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The Role of Public vs. Private Insurance

by

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Abstract

In the US healthcare system, patients of different socio-economic status (SES) often receive disparate treatment for similar conditions. Prior work documents this phenomenon for particular treatments/conditions, but we take a system-wide view and examine socio-economic disparities in spending for all medical conditions at the 3-digit ICD-9 level. We also compare SES spending gradients for those covered by private vs. public insurance (Medicare). Using data on adult respondents from the Medical Expenditure Panel Survey 2000-14, we estimate multivariate regressions for individual medical spending (total and out-of-pocket) controlling for medical conditions, demographics, health, and insurance, separately by sex, education, and age. Within age-sex categories, we assess how spending on each condition varies with education (a proxy for SES). In the predominantly privately insured population aged 24-64, system spending for several of the most socially costly conditions is strongly increasing in education (e.g., breast cancer for women and chest symptoms for men). These disparities are not explained by differences in health, insurance status, or ability-to-pay, suggesting they arise due to discrimination. However, we find no positive SES gradients for individuals over 64 covered by the public Medicare program, suggesting that Medicare plays an important role in improving equity.

Keywords: Education gradient, Health insurance systems, Healthcare equity, Private and Public health insurance, Socio-economic disparities

JEL Classification: I13; I14; I18

1. Introduction

In recent years, many policy experts have advocated market-based reforms as a way to enhance efficiency in healthcare delivery. This is true both in universal health care systems like the NHS in the UK, and national health insurance systems like Medicare in Australia. But most would agree that an equitable healthcare system, where each patient receives equal treatment regardless of socio-economic status (SES), is an important public policy goal as well. Thus, a key question is whether market-based reforms aimed at increasing efficiency may have adverse consequences for equity.

The US provides an interesting source of evidence on this question, as it has a mixed public/private system of healthcare financing. Specifically, most people under age 65 purchase private insurance through an employer, while most people aged 65 and over have access to the publicly funded Medicare system. In our study we compare healthcare system resources devoted to patients with a wide range of health conditions and different types of healthcare coverage. We focus on comparing the levels of resources devoted to patients with different levels of SES, conditional on detailed controls for insurance status and medical need.

We find evidence of important SES-based inequalities in U.S. healthcare spending. For example, spending on women diagnosed with breast cancer differs greatly by education level. Conditional on our extensive set of controls, a breast cancer diagnosis leads to an increase in annual medical spending of $10,865 (standard error [SE] $1892) among college educated women, compared to only $3832 (SE $1404) among high school dropout (<HS) women. So, on average, spending on women with a college degree exceeds that on <HS women by $7033 (SE $2356, p=.003). We find that differences in out-of-pocket spending (or ability to pay) cannot explain this result, so it appears to be driven by differences in how women of different education levels are treated by the healthcare system itself. We find similar pattrens for a range of other medical conditions as well (for both men and women).

We also find evidence that the public Medicare system leads to a more equitable allocation of resources than the private employer-based part of the US system. That is, for men and women under age 65, we find important SES gradients in spending on numerous health conditions. But these gradients largely vanish at age 65 when most people are covered by Medicare. This contrast holds true even if we focus only on the insured, and ignore the many who are uninsured under the private system. Thus, our results may serve as a cautionary tale for advocates of market based reforms, provided one is also concerned with equity.

Our work requires two key decisions: how to measure equity/inequity and how to measure SES. First, we focus on equity in the dimension of healthcare spending. We argue that one key attribute of an equitable healthcare system is that healthcare spending devoted to any particular patient should be determined by his/her medical needs rather than by socio-economic status (SES) (Andersen and Newman 1973, Andersen 1995). Of course, low income individuals who are constrained by out-of-pocket costs demand less medical care. But the key question is whether healthcare system spending varies with SES, controlling for ability to pay (i.e., net of out-of-pocket spending, and controlling for insurance type).

Second, we focus on education as a proxy for SES. Another potential proxy is income, but we feel education is a superior proxy for SES because it is a relatively fixed characteristic of a person, while income fluctuates substantially from year-to-year and over the life-cycle in ways unrelated to changes in SES. In particular, education is more meaningful in capturing SES for retirees, who are a key focus of our study. We also examine race/ethnicity as an additional proxy for SES. But our results suggest that SES spending gradients based on education are more significant than those based on race/ethnicity, so we focus on the former.

