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Doctors, Patients, and the Racial Mortality Gap: What Are the Causes?

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Abstract

Disparities in health outcomes between white and minority Americans are a significant and well documented challenge in improving equity in healthcare. Two frequently cited explanations are discrimination in treatment - doctors treating minority patients differently, and unequal access to care - patients being trapped in facilities of inferior quality. I use a new dataset from the Department of Veterans Affairs and employ a novel estimation strategy to investigate the sources of the racial gap in mortality for chronic heart disease, the most expensive chronic condition in the elderly. I find that racial differences in mortality persist even when the quality of clinics and doctors is controlled for. Investigating the doctor-patient interaction, I show that doctor quality significantly influences patient outcomes. While minority patients visit slightly less competent doctors, this does not explain the large gap in survival. Individual doctors are found to treat their patients similarly regardless of race. On the patient side, I demonstrate that variation in compliance triggers a racial mortality gap. Differences in patient response to treatment significantly alter survival probabilities. Considerable reductions in medical costs could be achieved by convincing patients of the importance of strictly following the therapy regimen. I estimate that targeting compliance patterns could reduce the black-white mortality gap by at least two-thirds.

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Introduction

Research in the last twenty years has uncovered persistent racial differences in health care access, utilization, and outcomes. Identifying the underlying causes may help analyze disparities in a wider range of economic outcomes that are affected either directly or indirectly through disparities in health. For example, good health has been shown to influence wages, labor force participation, and job turnover[2]. Understanding why health disparities exist and what can be done to eradicate them could help reduce differences in outcomes between minorities and whites in other areas.

The explanations of racial differences in health outcomes that have been offered can be grouped broadly into three categories: unequal access to treatment, unequal treatment, and unequal quality of care available to minorities. There has been significant exploration of the phenomenon, but many open questions remain. Are differences in facility and physician quality responsible for the racial gap in mortality? Will there be disparities if access and quality of care were equalized? Or does the racial gap reflect differences in patient responses to the same quality of care? This paper offers the first set of answers.

A great deal of research has been done to examine the effect of *between*-facility differences on the racial gap in survival. However, no study has investigated what happens *within* those facilities. This study reveals that in an equal-access set-up, *within*-facility differences are more important. Little has been done to assess how differences in doctor quality influence patient outcomes. I show that clinician quality is of foremost importance for patient survival. The literature offers conflicting evidence on whether doctors treat black and white patients the same. I demonstrate that differences in outcomes exist even when patients are treated the same.

While research has revealed that minorities are served by a small subset of physicians[3], there is no empirical evidence showing that this sorting leads to inferior outcomes. A legitimate question is: would minority patients still match with different physicians if they were given the same access as whites? Would they choose lower quality physicians? This is the first paper to investigate doctor-patient matching and its effects on patient outcomes. It also explicitly accounts for patient input into the treatment process and offers a new explanation for within-facility differences in outcomes.

[2] For an overview of the literature relating health and labor outcomes see Currie and Madrian, 1999
[3] Bach et al. (2004) report that 80% of black patient visits were to 20% of the physicians surveyed

The data set I use is ideally suited to answering these questions. Because there is such wide variation in supply of health care between racial groups, it is an empirical challenge to correctly identify the sources of disparate outcomes. I address this by studying patients suffering from a common condition who are served in an integrated, equal access medical care system. There are several advantages of the data set and the institutional setting.

First, I follow the same cohorts of patients through outpatient and pharmacy encounters for up to six years. This allows me to construct measures of both patient compliance with physician recommendations and the quality of clinical care. Both factors are shown to significantly influence outcomes.

Second, I examine the effect of observable physician quality indicators on patient survival. Common sense dictates that more competent doctors will affect positively their patients' health, but no previous study has identified an action-based measure of physician quality. Physician quality indicators derived from patient outcomes are subject to significant bias arising from the patient mix. Instead, I define a physician competence measure based on observance of nationally accepted standards of treatment and show that within-clinic differences in doctor quality significantly influence patient outcomes.

Third, the data come from the Veterans Health Administration (VHA), which is frequently commended for equalizing access to health care for minorities and implementing a fixed salary to limit physicians' financial incentives to over- or under-provide treatment. VHA facilities provide free care to all veterans. This institutional set-up eliminates health care access differences between minority and white patients.

The paper focuses on racial differences in death rates after a diagnosis of chronic heart failure (CHF). There are several reasons to focus on this condition. First, heart disease is the leading cause of death in the elderly and is the most costly single condition in Medicare in recent years (33.2 billion dollars in 2007)[4]. In addition, cardiovascular disease is a major contributor to the mortality difference between white Americans and African Americans, accounting for over 40 per cent of the racial gap. Third, heart disease is a chronic condition and an Ambulatory Case Sensitive Condition, i.e. expensive hospitalizations and rehospitalizations can be avoided with adequate preventive care and disease management. Approximately 10 per cent of all inpatient admissions are for CHF and hospitalizations

[4] According to the AHA statistical abstract, 2007
(http://www.americanheart.org/downloadable/heart/1166711577754HS_StatsInsideText.pdf)

are about twice as frequent in black males as in white males[5]. Finally, there are clear guidelines for the pharmacologic treatment of heart failure that allow me to test whether doctors provide the optimal therapy.

I document a significant medium-term difference in survival between whites and minorities in spite of the Veterans Health Administration's efforts to equalize the supply of health care. This difference cannot be attributed to inferior access to care for black patients. Differences in socio-economic status account for only 20 per cent of the racial gap in survival. Black patients see slightly lower quality physicians, but they go to better clinics. Doctor quality differences account for about 5 per cent of the survival gap. I show that within the VHA, doctors treat African American and white patients the same. The largest difference between races is in the compliance with therapy. Doctor-patient matching results in lower average doctor quality for minorities, but it helps improve their compliance. Further, there is no difference in survival among patients who mostly observe therapy prescriptions, so that the recorded racial gap is entirely due to racial differences among non-compliant patients.

Two directions for policy emerge from my findings. First, significant effort is needed to improve doctors' recognition and application of recommended therapies. Second, the mortality gap could be greatly reduced by improving patients' response to therapy. Interventions focused on increasing awareness in minority patients could go a long way towards eliminating disparities.

The next section examines previous attempts to explain the black-white differences in mortality and some hypotheses discussed in the literature. I describe the data and outline the empirical model in Sections 3 and 4. Section 5 presents the results and discusses their applicability to the general population. Section 6 outlines some implications for policy. Section 7 concludes.

2. Background and previous literature

Previous studies have found a consistent negative correlation between black race and patient outcomes (Institute of Medicine Report, 2000). There are many measurable and unmeasurable factors that contribute to better health. There exist physiological differences, such as sickle cell anemia, that are known to affect blacks and whites differently[6]. However, these are largely irrelevant when making comparisons in the US population. More pertinent to explaining the differences are ways in which

[5] In the population over 65 (Alexander et al., 1999)
[6] For an overview, see Cruickshank and Beevers, eds (1989) "Ethnic Factors in Health and Disease"

minority and white Americans differ on dimensions other than physiology. For example, there are large educational differences in the population over 65 years of age. Forty-seven per cent of black males over the age of 65 did not graduate from high school, compared to 22 per cent of whites. Similarly, only one third of elderly white males (65-74 years of age) have a disability, as contrasted with 43 per cent of elderly blacks. In the population over 74, two thirds of African American males are disabled, as compared to one half of the whites. One fifth of them live below the poverty line, but only one twentieth of whites can be classified as poor. Finally, recent research suggests that African Americans and whites may differ in their preferences for the consumption of health and health care.

Black race as a factor associated with worse health outcomes is as a catch-all variable reflective of socio-economic differences in a multitude of initial and intermediate determinants of final health outcomes. These determinants include differences in the initial stock of health, financial barriers to accessing preventive care, provider behavior motivated by financial motives, continuity of care received, differing attitudes to health seeking and health maintenance, and residential segregation implying geographically varying quality of available care. I discuss these factors in more detail below.

2.1 Factors contributing to the racial gap

Minority patients are more likely to face financial barriers and provider-level financial disincentives to better care. In particular, as a consequence of lower SES and insurance rates, more complicated and more expensive procedures may be withheld from them. Physicians and hospitals may fear that they will not be reimbursed and elect to withhold some treatments from their minority patients. Using data from the Veterans Health Administration gets around many of the differences stemming from unequal access or financial motives for over- or under-providing care to minorities. Institutional barriers to health care provision are minimal and any disparities remaining within the VHA are most likely due to other causes.

Second, African Americans are more likely to experience discontinuities of care. Many do not have a regular primary physician, and rely on emergency rooms as primary sources of medical attention (Oster and Bindman, 2003). Studies have shown that irregularity and fragmentation of medical care lead to less efficient health management and worse outcomes. Poverty, insufficient health education and awareness of one's health needs, distrust in the health system, and institutional hurdles to obtaining regular care are some of the underlying reasons discussed in the literature. Again, using VHA data alleviates this problem since the system is designed to provider uniform medical care for all.

A third explanation of the racial mortality gap is that the quality of health care received by minority patients is worse than health care available to whites. Studies have found that doctors who treat primarily black patients are less likely to be board certified and more likely to report not being able to provide high quality care to their patients. African Americans have less access to high-quality specialists and non-emergency hospitalizations. In particular, poorer African Americans are treated by lower-quality and lower-volume cardiac surgeons (Bach et al., 2004; Mukamel et al., 2000; Rothenberg et al, 2004). Yet, there are no studies relating this differential matching to inferior outcomes. This paper argues that in the context of the VHA, physician-patient matching has little effect on the quality of care received by minorities and may *improve* their outcomes.

Differences in health inputs between white and minority Americans may translate in disparities in health outcomes. Previous research shows that minorities differ in their attitudes towards health and the health care system. In a recent paper Charles, Hurst and Roussanov (2007) demonstrate that blacks spend about 56% less on health care than whites. They show that about 14 per cent of that gap is explained by preferences for "conspicuous consumption". Some of the attitudes underlying these differences in consumption may also contribute to differences in health maintenance. Goldman and Smith (2002) show that patients' adherence to prescribed therapy vary significantly with race and education. Blacks and less educated individuals are more likely to experience lapses in treatment as a result of their own non-compliance with physician recommendations. These lapses are especially important for chronic conditions where strict adherence to prescribed therapy can significantly prolong life. I confirm that racial differences in compliance with therapy exist in an equal access system. I show that these differences are the most pertinent factor in explaining the racial mortality gap.

Mistrust in the health care system is a potential source of the difference in attitudes. Black patients with cardiac conditions are less satisfied with the health care they receive and more likely to mistrust the system overall (LaVeist et al., 2000). Studies have shown that lower use of contraceptives among African American women can be related to perceived individual or group discrimination (Bird and Bogart, 2003). There may be differences in satisfaction with care and physician-patient cooperation based on racial matching. Saha et al. (1999) find that minority patients who see minority physicians are more likely to rate physicians highly and to report receiving preventive care. Patients holding negative stereotypes about their physicians are less likely to be satisfied with the care they receive and less likely to adhere to physician therapy recommendations (Bogart et al., 2004).

