 0$	0.1433	0.8119	0.1359
Observations	213,795	213,795	213,795
R-squared	0.378	0.216	0.552
Sample mean outcome	0.618	0.607	4.282

Note: This table examines the heterogeneous effects of race concordance with respect to patient severity levels. Outcome variables are the same as those in Table A.2. *Severe case* is a dummy variable that measures whether the index patient is triaged as a severe case (severity levels 1 and 2). All columns control for a full set of case characteristics and physician fixed effects. Standard errors reported in parentheses are clustered at the physician level. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.