In summary, the aim of this paper is to examine SES-based disparities in medical expenditures across the entire US healthcare system. While prior work has focused on disparities in particular aspects of treatment in particular settings, the main innovation of the present study is to take a system-wide perspective. At the same time, we also examine disparities at a more refined level than in prior work, in that we decompose disparities by 3-digit ICD-9 medical condition codes, age, sex, education, race, health status, and other demographics.[1] Importantly, we compare disparities across insurance status types, shedding light on which parts of the US healthcare system generate more or less equity in care.

2. Relationship to the Literature

There is a large literature on equity in healthcare. Numerous studies find that, even conditional on diagnosis, lower SES groups often receive lower quality treatment.[2] These differences are widespread across OECD countries, including even those with universal health systems (Alter et al. 1999, van Doorslaer et al. 2000, Van Doorslaer et al. 2006, van Doorslaer et al. 2008, Johar et al. 2013). Indeed, previous work based on cross-country comparisons has produced conflicting results on the question of equity in public vs. private systems. Some prior studies find the US ranks among the lowest in terms of equitable access to care (Van Doorslaer et al. 2006, Davis and Ballreich 2014). But others find inequality in US healthcare utilization is similar to many European countries with universal systems (van Doorslaer et al. 2000). Unfortunately, cross-country comparisons are plagued by the difficulty of controlling for underlying country characteristics such as intensity and efficiency of care (Garber and Skinner 2008). This highlights the value of a within country (i.e., US) comparison across groups with different insurance status (i.e., private insurance vs. Medicare).

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[1] The International Classification of Diseases (ICD) published by the World Health Organization is the most widely used classification of diseases. It is the international standard diagnostic tool for epidemiology, health management and clinical purposes. It classifies not only diseases but also a wide variety of signs, symptoms, abnormal findings, and external causes of injury and disease.

[2] See for example (Aliyu, Aliyu, and McCormick 2003, Alter et al. 1999, Andersen and Newman 1973, Andersen 1995, Ayanian, Weissman, et al. 1999, Ayanian, Cleary, et al. 1999, Ayanian et al. 2014, Bach et al. 1999, Berkowitz et al. 2014, Brunt 2016, Chen et al. 2016, Christian et al. 2006, Curry and Barker 2009, Davis and Ballreich 2014, Eichner and Vladeck 2005, Emoto et al. 2016, Franks et al. 2003, Garber and Skinner 2008, Gornick et al. 1996, Johar et al. 2013, Kapur et al. 2004, Li 2004, Molina, Silva, and Rauscher 2015, Moscelli et al. 2017, Philbin et al. 2001, Rathore et al. 2006, Sambamoorthi and McAlpine 2003, Schulman et al. 1999, Siciliani and Verzulli 2009, Smedley et al. 2002, Trivedi, Rakowski, and Ayanian 2008, Trivedi et al. 2011, van der Meer and Mackenbach 1999, Van Doorslaer et al. 2006, van Doorslaer et al. 2000, Wagstaff and Van Doorslaer 2000).

Much of the prior literature on SES disparities in healthcare focusses on particular health conditions in selected populations.[3] This research finds that lower SES patients often receive lower quality care or less adequate treatment for specific conditions like diabetes, early-stage lung cancer, and brain tumors (Bach et al. 1999, Curry and Barker 2009, Li 2004, Aliyu, Aliyu, and McCormick 2003, van der Meer and Mackenbach 1999). However, these studies generally do not jointly control for the two most important enabling factors: type of health insurance held and ability to pay out-of-pocket (i.e., income). As ability to pay is an important driver of consumer demand for services in a semi-private healthcare system, it remains unclear if the U.S. system discriminates based on SES *per se*, or if the observed SES differences just reflect differences in demand.

Another strand of literature focusses on particular health insurance arrangements (e.g., Medicare managed care plans, Medicare part B, and the Veterans Administration). Within particular insurance settings, there is evidence that lower SES groups use fewer health care services, have lower medical care expenditures, and experience poorer health outcomes (Ayanian et al. 2014, Brunt 2016, Kapur et al. 2004, Trivedi et al. 2011). However, these studies account for medical need in a limited way, controlling only for self-reported health status or a few chronic conditions.

Thus, we were unable to find prior evidence on discrimination that both: (i) covers the whole U.S. healthcare system, and (ii) covers a wide range of health conditions. This is the first study to adopt a system-wide perspective, examining SES differences in spending across all medical conditions at the 3-digit ICD-9 level, and across the entire U.S. healthcare system, including both the privately and publicly insured.