Finally, because of residential segregation and lower socioeconomic status, the quality of the hospitals, hospital equipment and personnel may be worse in areas predominantly populated by minorities. Even if patients are fully insured and maintain a regular schedule of check-ups and preventive care, they would have worse treatment and higher mortality because of the quality of the facility in which they are treated. I show that differences in death rates within the VA equal-access system are not due to lower quality of the facilities serving predominantly minority patients.

The persistence of these trends after adjusting for SES and regional differences has led to several theoretical explanations going beyond sources of disparities that are testable with aggregate data. The racial mortality gap could be the result of statistical discrimination, clinical uncertainty or stereotyping (Balsa and McGuire, 2002). Clinical uncertainty might contribute to over- or under-prescription of therapies to black patients because doctors are less aware of the severity or appropriate treatment in the minority group. Stereotyping refers to attributing certain qualities to patients based on expectations about the average behavior of members of their group. For example, Bogart et al. (2001) demonstrate that doctors are less likely to prescribe certain medications to minority patients because they expect lower patient compliance. Using data from doctor-patient encounters I show that there is no evidence of such statistical discrimination in the VA health care system.

2.2 Within- and between-facility differences

In the context of conditions like chronic heart failure, where care is primarily received by patients on an outpatient basis, the relative contributions of within- and between-hospital racial differences are especially important, since they point to where interventions could be most effective. Previous studies diverge in assessing the relative contributions of within- and between-hospital racial differences in care to the survival gap.

A major problem is that data are rarely recorded for the physician-patient pairs which form during an encounter. This is impossible in a hospital setting, where the patient is attended to by a number of staff. Empirical work assigns the remaining gap after controlling for hospital quality to within-hospital differences. Clearly, this is insufficient if the goal is to pinpoint the major source of disparities. The data I use enable the construction of physician-patient pairs that are used to study individual doctor-patient interactions.

Research on racial disparities in cardiac care has concentrated on patients who suffer heart attacks (acute myocardial infarctions, or AMI). Recent studies have found that a substantial part of the

racial disparity in treatments is accounted for by the specific hospital to which patients are admitted (Bradley et al. 2004; Barnato et al. 2005; Skinner et al., 2005). Skinner et al. (2005) find large between-hospital differences in the treatment of AMIs and yet a substantial fraction of the aggregate differences remains unexplained. They suggest that factors such as the quality of physicians may explain the remaining difference within hospitals. For example, if white physicians communicate more effectively with white patients, this would translate into more adequate treatment for white patients at all hospitals (Balsa and McGuire (2003)).

The trouble with using 30-day, 6 months, or 1 year mortality rates from AMI to estimate within versus between hospital sources of disparities is that patients being treated in emergency conditions are assigned doctors randomly at least in the first (and crucial) hours after the AMI. Hence the differences in mortality rates are largely driven by the differences in average doctor and equipment quality between hospitals. It is harder to pick up the effects of subsequent, post acute-stage patient sorting into different providers and variations in the response to treatment. Concentrating on a chronic condition, which requires regular interactions and follow-up between doctors and patients is one way to capture the outcomes of these processes.

A substantial advantage of this paper is that I can track the sequence of doctors that patients encounter over time. I use a sample of patients with chronic heart failure (CHF, or congestive heart failure, or heart failure) - a chronic and eventually fatal condition. This illness is managed on an outpatient basis by primary care physicians. These patients are treated in an equal-access integrated health care system, where financial incentives for patients and doctors and greatly reduced. The Veterans' Health Administration (VHA) provides free health care for all eligible veterans. The VHA's physicians are salaried and hospitals and outpatient centers receive funding depending on the number of patients treated. Using the population of patients with chronic (congestive) heart failure (CHF) treated in the VHA, I avoid many of the complications arising from differences in socioeconomic status between races. Any remaining differences by race are more easily attributable to unequal treatment by physicians or differences in patients' attitudes to health.

Substandard care leads to more frequent hospitalizations, lower quality of life, and ultimately larger costs. Efforts to address the mounting health care costs for the elderly must start with identifying the causes for worsening chronic conditions, especially in the economically disadvantaged populations who may wait to address their health needs until covered by Medicare. The VHA is frequently cited as a potential model for a future unified, universal access medical system. The remaining disparities in

patients' outcomes within the VHA exist *in addition* to differences due to unequal access to private care.

3. Data

The data in this study were drawn from the VHA Medical SAS inpatient and outpatient datasets, the Beneficiary Identification Records Locator Subsystem (BIRLS) death files, the VHA Enrollment files, and the Veterans Service Support Administration (VSSA) clinic performance measures database. Data on zip codes were extracted from the Census. The data cover all outpatients who were diagnosed with chronic heart failure between October 1998 and October 2004[7].

Currently, the majority of veterans belong to the age cohorts who served in World War II, the Korean War, and the Vietnam War. The median age of all veterans is 55, with veterans comprising the majority of all civilian males older than 65. The proportion varies by race. Veterans account for over 60 per cent of white males older than 65, but only for 37 per cent of black males aged 65-75 and 51 per cent of black males aged over 75 (Bureau of the Census 2001).

Table 1 shows variable means. I restrict the sample to patients who utilized community based outpatient clinics at least twice in the first year after CHF diagnosis. These people could be credibly identified as outpatients served by the Veterans Health Administration. Of those patients I exclude the individuals who did not have complete information on their race that could be verified either across visits and/or by using the inpatient datasets and Medicare data. There were 2487 patients whose race could not be determined because the different datasets reported it differently. Finally, I restrict the sample to male veterans only. Female veterans comprise less than 2 per cent of the veteran population in this age group and are arguably different from the average female in that age group. The final sample consists of 48972 VHA patients. CHF disproportionately affects elderly people and the military had restrictions on enrolling African Americans until the Korean War. This means that blacks are

[7] All outpatient visits are recorded in the outpatient files. Hospitalizations in a VA or related hospital are recorded in the inpatient files. The Enrollment files use Social Security administration data, as well as the VA's internal accounts to record death. The BIRLS files pool data from the veterans benefits administration (including death/burial benefits) as well as notifications from hospitals (through the inpatient files), relatives/acquaintances, cemeteries or any other branch of the veterans system. Death data were initially extracted from the VA BIRLS files, double checked against the VA enrollment files, and then checked again against data from Medicare. The triple-checking of the death data ensures that I use accurate vital status records.

underrepresented in this sample compared to the overall veteran population and to the US population in general. Black patients comprise about 7.6 per cent of the sample[8].

VHA data record income, which offers a substantial advantage in controlling for socio-economic status. Income is reported on the enrollment forms each year and is used to determine patients' benefits. Previous studies control for income using mean or median zip-code income data from the Census bureau. However this measure can be misleading especially when the emphasis is on the effect of minority status or SES on health. Segregated neighborhoods have wide variations in income. Median income would over-estimate the financial means of the minority population and at best provide a crude measure of the SES of the zip-code as a whole.

Because minorities on average have lower socioeconomic status (SES) and tend to delay seeking health care, it is likely that private and university-affiliated hospitals seeing a higher proportion of black patients are also "sicker" or poorer hospitals. The centralized budgeting system of the VA is government-sponsored, hence the SES of the patients does not influence the resources of the clinic. Resources are distributed on the basis of the patient load. Clinics that serve a larger proportion of patients get more funding. In the VHA physician visits, procedures and hospitalizations are virtually free, and prescription drugs heavily subsidized at prices lower than Medicare prices[9]. Co-payments are still in the process of being introduced and are required only from enrollees with the highest SES and no service-related conditions. Patients can only obtain prescription medications at subsidized prices if those medications are prescribed by a VHA physician. Patients must maintain a primary care physician in the VHA.

Congestive heart failure is a progressive disorder with fatal outcomes. Mortality rates in the first year after diagnosis are about 10 per cent. However, if care is managed well, patients' chances of living longer and their quality of life can be improved significantly. The recommended medical therapy is well publicized. Once the first year of treatment has passed successfully, chances of longer-term survival increasingly depend on the patients' and doctors' ability to adapt the treatment and

[8] LaVeist (1994) among others points out that race is a poorly measured variable whose designation varies depending on the reporting body. I use race data from Medicare and the VA. Nearly 90% of the patients have a record in Medicare. For the remaining 10% I use the data from the Veterans Affairs administration, where I cross-check race with data from different encounters. S. Arday et al. (2000) show that the Medicare race variable corresponds very closely to self-reported race. For the part of the sample which has a record both in Medicare and in the VA, I find that 3% of the patients had a difference in the coding of race between Medicare and VA. This discrepancy can be attributed to coding errors on both sides and is unavoidable in administrative data. Overall I believe the race designation which I use in the analysis is very close to self-reported race.

[9] As of November 2007, the price of a refill for any medication was 8 dollars.

lifestyles to counter the progression of the disease. Short-term (one-year) mortality is more likely to be influenced by the patient's initial physical condition at diagnosis, while longer-term survival would be more sensitive to medical therapy and the ability of the patient and the doctor to coordinate the management of the disease.

No other study so far has followed patients for more than 2 years or considered the effect of outpatient care on CHF mortality, both of which I find to be important phenomena. The largest estimate of the racial mortality gap in CHF was reported by the CDC - 7.8% [10]. This is a very crude benchmark of the yearly mortality rate, unadjusted for the number of years since diagnosis or differences in access and co-morbidities. The closest estimate of the gap to the one I find (and the only other estimate using horizons longer than a year) is reported using Medicare data by Dries at al (1999). They find a 3.1 percentage points higher probability of survival for white patients after two years of follow-up. I argue that at least two thirds of this mortality gap is attributable to differences in patient response to therapy, and not to variations in quality, physician discrimination, or institutional barriers to accessing health care.

Table 1 also shows that black patients are, on average, about 25 per cent poorer. The differences in income reported in the sample are close to those observed in Census data for the same age group[11]. White patients are also more likely to be married. Being married is an indicator of stronger social support. Elderly males in particular benefit from having a living spouse. White patients are more likely to have a stronger social network as proxied by marital status. Whites in the sample are on average they are six years older.

The VHA outpatient datasets contain data on all coexisting health conditions. I select controls for co-existing health problems to correspond closely to the conditions used in constructing the Charlson-Deyo index of co-morbidities, which is the standard reference in the health literature [Charlson, 1987][12]. I do not compute an index, but include the conditions as separate controls. The data do not supply an indicator of CHF severity, which is likely to differ across patients. However, there is

[10] MMWR Weekly, August 7, 1998; 47(30), 663-7

[11] About 15% of income values every year were coded as 0s. Whenever possible, I impute income by assigning the mean value of income for the years in which it is available. The VA may have coded zeros for a missing value. Alternatively, it could be a code for administrators indicating veterans who are eligible for care regardless of their income levels. Since I do not know the rule which was used, I flag the observations with a zero coded as income. I control for missing income values in all regression specifications which control for income.

[12] I include controls for old myocardial infarction, lymphoma, leukemia, pulmonary failure, diabetes, renal failure, colon cancer, angina, cardiomyopathy, ischemic heart disease, prostate cancer, liver disease, dysrhythmias, other cardiovascular disease, other cancers.

significant information on other cardio-vascular co-morbidities. CHF usually occurs as a result of, or in conjunction with some of these conditions. I therefore include indicators for other cardiovascular diseases as proxies for the severity of CHF.

The sample covers the period from October 1998 to October 2004. Patients join the sample throughout this period. The largest numbers of new patients enter in years 2001 and 2002. This coincides with the period of largest expansion of the VHA health care system. There was a significant increase in the number of patients per clinic over the examined period. The average number of patients per clinic goes up from 33 in 1999 to 117 in 2003. The years 1998 are 2004 are incomplete, since 1998 includes data from the last three months of the year and 2004 ends in September. A potential concern is that the patients joining the VHA health system after 1998 could have an advanced stage of CHF at the time of first diagnosis *within* the VHA. I control for such sources of bias by including cohort dummies. Most of the new patients who joined the VHA after 1998 are white patients with higher income. Therefore, any discrepancy in severity at first diagnosis would work against finding racial differences in survival and would bias the coefficient on black race in the survival regressions downwards.

I define a physician-patient pair as a match between a patient and a doctor for which I observe more than two interactions in the data. Patients see a number of doctors over the course of treatment. African Americans see more doctors, but they get fewer prescriptions per doctor, implying that the intensity of their relationship with any given physician is lower. Another dimension of this lower intensity of interaction is that it takes black patients on average two months longer to first encounter their main physician, i.e. the physician who wrote the largest number of prescriptions for them, but the chances that the main doctor leaves the clinic in any given month are the same.

Clinics vary in size from 1000 visits per year to 300000 visits per year. In this study clinics are divided into small (below 10000 visits per year), medium (between 10000 and 20000 visits per year) and large (above 20000 visits per year) categories. The ratio of black patients in the clinic is defined as the ratio of visits by black patients in a year divided by the total number of visits to the clinic in that year[13]. Black patients are more likely to be treated in large urban clinics (92% in urban and 55% in

[13] The data allow the construction of two measures of clinic racial mix. The other possibility is the ratio of black to total patients. The proportion of visits is a measure of the intensity of black patients' presence at the clinic. It can be understood as the likelihood of meeting a black patient in the waiting room. While there may be significant number of blacks registered at the clinic, they may not utilize it as much as the rest of the patients. Using the alternative measure of blackness based on the proportion of black patients corresponds to the question "What is the probability that I will select a black patient if I randomly pick a name from the clinic's patient list?" There may be a number of black patients who showed up once at the

large clinics), while white patients are more likely to go to small and medium-sized clinics. Table 1 breaks down the racial profile of the clinic by clinic size and race of the patient.

The key variables that I use in the empirical analysis are indicated in bold in Table 1. In the next subsections I define those variables that have not been used in the literature before.

3.1 Measuring doctors' adherence to treatment guidelines

I use the prescriptions data and the clinical guidelines set out by the American College of Cardiology to evaluate physicians' prescription patterns. The clinical guideline recommends prescribing Angiotensin Converting Enzyme inhibitors (ACE inhibitors, or ACEIs) and beta blockers (BBs) to all patients with chronic heart failure. Widely publicized clinical trials in the 90s showed that patients with CHF benefit from these medications. It has been demonstrated that there drugs improve the function of the heart and slow down the progression of the condition. In the early 2000s the VHA issued clinical guidelines suggesting to all providers that ACEIs and BBs must be considered in the course of therapy. All patients in this sample are eligible because they are diagnosed with congestive heart failure. The only exceptions may come from allergies. There is no evidence that black patients are more likely to suffer from allergies to ACEIs and beta blockers[14].

The rate of prescribing the recommended drugs provides an independent benchmark against which I can assess the doctor's clinical abilities. The measure of providers' adherence to clinical guidelines is constructed as the ratio of patients who encountered the provider in the year and were prescribed ACE inhibitors and beta blockers by that doctor over the total number of patients seen by the doctor.

Adherence ratio = ((N patients with ACEIs-BBs)/(Total N patients))

Since in theory all patients who visit the doctor and have this diagnosis should be prescribed these medications, a higher adherence ratio means stricter observance of the recommended therapy. Summary statistics by clinic size and race of patient are presented in Table 1. I use the adherence ratio as a proxy of doctor quality. Doctor quality and doctor competence are used interchangeably in the

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clinic and never came back, who will be accounted for in the patient-based measure. Having more black patients without more black patient visits does not add to the "blackness" of the clinic.

[14] However, at least one guideline suggests that finding the correct dosage may be harder with African American patients and hence more careful patient monitoring is advised.

text. This measure is directly estimated from data, and it is based on the actual decisions taken by the physician. While it is a popular measure in constructing hospital quality indices, it has not been used in outpatient data before. It is a better proxy for quality than, for example, indexes based on patient outcomes or board certification scores, because the former reflect biases from the patient mix and the latter are divorced from the practical side of physician competence. Another salient feature of the adherence ratio is that doctor quality measured in this way can be affected by policy. "Quality" in the sense used here thus refers to the doctor's abilities as a clinician, and does not explicitly measure other possibly relevant, but unmeasurable doctor characteristics such as cultural competence.

Measuring mean doctor quality per patient

Patients see more than one doctor every year. I calculate the weighted mean of doctor quality for every patient is calculated. The weights are based on the number of prescriptions written by the doctor for the patient. For example, if a patient has seen two doctors, and he has 5 prescriptions from the doctor of quality 1 and 2 prescriptions from the doctor with quality 0, his mean doctor quality is 5/7.

The relative importance of the quality of clinical care for patient health has not been explored in outpatient context despite numerous clinical trials showing that medicines recommended in clinical guidelines have a significant impact on mortality and morbidity. Most medical care studies are based on inpatient data, where it is impossible to identify the treating physician(s). In a hospital setting, a patient is seen by a multitude of doctors and it is very problematic to disentangle the parts of the therapy directed by different individuals. Moreover, medical therapy is highly personalized and depends on the idiosyncratic health needs of the patients. Few medical conditions have developed clinical guidelines at the level of CHF. These two problems make measuring the quality of health care difficult in the general population. Here I take advantage of the outpatient management of the health condition and demonstrate that doctor quality is of foremost importance for patient survival.

Robustness of the doctor quality measure

A problem arises if doctors of higher quality are matched to patients of better health along dimensions not captured by the controls. The coefficients on doctor quality would then be biased upwards. Positive matching of doctors to patient populations is more likely at the clinic level, i.e. doctors choose a clinic based on the clinic population. It is less likely that doctors would choose

patients within the clinic. The upward bias on the doctor quality coefficient arising from doctor-clinic matching is addressed by including clinic fixed effects. The inclusion of clinic fixed effects guarantees that the effects on patient survival are identified only by the variation across groups of doctors within the same clinic, and not by how doctors are distributed among clinics. However, it is still possible that doctors are non-randomly matched to patients within clinics. This is more likely to happen over time, i.e. in the course of patient tenure with the clinic both patients and doctors learn about each other's characteristics. I use the quality of the *first* doctor who prescribed medication for CHF to alleviate the effects assortative matching between doctors and patients *within* clinic[15].

3.2 Patient compliance measures

A major criticism of the health literature is that while studies evaluate the effect of doctor inputs, they rarely account for the effect of patients' response to physicians' efforts. Leonard and Zivin (2005), in one of the few studies that explicitly account for patient inputs into the health production function, show that in traditional societies patients choose between healers and medical doctors depending on the relative importance of the physician's and patients' efforts in determining outcomes. They demonstrate that interventions in which the patient takes a passive role are more likely to be performed by physicians. Patient response is especially important for chronic conditions like chronic heart failure that are managed on an outpatient basis, and that require an investment of daily effort by the patient. One of the conditions for efficient interaction between providers and patients is patient compliance with prescribed therapy.

I use data on prescription refills to define a measure of patient compliance with therapy. The VHA pharmacy data contain a "days supply" variable attached to each prescription, as well as the time when the first dose was dispensed and the time of subsequent refills. Using the "days supply" variable I can determine whether the prescription was refilled on time. I define a refill as "compliant" if it was picked up within 3 days of the expiration of the previous days' supply[16]. The compliance measure is

[15] The education literature offers the closest type of problem to the one discussed here. Studies attempt to estimate the importance of teacher quality on students' performance independently from the effect of schools, selection into schools, and students' family background. Rivkin, Hanushek and Kain (2005) provide an excellent review of the problem in the education context and discuss the challenges to obtaining robust empirical estimates of the effect of teacher quality.

[16] I choose 3 days because I do not observe opening hours of pharmacies in VA medical facilities. Patients whose previous supply expires on a Friday would not be able to obtain a re-fill until the following Monday (or Tuesday, for long weekends), even though they may have called it in on time. Even if pharmacies maintain weekend hours, some patients may be unwilling to go and pick up medications on Saturday or Sunday. Different time windows were considered ranging between 1 and 7 days. The results were very similar across measures.

defined as the number of prescriptions which were not re-filled on time over the total number of prescriptions. The same technique is used to formulate aggregate patient compliance per year and individual patient compliance for every patient-doctor pair.

Compliance ratio = ((N prescriptions filled on time)/(Total N prescriptions))

Table 1 shows the summary statistics by race for compliance. The average compliance rate in the sample is 50%, and black race is associated with a 3% -5% lower rate of compliant refills. In a study of HIV patients Goldman and Smith (2002) find that black race is associated with a 33% decrease in the probability of strict adherence to therapy. However, their measure of compliance is much stricter. They consider a patient compliant if she had taken all of her HIV medications correctly in 7 out of the past 7 days. The measure I use is less stringent. To the extent that I do not observe whether medication was taken correctly on the occasions when it was taken, my measure overestimates compliance for all patients. This implies that the estimates of the effect of compliance on outcomes reported here are more likely attenuated towards zero.

4. Determinants of survival from Heart Failure: Empirical Strategy

This paper aims to evaluate the effect of clinic and physician characteristics on the racial gap in survival from chronic heart failure. All patients who visit the same clinic are subjected to the same common clinic quality[17]. However, if there is assortative matching between patients and doctors, patients visiting the same clinic may be treated differently. Patients of the same physician in the same clinic could have different outcomes if the doctor treats them differently based on their personal characteristics.

In most general terms, individual survival is influenced by the quality of the clinic, the quality of the doctors, the personal characteristics of the patient and interactions between these variables.

Survival = F(patient characteristics, clinic quality, provider input, patient response)

[17] The vast majority of patients (over 80 per cent) went to the same clinic throughout the observed period. Those who changed clinics did so because they moved residence. The VHA strategically locates outpatient clinics so that they serve a population within a geographic area.

There are three types of variables in this model: 1) patient characteristics and doctor quality which change across patients and time; 2) clinic characteristics such as the clinic location which are constant over time; 3) clinic characteristics which change over time.