[3] See for example (Aliyu, Aliyu, and McCormick 2003, Alter et al. 1999, Ayanian, Cleary, et al. 1999, Ayanian, Weissman, et al. 1999, Bach et al. 1999, Berkowitz et al. 2014, Christian et al. 2006, Curry and Barker 2009, Franks et al. 2003, Li 2004, Molina, Silva, and Rauscher 2015, Philbin et al. 2001, Rathore et al. 2006, van der Meer and Mackenbach 1999).

3. Methods

3.1. Data

In order to analyze how the resources devoted to patients differ by medical condition and SES, we require data on total medical expenditures (both covered and out-of-pocket), medical conditions, insurance status, and demographics for a representative sample of the US population. The best available data for this purpose is the Medical Expenditures Panel Survey (MEPS) collected by the U.S. Dept. of Health and Human Services. We focus on adult respondents (>23 years of age) from 2000 to 2014. Each individual is followed for two years, and a new panel enters every year. After excluding those with missing observations, the sub-samples used in our analysis contain 132,327 women under age 65, 114,491 men under 65, 30,509 women who are 65+, and 22,193 men who are 65+. We employ the MEPS individual sampling weights. Section A.1 in the Appendix provides additional details on the MEPS data and on our sample selection criteria.

3.2. Dependent and Independent Variables

Our dependent variable is total annual healthcare spending at the individual level, expressed in 2010 US$. A great strength of MEPS is that it surveys both patients and insurers, so that both covered expenses and out-of-pocket (OOP) costs are obtained. Appendix Section A.2.1 provides details on the medical expenditure variables.

Our model contains a large set of variables that predict healthcare spending, described in detail in Appendix Sections A.2.2-A.2.8. We include controls for respondents' medical conditions coded based on the ICD-9 classification scheme at the 3-digit level.[4] For each 3-digit code, we construct a dummy indicating whether the respondent had the condition during the preceding reference period. There are 716 condition dummies for women <65, 641 dummies for men <65, 528 dummies for women >64, and 478 dummies for men >64.

[4] Each medical condition in MEPS is also coded according to the Clinical Classification System (CCS). When possible, we further break down the 3-digit ICD-9 codes into more detailed sub-categories using the CCS (see Appendix Section A.2.8).

We also control for age (i.e., dummies for five-year groups), an indicator for last year of life, health status (Poor, Fair, omitted category Good), region (Midwest, West, South, omitted category East coast), race/ethnicity (Hispanic, Black, Asian, omitted category White), marital status, and a time trend (to capture general changes in medical costs and spending levels over time). We note that health is measured approximately at the beginning of the year in which medical expenditures are measured, thus mitigating the potential problem of reverse causality (i.e., the effect of medical spending on health status).

In addition, we control for health insurance status. For ages <65 the categories are: Medicaid and SCHIP, Other public, and Uninsured; the omitted category is Private insurance. For ages>64 the categories are: Medicare plus any private, Medicare plus other public, No Medicare but other insurance, and Uninsured; the omitted category is Medicare only. A separate indicator variable for Medicare Part D is also included.

In the results section we focus primarily on SES spending gradients for medical conditions that have the greatest total expenditure within each age-sex cell. Appendix Section A.3 documents how these high-expenditure conditions are determined.

3.3. Statistical Analysis

We run regressions of individual-level total healthcare spending on the large set of covariates listed in Section 3.2 that are designed to predict spending. The coefficients on the ICD-9 codes in these regressions can be interpreted as the average increase in medical spending that occurs if a person is diagnosed with a particular condition, relative to the baseline level of spending on a "similar" person who does not have the condition, but who has the same values of the control variables.

We run separate regressions for people under and over 65, as we expect Medicare eligibility to substantially alter the processes that drive spending. And we run separate analyses for men and women, as the factors that drive healthcare costs (e.g., the most prevalent conditions) differ greatly by sex. Within each age-sex group, we also run separate regressions by education group: less-than high school (<HS), high school (HS), and college.

In addition, we re-run the same regressions using individual-level OOP medical spending as the dependent variable. We use the coefficients from these regressions to infer the extent to which differences in total medical spending by SES can be accounted for by differences in demand or ability-to-pay across groups.

Our main hypothesis is that, in the absence of disparate treatment based on socio-economic status, individuals with the same ICD-9 codes should have the same level of total healthcare spending, regardless of education. Differences in ICD-9 code coefficients across education groups are interpreted as evidence of socio-economic bias in treatment when these are not accounted for by OOP spending differences. We also hypothesize that the extent of bias may differ in the Medicare (65+) vs. non-Medicare populations.