Let X_{gtm} be a vector of characteristics for patient m who goes to clinic g at time t, including an indicator for black race. Let B_{gt} be a vector of clinic characteristics which vary between clinics and years, but have the same value attached to patients in the same clinic in the same year and μ be the clinic fixed effect. Variants of a survival model are estimated. The basic model relating patient characteristics and co-morbidities to outcomes is:

Model 1:

$$y_{gtm} = \alpha + \beta X_{gtm} + \varepsilon_{gtm}$$

Here the coefficient on race would capture some of the omitted variables' influence on survival outcomes and will be biased downward (i.e., more negative) if black patients are treated in worse clinics or by worse doctors.

Next, the basic model is expanded by adding clinic fixed effects to capture the unobserved clinic characteristics which do not vary by year. In addition, the ratio of black patient visits per year and the total number of patient visits per year are added as controls. Patient cohort dummies are included to control for the differing characteristics of patients being diagnosed in different years and for changes in the aggregate technology of treatment which affect all patients.

Model 2:

$$y_{gtm} = \alpha + \beta X_{gtm} + \delta B_{gt} + \mu_g + \eta_t + \varepsilon_{gtm}$$

The model is further complicated by adding the mean doctor quality per patient ($D_{gm)}$ and the interaction term between doctor quality and black race. The addition of the interaction term allows me to distinguish whether black patients visit lower quality doctors or benefit less from the same physician quality.

Model 3:

$$y_{gtm} = \alpha + \beta X_{gtm} + \delta B_{gt} + \gamma D_{gm} + \theta * black * D_{gm} + \mu_g + \eta_t + \varepsilon_{gtm}$$

The preferred empirical model is:

P(survival) = α + β(patient demographics, co-morbidities, physician quality) + γ(patient race∗physician quality) + δ(clinic ratio black) + year dummies + clinic dummies + ε

The weighted average quality of the providers per patient is included as a patient-level variable in X_{gtm}.

I concentrate the analysis on three-year survival horizons. While one-year survival probability is a common benchmark in the literature, it is more appropriate for acute conditions such as stroke or AMI (acute myocardial infarctions, or heart attacks). Unlike AMIs, Chronic heart failure is a chronic condition which may be contained or worsen over time given the prescribed therapy and the patients' compliance with it. Longer-term survival horizons are better suited to capture the effect of quality of care over time.

5. Survival from Chronic Heart Failure: Results

5.1 Three-year survival

Basic model

Table 2 reports the results of a linear probability regression of the probability of surviving the third year after initial diagnosis, conditional on surviving the first two[18]. Estimating three-year survival probability conditional on two-year survival is intended to partially offset potential differences in severity at first diagnosis. Taking a group of patients who have already survived two years of treatment selects those patients who have had less severe conditions at first diagnosis. Columns (1)-(4) report results from different specifications. In Column (1) I estimate a basic model including only controls for age and co-morbidities, similarly to many studies using private care data. I find that on average, black patients are 2 per cent less likely to survive the 3rd year of treatment.

Additional socio-economic factors

[18] One- and two-year survival estimates are available from the author. Different specifications were estimated including the square of age, as well as using age cohorts rather than a continuous measure of age. These yielded similar results. In robustness checks I also ran the estimation excluding different cohorts. The obtained results were similar. A logistic regression for model (1) was also estimated and revealed identical estimates.

I control for socio-economic factors in the model estimated in Column (2). Differences in socio-economic status account for about 22 per cent of the difference in survival. The magnitude of the coefficient on the race dummy is reduced. However, a significant negative correlation between black race and medium-term survival still exists.

Clinic quality

Next, I control for clinic quality. In Model 3 I add controls for the ratio of black patients in the clinic in every year, the number of visits to the clinic, and a clinic fixed effect. The coefficient on the race dummy becomes larger in absolute value and maintains a negative sign. Differences in clinic quality do not explain the difference in the survival rate between blacks and whites. Moreover, blacks in the VHA visits *better* clinics on average. Numerous studies using data from the private health care system have found the opposite result. Because of geographic segregation, which is also related to differences in SES among residential areas, hospitals in predominantly black neighborhoods are underfunded and often understaffed. The case is different in the VHA, where clinics are funded on the basis of their patient load. These estimation results confirm that using VHA data effectively controls for differences in access to quality care and care provision in explaining the black/white mortality gap.

Physician quality measures

Physician quality matters. Going to a top-quality doctor improves survival by two months in any year. The model in Column (4) includes a measure of mean doctor quality per patient. The effect of quality is large and statistically significant. Competence levels do vary within clinics, and they have an independent effect on survival. However, a surprising result is that including controls for doctor competence reduces the coefficient on black race by only 5 per cent, implying that blacks and whites are subjected to similar average doctor quality in the VHA.

African Americans see different doctors, who are of lower quality, but this does not explain the difference in survival. Figure 1 shows a histogram of the distribution of black and white patients within doctor quality quintiles. Blacks are more likely to see doctors in the bottom and third quintile, and less likely to see doctors in the top 2 quintiles. Minority patients go to slightly lower quality doctors, but differential sorting is not the driving factor behind lower survival rates. The coefficient on the black race dummy in the model in Column (4) is still negative and statistically significant.

Doctor quality does not affect whites and blacks in the same way. The regression in Column (5) adds an interaction term between doctor quality and black race. The estimates reveal that the difference in survival rates captured by the negative coefficient on the black race dummy in previous models is in fact due to a difference in the effect of doctor quality by race. Black patients benefit from quality doctors half as much as white patients do. Figure 2 plots the coefficients on doctor quintile dummies. The omitted category is the lowest quintile. Blacks receive lower benefits at all levels of doctor competence, but the largest difference occurs in the middle range of the doctor quality distribution.

In practical terms this means that reassigning a white patient from doctors with average quality mix in the lowest quintile (<0.2) to doctors with average quality in the top quintile (>0.4) will increase his chances of survival by 8 per cent. An equivalent exercise for a black patient will increase his chances of survival only by 4 per cent. This is a puzzling and unprecedented result in the literature and it motivates the rest of the empirical investigation.

Physician-patient matching could be the cause of this result. Unobserved characteristics of doctors, patients, and the doctor-patient pair may determine selection into doctors over the course of 3 years. This selection could influence blacks and whites differently and drive the result. The quality of the first doctor, however, is less likely to be influenced by a selection process. In Table 3 Columns (3) and (4) I include the quality of the first doctor instead of the mean doctor quality per patient. The results are the same. Black patients benefit from quality about half as much as whites do.

There are two potential reasons why this is the case. First, high quality doctors may treat minority patients differently – a hypothesis I test in the next subsection. Second, black patients may react differently to the same doctor quality. This hypothesis is also tested below.

5.2 Do the same doctors treat black and white patients differently?

I test for differences in treatment using data on doctor-patient pairs. In Table 4 I report a series of linear probability regressions estimating the probability that a patient would be prescribed a combination of ACE inhibitors (ACEIs) and beta blockers (BBs) by a doctor. Column (1) reports the basic specification controlling for black race and co-morbidities only. Based on this specification there are no differences in treatment of black patients across doctors. Column (2) adds controls for income and marital status. After controlling for SES, on average black patients appear less likely to be prescribed the recommended therapy. There are two possibilities. First, they may be treated differently by all doctors. Second, they may be seeing a different mix of doctors.

Next, I consider the possibility that the same doctors treat patients differently. In Column (3) I include doctor fixed effects, which allow me to restrict the test of differential treatment within the same doctors and also controls for unobserved doctor characteristics. After controlling for doctor fixed effects, blacks and whites are equally likely to be prescribed the same treatment regimen. Two patients visiting the same physician are treated equally regardless of race.

5.3 The role of patient compliance

Using the measure of patient compliance described in Section 3, I test for differences in patient's response to treatment on several levels. I examine yearly compliance by patients across all doctors and all medications as an indicator of the average compliance.

It is possible that some doctors are better at motivating compliance and the patients' response to this skill could vary by race. Patients could match into different doctors on the basis of these unobserved skills. For example, doctors with minority backgrounds may be better at motivating compliance in black patients, but not so good with white patients and vice versa. If minority doctors were scarce and black patients were forced to see white doctors, then their average compliance would be lower. Therefore, a measure of patient compliance was constructed for every patient-doctor pair to capture such differences in the effectiveness of doctor-patient interaction.

Black patient comply less with prescribed therapy. Tables 5 and 6 report a series of regressions estimating the effect of demographic characteristics on yearly and doctor-specific patient compliance. I first examine the yearly compliance of patients and detect a negative association between black race and compliance. Having a spouse is associated with higher compliance, but worse family support does not explain the difference in compliance with therapy. Within the same clinic, blacks are 3.6 percentage points less likely to pick up medications on time (Column (3)). Again, differences in clinic unobservables in fact increase the magnitude of the race coefficient, suggesting that minority patients visit clinics with better average compliance.

In Table 6 I focus exclusively on individual doctor-patient pairs. It is possible that differences between doctors account for the observed black/white differences in the aggregate. There may be unobserved doctor characteristics (such as the doctor's race, gender, cultural sensitivity), that induce different compliance rates in minority patients. The difference persists after controlling for unobserved doctor characteristics in Model (3) (Table 6). In the preferred specification with doctor fixed effects in Column (3) black patients have 5.6 percentage points lower compliance than whites.

If black and white patients were restricted to visiting the same physicians, minorities would have even lower relative compliance with therapy. The results obtained from the doctor fixed effects regressions in Table 4 and Table 6 suggest that if blacks and whites were seeing the same doctors within the clinics, they would receive the same treatment, however minorities would be about 40 per cent (1.8 percentage points) less compliant than otherwise. Differential sorting is associated with lower mean doctor quality for blacks, but it improves average compliance. The counter-intuitive implication here is that sending blacks and whites to the same doctors may *increase* the survival gap through its negative effect on compliance.

Next I examine more closely the types of doctor-patient relationships which trigger the largest differences in patient compliance. Figure 4 plots the coefficient obtained on the interaction term between black race and the number of prescriptions associated with a doctor-patient pair. I take the number of prescriptions as a proxy for the intensity or regularity of the doctor-patient relationship. The model estimated is model (3) in Table 6. The solid line traces the interaction coefficient across all doctors. The dotted line denotes the average black dummy coefficient in a regression restricted to the most frequently visited (main) doctor. The dashed line denotes the average coefficient on the black dummy for a regression restricted to the least frequently visited doctor. Black patient compliance is between .04 and .08 lower than white patient compliance. There is a U-shaped correspondence between the regularity of the doctor-patient relationship and the compliance of the patient. Doctors that are seen less often receive relatively more compliant response from minority patients. Providers that are seen more often and are more likely to prescribe and oversee the main therapy receive a relatively lower patient response from minority patients. Across the board, black race is associated with worse patient response to doctor's therapy choices, and the largest differences occur in high-intensity relationships.

Compliance may vary across different types of medication and the patterns of non-compliance may differ with race. For example, more educated patients (who are more likely to be white) could be more aware of the various purposes of medications and may selectively comply more with the some types than with others. To capture such differences, I construct a separate measure of compliance with ACE inhibitors and beta blockers.

Not all patients received prescriptions for these medications. An estimation of average compliance with all medications using the subsample of patients who were treated with ACE inhibitors and beta blockers yielded a coefficient on black race -0.035, which is very similar to the coefficient

obtained from the identical specification in Table 6 Panel I Column (3) which uses a larger sample of patients. Table 6 Panel II reports the coefficients from linear regressions of average yearly patient compliance with ACEIs and BBs. It also shows average compliance with the physicians who prescribed the recommended therapy. The minority patients who were prescribed these drugs were even less likely to pick up their refills on time as compared to whites. The preferred specification in Panel II Column (3) yields a 5.8 percentage points lower compliance estimate for blacks, which in relative terms is more than 11 per cent lower than compliance for whites. There are two possible reasons. First, African Americans are less likely to comply with therapy-prescribing physicians compared to other doctors. Second, there could be doctor-specific unobserved characteristics which make blacks less likely to comply with some high quality doctors.

Table 7 reports the results using patient-doctor pairs. In Column (1) I report compliance with all medications for the subsample of patients who got prescribed ACE inhibitors and beta blockers and those physicians who prescribed them. The coefficient on black race is -0.062, i.e. minorities comply even less with therapy-prescribing physicians for *all* medications that those physicians prescribe. The preferred specification with doctor fixed effects in column (4) yields an even larger compliance gap for compliance with ACE inhibitors and beta blockers in particular. Comparing across doctor-patient pairs, minority patients show lower compliance with high quality doctors than with others, and comply less with the clinically recommended therapy. This is one of the potential reasons why minorities benefit less from interactions with high quality doctors, who are more likely to prescribe such drugs. This result suggests that increasing doctor quality may in fact *decrease* patient compliance for minority patients.

The measure of patient compliance used here is fairly broad since it only captures whether a patient called in a re-fill on time. But there are many aspects of compliance. Patients might be taking the wrong doses, taking the wrong medication, missing doses, or they could be over-medicating. A possibility is that being late in requesting a refill might not be as important as *how late* the patient is. For example, missing one day of therapy is less likely to have disastrous consequences than missing one week. This is why in addition to the broad patient compliance measure introduced above I report the average lapsed time by race in Table 1. When late, black patients are on average one more week behind their therapy regimen than whites. It is important to note that the same level of non-compliance implies a much larger lapse in treatment for blacks.

5.4 The effect of patient compliance on survival

If patient compliance accounts for the difference in benefiting from doctor quality then including a measure of compliance in the survival regressions should reduce the gap in survival. To get an idea about the joint effect of compliance and doctor quality I include the patient's compliance with the first doctor who prescribed CHF medication in the medium-term survival regression. This is a lagged measure of compliance that is less likely to be influenced by doctor-patient matching on unobservables.

In Table 8 I include a measure of the compliance with the first doctor who prescribed medication for CHF. Studies in the medical literature define patients as "compliant" if they obtain more than 80% of their re-fills on time (Rossack, 2004; Ostrop et al, 2000). It is possible that the effect is not linear and only the patients who are at the top levels of compliance do better than the rest. To test the hypothesis that only the top patients exhibit a benefit I create an indicator equal to one if the patient was more than 90 per cent compliant. Column (2) in Table 8 reports the regression estimates. In Column (3) I include interaction terms with mean doctor quality and with black race. The interaction with black race is positive and important in magnitude, even though it is not statistically significant. These results imply that patient compliance with therapy affects mortality in a non-linear binary fashion, and the positive effect is restrained to the top levels of compliance. Minority patients who are at the top levels of compliance appear especially likely to benefit from strictly following the medication regimen.

Next I divide the sample into compliant and non-compliant patients based on where their compliance levels fall relative to the mean. The idea is to test whether the observed lower benefits of doctor quality for black patients are isolated for non-compliant patients[19]. Table 9 reports the results a series of regressions on the samples of compliant and non-compliant patients. Dividing the sample in this fashion reveals that the observed lower benefit of physician quality for minority patients is entirely driven by the non-compliant part of the population. In fact, there are no differences in survival between compliant blacks and whites. The negative coefficient on black race appears only in the sample with compliance below the mean.

[19] A potential concern is that selection into compliance is influenced by doctor quality. A probit regression of the binary compliant/non-compliant indicator on observables shows no significant effect of mean doctor quality on selection into compliance. In fact, mean doctor quality for non-compliant patients is higher at .285, while for compliant patients it is .28.

A valid question is why this effect is restricted to non-compliant black patients. There are several possible reasons. First, non-compliance in whites may be different from non-compliance in blacks. For example, when late picking up a medication, black patients take longer than whites. Moreover, as demonstrated earlier, non-compliance with clinically recommended therapy is even more pronounced in minorities that non-compliance with the average medication pick-up. Second, it is possible that non-compliance is common for the most physically active whites and the least active blacks and so the reasons for non-compliance may be different in the two samples. For example, whites are late picking up a medication because they are feeling well, while blacks are late because they don't have the strength to go to the clinic. Third, lower income and weaker social support may play a significant role. For example, a white non-compliant patient may have more alternative venues of obtaining the medication. Finally, unobserved, but equally important characteristics of compliance such as taking the correct dose at the right time and adjusting one's lifestyle to manage and mitigate the effects of CHF may contribute to the difference.

A comparison between compliant and non-compliant patients by race reveals some patterns that lend partial evidence to some of the hypotheses described above. Means and standard deviations are presented in Table 10. Both black and white patients of low compliance are less likely to be diabetic. Less compliant blacks have fewer cases of some forms of cancer, but more incidence of ischemic heart disease. It is unlikely that non-compliance in black patients is due to poverty – the average annual income for low-compliant black patients is 17,710 dollars, compared to 17,450 in the compliant group. They do not appear any more infirm than the rest of the population and are generally younger by about 2 years. Overall, across all patients, those who suffer from other chronic conditions such as diabetes and/or pulmonary failure are more compliant. The only significant observable difference between non-compliant blacks and whites is in the extent of the social support network, as proxied by marital status. A promising venue for future work is to investigate in more detail the mechanisms leading to suboptimal patient response to therapy and whether they differ across groups.

The results in this section have several important implications. First, minority patients are less compliant regardless of who their doctor is. Second, strict patient compliance to the prescribed medication regimen yields positive results. Third, should a black patient fall below the mean level of patient compliance, he experiences lower benefits from doctor quality. In practice this means that sending a non-compliant black patient to the top doctor would result in the same survival benefit as sending a compliant black (or white) patient to doctors with mean quality in the second quintile.

5.5 Decomposing the survival gap

The difference in raw three-year survival conditional on two year survival between whites and blacks is -0.008. This does not appear a large difference at first, but it should be pointed out that minority patients are significantly younger (by 6 years) in this sample. In Table 11 I report the results of Oaxaca-Blinder decompositions of the survival gap by race and compliance level. Coefficients for white patients are taken as the base. Using white patients as the base asks the question: How well would blacks do if they responded to the medical encounter in the same way as whites but also had the same characteristics? Negative signs denote an advantage for blacks, positive signs denote advantage for whites. Adjusting for age and co-morbidities yields a 2.8 per cent *unrealized* survival advantage for African American patients. If all were equal, and there were no differences by race in the benefits from the various factors affecting survival, they would have a 2.8 percentage points higher probability of survival than whites. The 2 percentage points unrealized survival potential for blacks after adjusting for age and co-morbidities is more meaningful than the raw difference in survival.

The effects of socio-economic status account for 30 per cent of this difference. If African Americans had the same rates of marriage and the same income as whites, and responded similarly to factors influencing survival probabilities, they would have 2.2 per cent higher chance of survival than whites. Whites also have higher returns to marriage and income, suggesting that the social support network operates better for whites than for blacks.

Adding clinic fixed effects reveals that on average black patients go to better clinics. Mean doctor quality is not significantly different between the two groups and in itself does not contribute to the black-white survival gap. After accounting for all factors except patient compliance, there is a 1.7 per cent difference in black-white mortality which is attributable to differences in ways blacks and whites respond to different conditions influencing health.

The raw difference in survival between races in the compliant sample is 1.5 percentage points in favor of blacks. After accounting for all observable differences between black and white compliant patients, there remains a very small difference of 0.5 percentage points in favor of whites and attributable to coefficients. This suggests that there is essentially no difference in the way black and white compliant patients respond to factors influencing survival. The important policy implication here is that patient compliance serves as a marker that can be used when designing interventions. Low patient compliance should be used as a signal that something is not working in the way health care is

delivered to the patient, and that break in the process is likely to influence minorities more negatively than whites.

A very different scenario emerges from the sample of non-compliant patients, where African Americans and whites show significantly larger differences attributable to coefficients. The raw difference in survival probabilities is only 0.3 percentage points in favor of blacks. However, adjusting for age and co-morbidities suggests that the difference should instead be over ten times larger in favor of minority patients. Adding controls for income and marital status eliminates about 14 per cent of the difference due to coefficients. Non-compliant blacks go to better clinics, but they see worse doctors. They benefit less from being married, and from clinic and doctor quality. After accounting for all patient, doctor and clinic characteristics, the part of the survival gap attributable to coefficients for non-compliant patients is more than one and a half times larger than the overall survival gap.

In summary, there are almost no differences in the way patients from the top half of the compliance distribution react to the medical encounter. The observed difference in survival rates associated with black race is entirely accounted for by black patients in the lower half of the compliance distribution. These patients should be the focus of policy interventions intended to reduce the racial mortality gap.

5.6 Applicability to the general population

The results presented above are based on a sample of veterans utilizing the VA health care system and diagnosed with CHF by a VA physician. The VA health care system presents a convenient case study and avoids many of the unobservable heterogeneities that plague studies using Medicare data. Yet, it caters to a specific population. First, all veterans who were not drafted, have self-selected into the military. This selection may have happened differently among whites and minorities. Second, not all veterans elect to use the VA health care system and again, selection into the VA health care system may differ by racial group. I use data from the Current Population Survey (CPS) and the National Survey of Veterans (NSV) to examine the selection process and assess the bias it introduces into the results.

Selection into veteran status

I use the August 2000 CPS Veteran supplement to compare veterans to non-veterans among the white and the African American populations. More than half of the male population (56%) over the age of 65

had veteran status in 2000. As a group, veterans are more likely to be married and have higher educational attainment. African American veterans are equally likely to have a spouse as non-veterans, but they have one more year of education on average. White veterans are more likely to be married than non-veterans and have a higher educational attainment. Veteran status serves as a mediator of the education gap between black and whites, with black veterans being closer to their white counterparts than in the rest of the population. Higher education has been found in numerous studies to positively influence health, hence the selection into veteran status by African Americans serves to bias the black-white mortality gap *downwards*.

Selection into VA care

The 2001 NSV is a nationally representative survey of veterans that asks several questions related to the use of VA care as well as veterans' health status and chronic conditions. Among patients who are eligible for Medicare those choosing to use the VA health care services are less likely to be married and have lower education. However, African Americans in VA care have higher educational attainment than African Americans who elect not to use it relative to whites. Married individuals are less likely to use VA care across races. Similar comparisons apply to the sample of patients who report having a heart condition and for those among them who are eligible for Medicare.