4. Results

4.1. Women Aged 24-64

Table 1 presents the results for women aged 24 to 64. The adjusted R^2s of the regressions are 0.356, 0.331 and 0.381 for the college, HS, and <HS education groups. These values are relatively high given the very unpredictable nature of year-to-year health shocks (Keane and Stavrunova 2011), implying that our model performs very well in capturing the predictable part of health spending.

The regressions control for 716 medical condition codes that are relevant for women in this age group. However, in Table 1 we only report coefficients on medical conditions that are (i) in the top 30 in terms of total cost and (ii) that exhibit significant SES gradients.

We find that total spending on women diagnosed with breast cancer differs greatly by education level. Conditional on our extensive set of controls, a breast cancer diagnosis leads to an increase in annual medical spending of \$10865 (SE \$1892) among college educated women, compared to only $3832 (SE $1404) among <HS women. So, on average, spending on women with a college degree exceeds that on <HS women by $7033 (SE $2356, p=0.003).

An important question is whether this extra spending arises because college women spend more out-of-pocket, or because the healthcare system itself devotes more resources to them. To answer this, we estimate the same regressions, but use OOP spending rather than total spending as the dependent variable (see Table 2). We find college women spend roughly $700 more OOP than <HS women, explaining only 10% of the difference in total spending.

The SES gradient in spending for breast cancer is consistent with findings that more educated women are more likely to receive breast reconstruction, even in comprehensive cancer care centers where access is not an issue, and that in general, low SES women are more likely to experience diagnostic delays and receive less appropriate treatment (Li 2004, Christian et al. 2006, Dookeran et al. 2015, Molina, Silva, and Rauscher 2015, Shavers, Harlan, and Stevens 2003).

We also find significantly positive SES spending gradients for seven of the other top 30 high-cost conditions for women aged 24 to 64: normal pregnancy, esophageal disorders, depression, disc disorders, joint disorders, anemia, and consultation without sickness. For instance, in the case of normal pregnancy, spending on college women is $1630 greater than for HS dropout women (SE $412, p<0.0001). Only 16% of this difference is accounted for by the difference in out-of-pocket spending.

Interestingly, there are four conditions for which we find negative SES spending gradients: diabetes, anxiety, allergic rhinitis, and pneumonia. However, there is evidence these conditions are more severe among the less educated due to less adequate preventive care and case management (Berkowitz et al. 2014, Emoto et al. 2016, Goldman and Smith 2002, van der Meer and Mackenbach 1999, Young et al. 2001, Billings et al. 1993). Thus, for these conditions, higher spending on the less educated may in fact be the result of unequal quality of care. We return to this issue in the Discussion section.

A broader indicator of disparate treatment comes from differences across education groups in the coefficient on poor health. Poor health leads to increases in total medical spending of $1761, $3257, and $5349 for <HS, HS, and college women, respectively. (The $3588 gap between college and <HS women has SE=$922 and p=0.0001). And only a small fraction of this difference is explained by OOP. Thus, the resource response of the healthcare system to poor general health is considerably greater for college women. A related phenomenon is incremental spending in the year of death. For college women this is a substantial $21,689 (SE $6860) compared to only $8518 (SE $2912) for HS women.

Interestingly, we find no systematic spending disparities by race/ethnicity (Trivedi et al. 2014). This is true for other groups as well (see below). This suggests that our controls for health conditions are sufficiently rich to capture any differences in health status by race/ethnicity.

4.2. Men Aged 24-64

Table 3 reports the results for men aged 24 to 64. A striking result is the large education gradient in spending on "non-specific chest pain." Conditional on our extensive controls, a diagnosis of "non-specific chest pain" leads to a $8292 (SE $2647) increase in annual medical spending on college educated men, compared to only $2324 (SE $709) for HS men, a difference of $5968 (SE $2740, p=0.029). This difference is generated entirely by the healthcare/insurance system itself, in the sense that we find no differences in OOP spending between education groups (see Table 4). In addition, average spending on esophageal disorders and disk disorders is higher for more educated men (just as it was for women). Also similar to women is that spending on diabetes is higher for less educated men.