There is a double selection bias likely to reduce the mortality gap observed among veterans using VA health care. First, African Americans with military experience have relatively higher education than their civilian brothers as compared with whites. Second, while both black and white veterans of high education prefer to use health care sources outside the VA, the gap in education attainment between users and non-users is larger among whites.

6. Policy implications

Designing and implementing policies that improve physicians' awareness of clinically recommended therapies and patients' response to therapy will have first-order effect on overall mortality and the racial gap in survival. Numerous techniques for improving patient compliance have been suggested. However, few offer a cost-benefit analysis of the proposed interventions. Two dimensions of such an analysis are offered here – the efficiency gain from better drug regimen compliance, and the gains in value of statistical life-years.

A well-known quantification of the benefits of better compliance comes from the town of Asheville, North Carolina. The Asheville project involved patients with diabetes mellitus, another chronic, common, and potentially fatal disease associated with high hospitalization costs and decrease in quality of life. The project recruited pharmacists to monitor and assess the compliance of diabetic patients over 12 months[20]. During the next 12 months inpatient claims went down by 40 per cent.

The annual hospital costs of CHF have been estimated at $8 billion dollars and the overall annual cost of managing CHF at $12 to $20 billion dollars (Alexander et al., 1999). Achieving the efficiency of the Asheville project would reduce impatient CHF costs by $3.2 billion dollars per year. About 550000 new CHF cases are diagnosed annually. The cost of an identical program for heart failure patients would be about 400 dollars per patient in the first year of treatment, and the effect could last much longer than the initial 12 months. If *every* patient is given the type of pharmacy counseling used in Asheville, the total bill would be 220 million dollars, which is less than 10 per cent of the total savings from preventable hospitalizations *only*.

Closing the survival gap requires equalizing black and white therapy compliance rates. Increasing black patient compliance by 5 per cent and equalizing it with white patients' compliance will reduce absolute medium-term black mortality by 1.5 per cent. Values of statistical life-years range between fifty thousand dollars and one hundred and fifty thousand dollars. Increasing mean black compliance to the level of white patients could result in expected savings ranging from one to three thousand dollars per black patient per year. There are about 700000 African Americans with heart failure in the US, and this number is expected to grow to 900,000 by 2010. Potential reductions in the cost of care and benefits to society are in the order of billions of dollars.

7. Conclusions

Equalizing access for patients and financial incentives for physicians is not sufficient to close the racial mortality gap in elderly patients with chronic heart failure. I find that two thirds of the gap recorded using Medicare data persist in an equal-access, government-sponsored medical system with salaried physicians. Several reasons for this phenomenon are examined. Differences in socio-economic status account for less than one third of the remaining gap in survival. While doctor quality is a

[20] Pharmacists were compensated to initially assess patient compliance, evaluate intermediate outcomes and perform routine visits lasting no more than 20 minutes. They were paid 75$ for the first pharmacy consultation, 45$ for the intermediate, and 20$ for routine visits.

significant factor in improving survival probabilities, there is little evidence of sorting of minorities into lower quality doctors and it explains only five per cent of the difference in outcomes. Patient-doctor matching is efficient in improving patient compliance and may counter the effect of lower doctor quality through increased patient compliance. I also show that personal or institutional prejudice do not account for the observed disparity. Rather, divergent patient responses to provider input appear to trigger some of the differences in survival.

The largest differences between minorities and whites exist in patient compliance with prescribed therapy. One obvious policy recommendation is to invest in changing the compliance patterns of minority patients. Clearly, more work is needed to identify the reasons behind diverging responses to health care and why they affect whites and minorities differently. The key to solving the predicament of racial disparities in health, beyond the effects of unequal supply of care, lies in the patient response to the medical encounter.

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Tables and Graphs

Table 1: Variable definitions and means; variables not used in previous studies and introduced in this paper are in **bold**

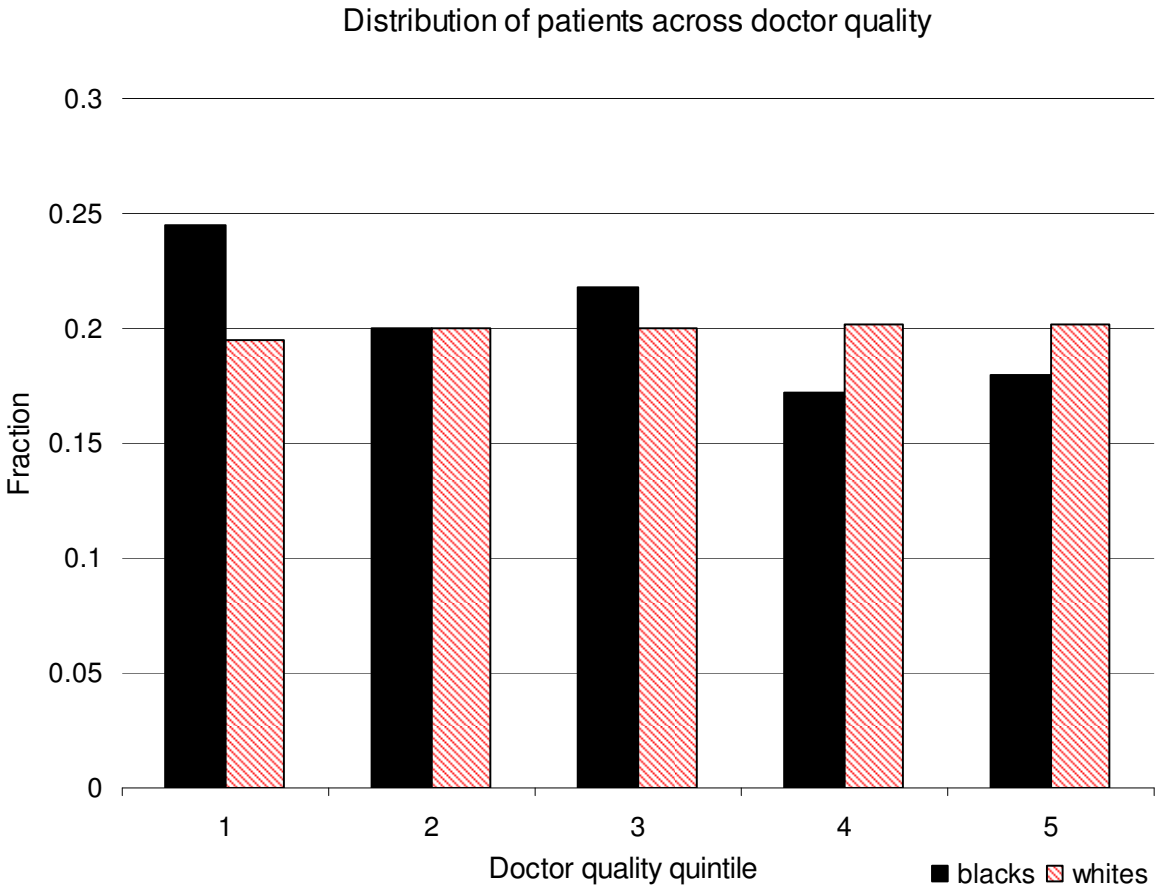
	White patients			Black patients		
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Yearly income	**45512**	**24890**	**20000**	**3460**	**18644**	**10500**
Age	45512	73	9	3460	67	12
Married	**45512**	**0.70**	**0.46**	**3460**	**0.50**	**0.50**
Patient compliance (all)	**41436**	**0.49**	**0.28**	**3074**	**0.53**	**0.28**
Patient compliance (ACEIs-BBs)	**32716**	**0.56**	**0.29**	**2611**	**0.51**	**0.29**
N days late with refill	39929	17	18	3152	22	22.5
			Outcomes			
% Survived the first year	45512	84%	0.37	3460	0.87	0.34
% Survived the 2nd year|surviving 1st	26365	86%	0.43	2141	0.88	0.41
% Survived the 3rd year|Surviving 2nd	17681	89%	0.46	1566	0.90	0.44
			Clinic characteristics			
Ratio black in clinic	45167	5.57%	7%	3455	15.13%	12%
% in Small clinics	45512	25.53%	44%	3460	16.82%	37%
% in Large clinics	45512	34.63%	48%	3460	54.57%	50%
% in Rural clinics	45314	11.77%	17%	3385	7.79%	14%
			Patient-doctor matching			
Doctor ratio black	40639	0.06	0.078	3243	0.245	0.18
Mean doctor quality	**40639**	**0.29**	**0.09**	**3243**	**0.28**	**0.09**
First doctor's quality	**40639**	**0.34**	**0.08**	**3243**	**0.33**	**0.08**
Time to meeting main doctor	40639	254	421	3243	303	478
doctors /year	40639	1.6	0.2	3243	1.8	0.2
prescriptions/doctor	40639	8.5	0.3	3243	8.2	0.4
main doctor absent	40639	2.8	3.87	3243	2.8	3.66
			Small clinics			
Doctor ratio black	10631	0.04	0.06	545	0.28	0.24
Mean doctor quality	10631	0.3	0.09	545	0.3	0.1
			Medium clinics			
Doctor ratio black	15775	0.05	0.06	896	0.19	0.008
Mean doctor quality	15775	0.29	0.087	896	0.28	0.04
			Large clinics			
Doctor ratio black	14233	0.09	0.09	1802	0.26	0.17
Mean doctor quality	14233	0.29	0.09	1802	0.27	0.09

Table 2: Three-year survival probability conditional on two-year survival. Linear probability models. The dependent variable equals one if the patient survived the third year after diagnosis. All standard errors are adjusted for clinic-level clustering.

Outcome: Three year survival conditional on two year survival					
	(1)	(2)	(3)	(4)	(5)
Black	-0.022**	-0.017*	-0.019**	-0.018*	0.036
	(0.009)	(0.009)	(0.009)	(0.009)	(0.034)
Age	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Income		0.002	0.002	0.002	0.002
		(0.002)	(0.002)	(0.002)	(0.002)
Married		0.029***	0.029***	0.026***	0.026***
		(0.007)	(0.007)	(0.007)	(0.007)
Mean_doc_quality				0.375***	0.398***
				(0.051)	(0.052)
Black*doc_quality					-0.193*
					(0.107)
Co-morbidities	YES	YES	YES	YES	YES
Cohort FE	YES	YES	YES	YES	YES
Clinic FE	NO	NO	YES	YES	YES
Constant	1.284***	1.251***	1.230***	1.127***	1.121***
	(0.026)	(0.021)	(0.037)	(0.041)	(0.041)
Observations	11463	11542	11463	11463	11463
R-squared	0.032	0.034	0.033	0.039	0.039
Robust standard errors in parentheses					
* significant at 10%; ** significant at 5%; *** significant at 1%					

Controls for co-morbidities include: old myocardial infarction, lymphoma, leukemia, pulmonary failure, diabetes, renal failure, colon cancer, angina, cardiomyopathy, ischemic heart disease, prostate cancer, liver disease, dysrhythmias, other cardiovascular disease, other cancers.

Figure 1: Mean doctor quality by patient race. Shaded red indicates white patients, black denotes black patients. Doctor quality is measured as the weighted average of the individual adherence measures of all doctors who treated the patient during the period. Adherence to clinical guidelines is constructed as the N of patients who were prescribed ACEIs and beta blockers/ total N patients treated by the doctor.



The following were used as cut-off points for doctor quality quintiles:

1. mean doctor quality$\leq$ 0.21
2. 0.21 < mean doctor quality $\leq$ 0.26
3. 0.26 < mean doctor quality $\leq$ 0.3
4. 0.3 < mean doctor quality $\leq$ 0.35
5. 0.35 < mean doctor quality

Figure 2: Effect of doctor quality on patient survival. The top line (red) indicates white patients. The lower line (in black) indicates African American patients. Doctor quality is measured as the weighted average of the individual adherence measures of all doctors who treated the patient during the period. Adherence to clinical guidelines is constructed as the N of patients who were prescribed ACEIs and beta blockers/ total N patients treated by the doctor. Large markers indicate significance of 80% and above.

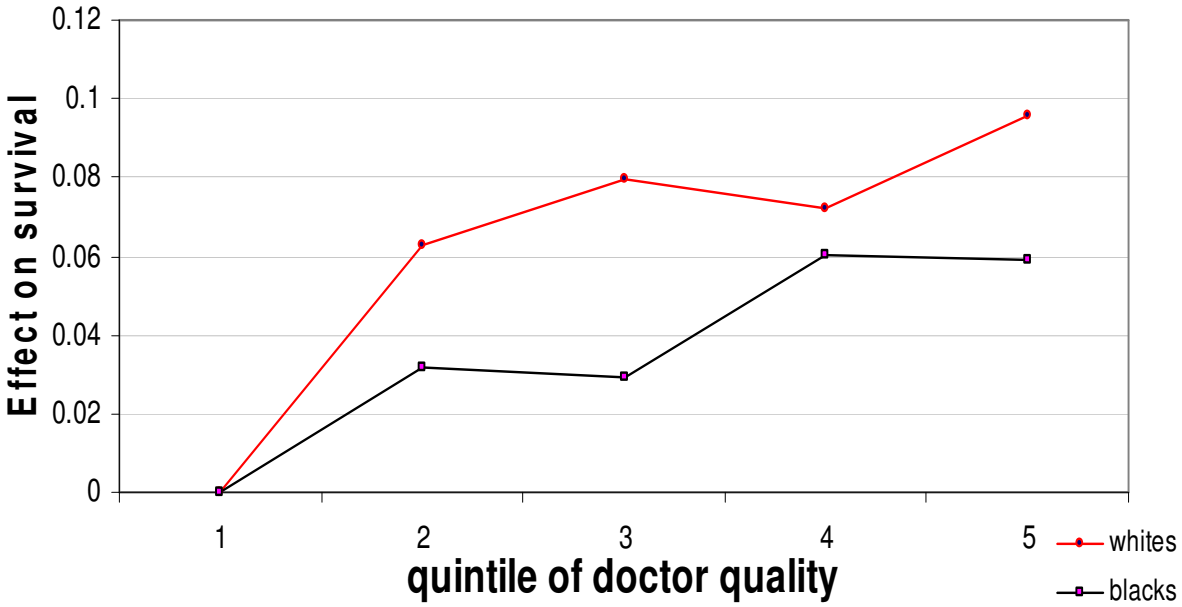


Table 3: Three-year survival conditional on two-year survival. Linear probability models. The dependent variable equals one if the patient survived the third year after diagnosis. All standard errors are adjusted for clinic-level clustering.

Outcome: Three year survival conditional on two year survival				
	(1)	(2)	(3)	(4)
Black	-0.018*	0.036	-0.019**	0.054
	(0.009)	(0.034)	(0.009)	(0.04)
Age	-0.005***	-0.005***	-0.005***	-0.005***
	(0.000)	(0.000)	(0.000)	(0.000)
Married	0.026***	0.026***	0.027***	0.028***
	(0.002)	(0.002)	(0.007)	(0.007)
Income	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.001)	(0.001)
Mean_doc_quality	0.375***	0.398***		
	(0.051)	(0.052)		
Black*doc_quality		-0.193*		
		(0.107)		
First_doc_quality			0.37***	0.4***
			(0.046)	(0.048)
Black*first_doc_quality				-.21**
				(0.11)
Constant	1.127***	1.121***	1.125***	1.12***
	(0.041)	(0.041)	(0.04)	(0.041)
Co-morbidities	YES	YES	YES	YES
Cohort FE	YES	YES	YES	YES
Clinic FE	YES	YES	YES	YES
Obs	11463	11463	11463	11463
R-squared	0.039	0.039	0.036	0.036
Robust standard errors in parentheses				
* significant at 10%; ** significant at 5%; * **significant at 1%				

Controls for co-morbidities include: old myocardial infarction, lymphoma, leukemia, pulmonary failure, diabetes, renal failure, colon cancer, angina, cardiomyopathy, ischemic heart disease, prostate cancer, liver disease, dysrhythmias, other cardiovascular disease, other cancers.

Table 4: Probability of being treated with recommended therapy of ACE inhibitors and beta blockers by a doctor. The unit of observation is the doctor-patient pair. Linear probability models. Controls for co-morbidities and year fixed effects included, coefficients not reported. Standard errors are clustered at the patient level.

Outcome: Probability of being treated with ACEIs and BBs; patient-doctor pairs			
	(1)	(2)	(3)
Black	-0.003	-0.009*	0.003
	(0.004)	(0.005)	(0.006)
Age		-0.003***	-0.003***
		(0.000)	(0.000)
Married		0.005*	0.002
		(0.0026)	(0.002)
Income		0.003***	0.001
		(0.000)	(0.0006)
Co-morbidites	YES	YES	YES
Cohort FE	YES	YES	YES
Doctor FE	NO	NO	YES
Obs	157469	157469	157469
R-squared	0.0116	0.029	0.027
Robust standard errors in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			

A patient-doctor pair is a match between a patient and a doctor which produces more than 2 prescriptions for the patient. Controls for co-morbidities include: old myocardial infarction, lymphoma, leukemia, pulmonary failure, diabetes, renal failure, colon cancer, angina, cardiomyopathy, ischemic heart disease, prostate cancer, liver disease, dysrhythmias, other cardiovascular disease, other cancers.

Table 5: Patient compliance with therapy. All medications, all doctors. Yearly measures. The dependent variable is the ratio of compliant re-fills (re-fills which were picked up within 3 days of expiration of the supply of medication from the previous re-fill) for all medications. Standard errors are clustered at the clinic level.

Outcome: Patients' average yearly compliance; all doctors, all medications			
	(1)	(2)	(3)
Black	-0.024***	-0.023***	-0.036***
	(0.008)	(0.008)	(0.005)
Age	0.000	0.000	0.000***
	(0.00)	(0.00)	(0.00)
Income		-0.001	-0.000
		(0.001)	(0.000)
Married		0.008***	0.006***
		(0.0018)	(0.0016)
Co-morbidities	YES	YES	YES
Cohort FE	YES	YES	YES
Clinic FE	NO	NO	YES
Constant	0.079***	0.076***	0.042***
	(0.014)	(0.014)	(0.012)
Obs	43578	43578	43578
R-squared	0.026	0.028	0.032
Robust standard errors in parentheses			
* significant at 10%; ** significant at 5%; ***significant at 1%			

Controls for co-morbidities include: old myocardial infarction, lymphoma, leukemia, pulmonary failure, diabetes, renal failure, colon cancer, angina, cardiomyopathy, ischemic heart disease, prostate cancer, liver disease, dysrhythmias, other cardiovascular disease, other cancers.

Table 6: Patient compliance with therapy. Patient-doctor pairs. The dependent variable is the ratio of compliant re-fills for every patient-doctor match. Standard errors are clustered at the patient level.

Outcome: patient compliance with doctors; all medications; patient-doctor pairs				Outcome: patients' average yearly compliance with ACEIs and BBs		
	Panel I			Panel II		
	(1)	(2)	(3)	(1)	(2)	(3)
Black	-0.037***	-0.038***	-0.056***	-0.041***	-0.042***	-0.058***
	(0.004)	(0.005)	(0.005)	(0.011)	(0.01)	(0.009)
Age	-0.000	-0.000	0.000***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.00)	(0.00)	(0.00)
Income		-0.002***	-0.001**		-0.003**	-0.002*
		(0.001)	(0.001)		(0.001)	(0.001)
Married		0.000	0.002		0.008**	0.005
		(0.003)	(0.002)		(0.003)	(0.0037)
Co-morbidities	YES	YES	YES	YES	YES	YES
Cohort FE	YES	YES	YES	YES	YES	YES
Doctor FE	NO	NO	YES	NO	NO	YES
Constant	14.811***	14.314***	12.391***	0.514***	0.515***	0.486***
	(1.511)	(1.516)	(1.604)	(0.023)	(0.024)	(0.018)
Obs	121368	121368	121368	34928	34928	34928
R-squared	0.004	0.004	0.005	0.005	0.005	0.006
Robust standard errors in parentheses						
* significant at 10%; ** significant at 5%; *** significant at 1%						

A patient-doctor pair is a match between a patient and a doctor which produces more than 2 prescriptions for the patient. Controls for co-morbidities include: old myocardial infarction, lymphoma, leukemia, pulmonary failure, diabetes, renal failure, colon cancer, angina, cardiomyopathy, ischemic heart disease, prostate cancer, liver disease, dysrhythmias, other cardiovascular disease, other cancers.

Table 7: Patient compliance with therapy. Patient-doctor pairs. The dependent variable is the ratio of compliant re-fills for every patient-doctor match. Column (1) shows compliance with all medications for the sub-sample of doctors who prescribed ACE inhibitors and beta blockers. Columns (2)-(4) have compliant with ACEIs and BBs as an outcome variable. Standard errors are clustered at the patient level.

Outcome: patient compliance with doctors; patient-doctor pairs; model (1) has all medications; models (2)-(4) are for ACEIs and beta blockers only				
	All medications	ACEIs-BBs	ACEIs-BBs	ACEIs-BBs
	(1)	(2)	(3)	(4)
Black	-0.062***	-0.041***	-0.042***	-0.064***
	(0.005)	(0.006)	(0.006)	(0.006)
Age	0.001***	0.000	0.000	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Income	-0.001**		-0.002***	-0.001**
	(0.001)		(0.001)	(0.001)
Married	0.003		0.002	0.003
	(0.003)		(0.003)	(0.003)
Co-morbidities	YES	YES	YES	YES
Cohort FE	YES	YES	YES	YES
Doctor FE	YES	NO	NO	YES
Constant	9.548***	17.130***	16.661***	13.292***
	(1.746)	(1.826)	(1.835)	(1.990)
Obs	76853	76853	76853	76853
R-squared	0.006	0.004	0.004	0.005
Robust standard errors in parentheses				
* significant at 10%; ** significant at 5%; *** significant at 1%				

A patient-doctor pair is a match between a patient and a doctor which produces more than 2 prescriptions for the patient. Controls for co-morbidities include: old myocardial infarction, lymphoma, leukemia, pulmonary failure, diabetes, renal failure, colon cancer, angina, cardiomyopathy, ischemic heart disease, prostate cancer, liver disease, dysrhythmias, other cardiovascular disease, other cancers.