4.3. Women Aged 65 and Over

We find no clear evidence of positive socio-economic spending gradients for women aged 65 and over. The only significant positive SES gradient is for neck fractures (which ranks only 16th in terms of cost), while negative gradients are found for diabetes and digestive disorders (see Appendix Table A.2). Given we find only one significant positive SES gradient among 30 conditions, we can't rule out that it arises due to chance. This is in sharp contrast to the results for younger women, where we found eight conditions with significant positive SES gradients. The lack of SES gradients for women 65+ is consistent with the hypothesis that healthcare spending is allocated more equitably in the Medicare population.

4.4. Men Aged 65 and Over

For men aged 65 and over, our results are rather mixed. We find significant *negative* education spending gradients for heart attack (i.e., acute myocardial infarction) and heart failure (see Appendix Table A.4). The mean increment in spending for a <HS male diagnosed with heart failure is $7147 (SE $1526), while that for a college male is only $2216 (SE $1660). In contrast, year-of-death spending and spending on patients with general poor health increases with education. For instance, end-of-life spending is $5276 greater for college men than for <HS men (p=0.076). And incremental spending on men in poor health is $8344 for college men (SE $2459) but only $1887 for <HS men (SE $824), a difference of $6457 (p=0.013). No significant part of these differences is accounted for by out-of-pocket spending (see Table A.5).

4.5. Education Gradients of Total Healthcare Spending by Health Status

As an alternative way to examine the data, we also sorted people by health status (i.e., good, fair or poor) and ran separate regressions of medical spending for each health type. Each regression contains indicators of education level (<HS, HS, Some college, College), and controls for ICD-9 condition codes, health insurance status, age, last year of life, region, race/ethnicity, marital status, and a time trend. The two main virtues of this specification are: (1) it captures in a flexible way the fact that the cost of treatment for ICD-9 conditions may

vary by baseline health status, which partially accounts for differences in severity and effects of co-morbidities, and (2) we obtain estimates of how overall healthcare spending differs by education level. As before, the regressions are estimated separately for each age-sex group. The results are reported in Table 5, where we report only coefficients on education.

For people in poor health, healthcare spending is strongly increasing with education. Compared to <HS (the omitted category), spending on college educated individuals in poor health is on average: $4135 greater for men <65 (SE $1581, p=0.009), $3991 greater for women <65 (SE $1138, p=0.0005), and $8192 greater for men 65+ (SE $2100, p=0.0001). But there is no significant educational spending gradient for women 65+. Differences in OOP spending can explain at most 17% of these differentials (see Table A.6).

There are also modest positive gradients of spending with respect to education for women <65 in good or fair health, and for women >64 in fair health. In the latter case, this is largely accounted for by greater OOP spending.

4.6. The Role of Private Insurance vs. Medicare

A key finding in Table 5 is that a positive SES gradient exists for healthcare spending for men over 65 who are in poor health, but not for women. This may appear to contradict the hypothesis that Medicare coverage should reduce SES gradients. Notably however, many retired people in the U.S. have private health insurance as a retirement benefit provided by their former employers. And such benefits are more common for men: 52% of men 65+ have private insurance vs. 44% of women**.** We hypothesized that this prevalence of private insurance among men 65+ may account for the persistence of SES gradients in that group.

Thus, we re-ran the regressions for both men and women aged 65+ deleting from the sample anyone with private insurance coverage. As one can see in the bottom two panels of Table 5, no significant SES spending gradients remain for either men or women aged 65+

once we limit the sample to those who rely only on Medicare (or other public insurance).[5] This suggests the allocation of healthcare spending is more equitable under the public system.

5. Discussion

We examined how the U.S. healthcare system allocates resources to patients from different SES groups who present with the same medical conditions. In an equitably functioning system, we should not find SES-based differences in treatment conditional on diagnosis. But we find that spending is increasing with education for several important medical conditions that account for a large share of total costs.

A particularly striking finding is that, for women under 65, healthcare system spending on breast cancer treatment is on average $7033 greater if the woman is a college graduate rather than a high school dropout. Similarly, for men under 65 presenting with non-specific chest pain, spending is typically greater by $5968 if a man has a college degree vs. a high school degree. Positive educational spending gradients were found for several other conditions as well. In no instance does OOP spending account for a substantial part of these differences in total spending.

However, we also find that for women aged 65 and over, who primarily rely on public insurance through the Medicare program, there is no evidence of SES spending gradients. Some significant SES spending gradients remain for men aged 65 and over, but these vanish once we eliminate from the sample those who have employer-provided private insurance as a retirement benefit. Thus, it appears that SES spending gradients are greatly mitigated by the public Medicare system for those in the 65+ population.

In a mixed public/private system, we would expect differences in treatment based on

[5] An alternative way of studying the effect of Medicare on equity would be to limit the analysis to individuals who, in the MEPS data, are observed transitioning from a private system (aged under 65) to the public Medicare system (age 65 and over). We could then examine whether SES spending gradients change once they become covered by Medicare. Unfortunately such an analysis is not possible due to the small sample size of those observed at both ages 64 and 65 in the MEPS.

ability-to-pay (Davis and Ballreich 2014, Trivedi, Rakowski, and Ayanian 2008). But we find education gradients in spending for people aged 24-64 even conditional on insurance status, and these are not explained by OOP expenditures (ability-to-pay). In addition, if differences in spending were demand driven, we would expect them to persist in the sample of individuals over 64, yet we find they disappear in the sample of individuals covered by Medicare. This is *prema facia* evidence of discrimination in healthcare in the population not eligible for Medicare.

There are several channels through which discrimination may arise. For instance, patient SES is found to be associated with physicians' perceptions of patients' abilities and behavioral tendencies, which may affect recommended treatment (van Ryn and Burke 2000). Differences could also arise if SES groups differ in their ability to navigate the insurance system to obtain the care they desire (Schoen et al. 2013). These channels would imply a strong case for policy intervention.

Of course, there are explanations for SES spending differences besides discrimination. They could arise from SES differences in preferences/beliefs towards healthcare leading to heterogeneous demand (Garber and Skinner 2008, Moscelli et al. 2017). Or SES may alter the effectiveness of specific health treatments (Feinstein 1993, Goldman and Smith 2002). Medical providers may also price discriminate, such that high SES individuals pay more for the same treatment.

Exceptionally, we find *negative* education spending gradients for diabetes (for all groups except older men). But this may arise because diabetes is more severe and less well-managed among less educated individuals, who have a significantly higher prevalence of hypoglycemia events, faster progression of retinopathy, and more complications such as leg pain and visual impairments (van der Meer and Mackenbach 1999, Goldman and Smith 2002, Berkowitz et al. 2014, Emoto et al. 2016). If the negative spending gradient for diabetes is due to less adequate preventive care and case management, it is consistent with discrimination against lower SES groups. This also illustrates how heterogeneity in healthcare utilization by SES may imply substantial loss of efficiency in the health system (in addition to lack of equity) (Garber and Skinner 2008).

We also find *negative* education spending gradients for anxiety disorders, allergic rhinitis, and pneumonia for women <65 and heart attack and heart failure for men >64. There is evidence that such results may arise from differences in severity. For instance, there are significant racial disparities in hospitalization rates for chronic conditions that could have been prevented with high-quality primary care (Mukamel et al. 2015). And low SES is a positive predictor of readmission risk among those hospitalized for treatment of heart failure (Philbin et al. 2001, Rathore et al. 2006).

6. Conclusion

In conclusion, we analyze the allocation of resources across SES groups by the US healthcare system, using more comprehensive measures of spending and conditioning on a much richer set of medical conditions and individual characteristics than previous literature. We find clear evidence on inequality in healthcare spending based on socio-economic status.

In particular, we find that, the predominantly private employer-sponsored health insurance system allocates more resources to the treatment of better educated patients of working age. One striking finding is that the healthcare system spends much more on women diagnosed with breast cancer if they are college educated. Similarly, for men under 65, spending on chest symptoms treatment increases sharply with education.

In contrast, we find that the public Medicare program largely eliminates positive SES spending gradients among the 65+ population. An obvious implication is that market based reforms to the healthcare system run the risk of increasing inequality in healthcare provision.

Some limitations of the analysis are worth noting. First, we only examine spending conditional on diagnosis. But medical conditions of low SES individuals are more likely to be undiagnosed, as high SES patients receive more screening and diagnostic tests (Sambamoorthi and McAlpine 2003, Ross et al. 2007). This may lead us to understate discrimination. Second, as we do not observe severity of disease in our data, we are forced to infer differences in severity across SES groups from previous research. Third, a finer disaggregation of conditions would be desirable, as severity within three-digit ICD-9 codes may vary with SES. More research is needed to better understand the root causes of SES discrimination and the implications in terms of system equity and efficiency.

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Conflict of Interest:

The authors declare that they have no conflict of interest.