Figure 3: Difference in black/white compliance rate by doctor and N prescriptions. Solid line indicates plot the black coefficient from regressions of compliance with any doctor at the given level of prescriptions. The dotted line plots the black coefficient on from regressions of compliance with the most preferred doctor (the doctor with the highest number of prescriptions). The dashed line plots the black coefficient from regressions of compliance with the least visited (bottom) doctor. Controls for income, marital status, age and co-morbidities. Corresponds to regression (3) in Table 6.

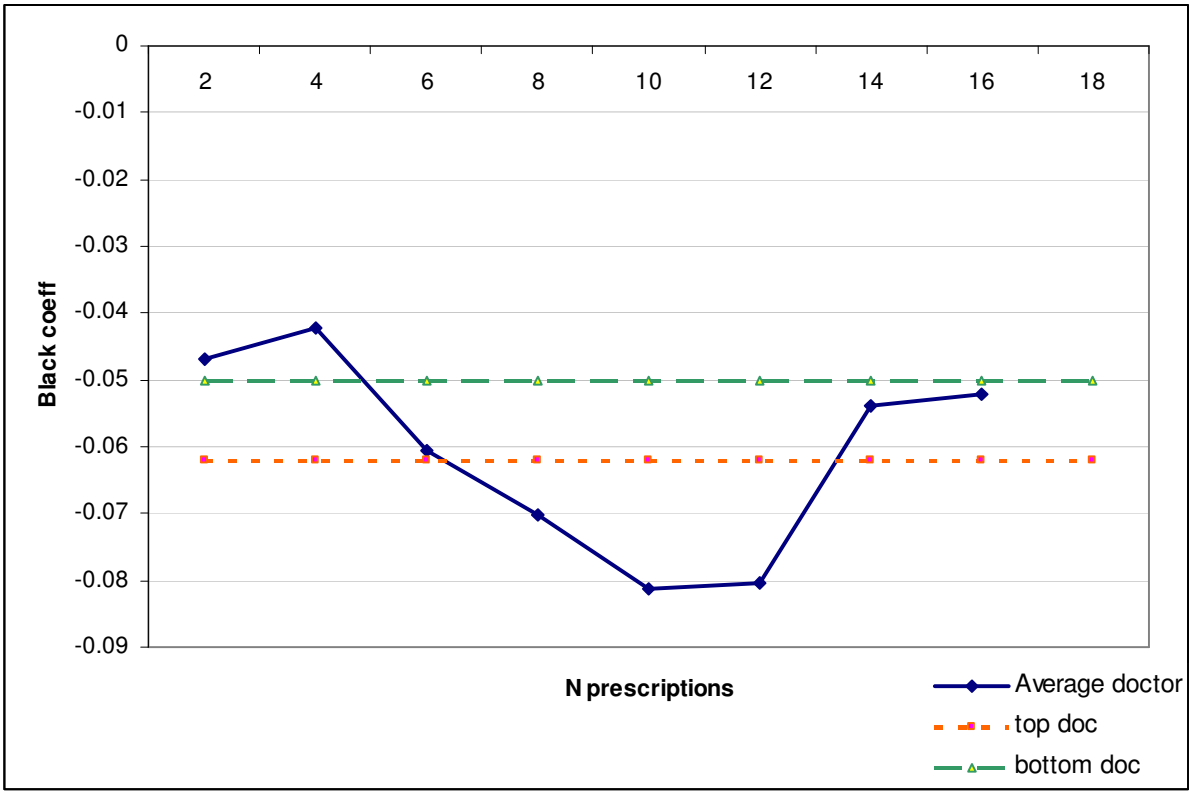


Table 8: The effect of patient compliance on medium-term survival. Three-year survival conditional on two-year survival. All standard errors are adjusted for clinic-level clustering.

Outcome: three year survival probability conditional on two-year survival			
	(1)	(2)	(3)
Black	-0.018*	-0.017*	-0.021**
	(0.009)	(0.009)	(0.009)
Age	-0.005***	-0.005***	-0.005***
	(0.000)	(0.000)	(0.000)
Income	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)
Married	0.026***	0.026***	0.026***
	(0.007)	(0.007)	(0.007)
Mean_doc_quality	0.375***	0.378***	0.379***
	(0.051)	(0.051)	(0.051)
Full_compliance		0.018**	0.015*
		(0.008)	(0.009)
Black*Full_compliance			0.042
			(0.026)
Co-morbidities	YES	YES	YES
Cohort FE	YES	YES	YES
Clinic FE	YES	YES	YES
Constant	1.127***	1.124***	1.124***
	(0.041)	(0.041)	(0.041)
Observations	11463	11463	11463
R-squared	0.039	0.039	0.039
Robust standard errors in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			

Controls for co-morbidities include: old myocardial infarction, lymphoma, leukemia, pulmonary failure, diabetes, renal failure, colon cancer, angina, cardiomyopathy, ischemic heart disease, prostate cancer, liver disease, dysrhythmias, other cardiovascular disease, other cancers.

Table 9: The effect of different levels of patient compliance by race. Non-compliant is 1 if the patient was below the mean level of compliance with his first doctor. Three-year survival conditional on two-year survival. All standard errors are adjusted for clinic-level clustering.

Outcome: Three year survival probability conditional on two-year survival						
	Non-compliant patients			Compliant patients		
	(1.1)	(1.2)	(1.3)	(2.1)	(2.2)	(2.3)
Black	-0.036**	-0.034**	0.057	-0.004	-0.005	0.006
	(0.014)	(0.014)	(0.048)	(0.016)	(0.017)	(0.045)
Age	-0.005***	-0.006***	-0.006***	-0.005***	-0.005***	-0.005***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Income	-0.000	-0.000	-0.000	0.003	0.003	0.003
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Married	0.022**	0.020**	0.020**	0.037***	0.034***	0.034***
	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)
Mean_doc_quality		0.394***	0.447***		0.358***	0.361***
		(0.076)	(0.075)		(0.061)	(0.065)
Black*doc_quality			-0.326**			-0.040
			(0.162)			(0.146)
Co-morbidities	YES	YES	YES	YES	YES	YES
Cohort FE	YES	YES	YES	YES	YES	YES
Clinic FE	YES	YES	YES	YES	YES	YES
Constant	1.239***	1.137***	1.123***	1.220***	1.121***	1.120***
	(0.045)	(0.050)	(0.051)	(0.048)	(0.052)	(0.052)
Obs	5194	5194	5194	6269	6269	6269
R-squared	0.035	0.041	0.042	0.036	0.042	0.042
Robust standard errors in parentheses						
* significant at 10%; ** significant at 5%; *** significant at 1%						

Table 10: Observable characteristics of compliant and non-compliant patients by race for the sample of patients who survived two years after diagnosis.

Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
	White patients			Black patients			White patients			Black patients		
	Compliant						Non-compliant					
Income	6044	22930	16900	392	17450	9080	4639	23250	16630	700	17710	9460
Marital	6044	0.669	0.470	392	0.474	0.500	4639	0.703	0.457	700	0.501	0.500
Age	6044	70.89	9.413	392	67.19	11.372	4639	71.47	9.27	700	65.31	11.43
Colon cancer	6044	0.008	0.091	392	0.013	0.112	4639	0.008	0.089	700	0.009	0.092
Old AMI	6044	0.049	0.217	392	0.046	0.210	4639	0.057	0.232	700	0.063	0.243
Angina	6044	0.047	0.211	392	0.046	0.210	4639	0.060	0.238	700	0.067	0.250
Hernia	6044	0.025	0.157	392	0.041	0.198	4639	0.025	0.155	700	0.016	0.124
Pulmonary disorders	6044	0.318	0.466	392	0.260	0.439	4639	0.287	0.452	700	0.270	0.444
Lymphoma	6044	0.001	0.036	392	0.000	0.000	4639	0.002	0.039	700	0.003	0.053
Leukemia	6044	0.013	0.114	392	0.023	0.150	4639	0.015	0.122	700	0.016	0.124
Other_cancers	6044	0.055	0.228	392	0.071	0.258	4639	0.055	0.229	700	0.059	0.235
Prostate Cancer	6044	0.060	0.237	392	0.059	0.235	4639	0.059	0.236	700	0.073	0.260
Skin/bone cancer	6044	0.010	0.102	392	0.015	0.123	4639	0.012	0.108	700	0.001	0.038
Liver disorders	6044	0.031	0.174	392	0.033	0.179	4639	0.029	0.168	700	0.031	0.175
Renal/ disorders	6044	0.143	0.350	392	0.161	0.368	4639	0.134	0.341	700	0.154	0.361
Diabetes	6044	0.374	0.484	392	0.406	0.492	4639	0.356	0.479	700	0.367	0.482
Other Cardiovascular	6044	0.106	0.308	392	0.133	0.340	4639	0.100	0.300	700	0.107	0.310
Dysrhythmias	6044	0.282	0.450	392	0.173	0.379	4639	0.292	0.455	700	0.200	0.400
Cardiomyopathy	6044	0.074	0.261	392	0.125	0.331	4639	0.077	0.267	700	0.130	0.337
Ischemic heart disease	6044	0.539	0.499	392	0.398	0.490	4639	0.544	0.498	700	0.453	0.498
Cohort	6044	1999.5	0.681	392	1999.4	0.662	4639	1999.5	0.674	700	1999.4	0.692

Table 11: Oaxaca-Blinder decompositions of the survival gap by race and compliance level. Coefficients for white patients taken as base. A negative sign means advantage for blacks, a positive sign indicates advantage for whites. Decompositions based on the sample of patients who survived two years of treatment.

	All patients		
Factors	Total racial survival gap	Amount attributable to endowments	Amount attributable to coefficients
1. Age, co-morbidities	-0.008	-0.028	0.02
2. Line (1) plus income, marital status	-0.008	-0.022	0.014
3. Line (2) plus clinic FE	-0.008	-0.025	0.017
4. Line (3) plus mean doc quality	-0.008	-0.025	0.017
	Compliant patients		
1. Age, co-morbidities	-0.015	-0.023	0.008
2. Line (1) plus income, marital status	-0.015	-0.016	0.001
3. Line (2) plus clinic FE	-0.015	-0.02	0.005
4. Line (3) plus mean doc quality	-0.015	-0.02	0.005
	Non-compliant patients		
1. Age, co-morbidities	-0.003	-0.031	0.028
2. Line (1) plus income, marital status	-0.003	-0.027	0.024
3. Line (2) plus clinic FE	-0.003	-0.034	0.031
4. Line (3) plus mean doc quality	-0.003	-0.032	0.029