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Table 1: Total medical spending regression by education level: Women, age 24-64

		Education level		
		College	High School	No High School
Medical Condition	Cost Rank			
Normal pregnancy	1	4764.8***	4213.8***	3135.0***
(ICD9-V22; CCS-196)		(236.6)	(186.3)	(337.6)
Diabetes mellitus	3	1227.0**	1709.2***	2229.8***
(ICD9-250; CCS-49)		(467.0)	(292.2)	(325.3)
Esophageal disorders	6	2710.3***	1205.2***	477.0
(ICD9-530; CCS-138)		(477.9)	(242.5)	(404.2)
Breast cancer	7	10864.8***	7647.2***	3831.8**
(ICD9-174; CCS-24)		(1891.7)	(995.0)	(1403.8)
Depression	8	1015.9***	661.8**	80.18
(ICD9-311; CCS-657)		(291.7)	(222.0)	(288.7)
Intervertebral disk disorders	13	2574.6***	1055.7**	1196.5*
(ICD9-722; CCS-205)		(536.6)	(389.9)	(585.0)
Anxiety disorders	14	253.1	309.0	1254.5***
(ICD9-300; CCS-651)		(287.1)	(207.8)	(334.4)
Other joint disorders	19	671.1**	280.5	-1.5
(ICD9-719; CCS-204)		(254.8)	(210.4)	(270.3)
Allergic rhinitis	20	-81.1	494.3**	686.1**
(ICD9-477; CCS-134)		(140.4)	(163.2)	(260.9)
Anaemia unspecified	21	4452.4***	2272.9***	1288.3
(ICD9-285; CCS-59)		(1171.4)	(646.1)	(658.1)
Pneumonia	23	264.1	2417.5***	3615.3***
(ICD9-486; CCS-122)		(826.3)	(594.8)	(679.2)
Consultation without sick	29	3888.7***	5461.9**	781.6
(ICD9-V65; CCS-255)		(1496.2)	(1673.5)	(1084.1)
General health (base: Good)				
Fair		193.4	206.9	101.4
		(133.2)	(79.53)	(108.7)
Poor		5348.9***	3256.7***	1760.5***
		(801.7)	(336.4)	(456.4)
Death		21689.4**	8517.8**	13915.9***
		(6860.1)	(2911.6)	(3144.4)
Insurance status (base: Any private)				
Medicaid/SCHIP		-2064.5***	-1411.3***	-538.4*
		(581.5)	(202.8)	(246.4)
Other public		-2855.7*	-2283.4***	-1422.0**
		(1172.0)	(449.8)	(532.2)
Uninsured		-1218.4***	-1508.1***	-1461.3***
		(170.6)	(84.03)	(170.1)
Race/ethnicity (base: White)				
Hispanic		-57.74	-160.2	240.3
		(172.0)	(91.19)	(179.7)
Black		99.32	150.6	252.3
		(191.5)	(111.3)	(206.8)
Asian		-233.1	-379.6**	-499.7
		(129.4)	(126.9)	(291.8)
N		33448	70011	28868
Adjusted *R*-squared		0.356	0.331	0.381

Notes: Standard errors in parentheses. All regression models include dummies for 716 ICD-9-CCS conditions, age groups, marital and region dummies, a linear time trend and a constant term. When possible, ICD-9 codes are broken down into finer categories based on the Clinical Classification System (CCS). We present results only for conditions amongst the top 30 (in terms of cost) that exhibit significant SES gradients. * p<0.05, ** p<0.01, and *** p<0.001.

Table 2: Out-of-pocket medical spending regression by education level: Women, age 24-64

		Education level		
		College	High School	No High School
Medical Condition	Cost Rank			
Normal pregnancy	1	486.0***	309.3***	227.3***
(ICD9-V22; CCS-196)		(55.3)	(35.42)	(40.4)
Diabetes mellitus	3	221.5**	309.9***	433.5***
(ICD9-250; CCS-49)		(79.0)	(50.8)	(88.2)
Esophageal disorders	6	253.9***	253.9***	320.0*
(ICD9-530; CCS-138)		(64.0)	(56.8)	(163.1)
Breast cancer	7	647.1***	753.5**	-39.5
(ICD9-174; CCS-24)		(177.8)	(258.2)	(133.8)
Depression	8	283.6***	137.4**	27.1
(ICD9-311; CCS-657)		(54.6)	(46.9)	(41.0)
Intervertebral disk disorders	13	245.1**	264.9**	168.8*
(ICD9-722; CCS-205)		(86.5)	(81.1)	(71.7)
Anxiety disorders	14	27.6	88.8*	123.8**
(ICD9-300; CCS-651)		(46.9)	(38.8)	(47.9)
Other joint disorders	19	170.8**	-34.9	-40.1
(ICD9-719; CCS-204)		(53.6)	(28.4)	(37.5)
Allergic rhinitis	20	67.0*	114.3***	51.1
(ICD9-477; CCS-134)		(30.4)	(28.2)	(37.7)
Anaemia unspecified	21	349.3	125.8	195.4
(ICD9-285; CCS-59)		(217.4)	(103.5)	(104.0)
Pneumonia	23	121.9	34.0	118.7
(ICD9-486; CCS-122)		(112.5)	(62.4)	(81.4)
Consultation without sick	29	981.3**	251.9	163.5
(ICD9-V65; CCS-255)		(300.7)	(129.1)	(189.0)
General health (base: Good)				
Fair		27.6	49.5***	58.5***
		(24.4)	(14.0)	(17.1)
Poor		614.7***	210.2***	87.3
		(168.3)	(60.6)	(50.7)
Death		319.1	29.8	18.3
		(496.7)	(423.7)	(213.5)
Insurance status (base: Any private)				
Medicaid/SCHIP		-776.6***	-608.6***	-418.6***
		(73.1)	(29.3)	(26.8)
Other public		267.0	206.1**	630.3*
		(226.0)	(75.3)	(285.5)
Uninsured		212.0***	197.4***	145.3***
		(47.8)	(23.0)	(24.9)
Race/ethnicity (base: White)				
Hispanic		-177.2***	-150.3***	-120.8**
		(31.8)	(17.8)	(37.2)
Black		-305.3***	-190.3***	-150.0***
		(30.4)	(19.6)	(38.5)
Asian		-213.7***	-151.6***	-96.3*
		(28.3)	(24.7)	(46.0)
N		33448	70011	28868
Adjusted *R*-squared		0.212	0.180	0.173

Notes: Standard errors in parentheses. All regression models include dummies for 716 ICD-9-CCS conditions, age groups, marital and region dummies, a linear time trend and a constant term. When possible, ICD-9 codes are broken down into finer categories based on the Clinical Classification System (CCS). We present results only for conditions amongst the top 30 (in terms of cost) that exhibit significant SES gradients for total medical spending (see Table 1). * p<0.05, ** p<0.01, and *** p<0.001.

Table 3: Total medical spending regression by education level: Men, age 24-64

		Education level		
		College	High School	No High School
Medical Condition	Cost Rank			
Diabetes mellitus	1	975.4*	2275.6***	2554.2***
(ICD9-250; CCS-49)		(441.0)	(388.3)	(418.3)
Esophageal disorders	5	2145.9***	1288.9**	647.4
(ICD9-530; CCS-138)		(632.2)	(405.2)	(498.9)
Non-specific chest pain	7	8291.5**	2324.4**	2558.1*
(ICD9-786; CCS-102)		(2646.8)	(709.3)	(1169.4)
Intervertebral disk disorders	17	2298.1***	1058.6*	302.1
(ICD9-722; CCS-205)		(547.3)	(420.8)	(665.1)
General health (base: Good)				
Fair		304.3*	273.7*	143.6
		(147.3)	(107.3)	(125.9)
Poor		4002.2	3254.9***	1376.2**
		(2055.8)	(502.4)	(454.9)
Death		10275.5	2179.8	5974.5*
		(7693.2)	(2602.4)	(2342.5)
Insurance status (base: Any private)				
Medicaid/SCHIP		-689.9	-1141.0**	-610.9
		(929.1)	(351.0)	(367.1)
Other public		-1046.3	-2893.4***	-1402.1*
		(1707.3)	(533.7)	(592.6)
Uninsured		-793.5***	-952.2***	-1131.8***
		(154.7)	(124.0)	(155.5)
Race/ethnicity (base: White)				
Hispanic		-184.0	70.64	-156.3
		(178.8)	(129.2)	(213.5)
Black		429.7*	534.6***	-198.2
		(218.0)	(152.4)	(231.6)
Asian		234.8	672.0	2241.3
		(258.1)	(808.7)	(1717.3)
N		29648	58957	25886
Adjusted *R*-squared		0.359	0.280	0.257

Notes: Standard errors in parentheses. All regression models include dummies for 716 ICD-9-CCS conditions, age groups, marital and region dummies, a linear time trend and a constant term. When possible, ICD-9 codes are broken down into finer categories based on the Clinical Classification System (CCS). We present results only for conditions amongst the top 30 (in terms of cost) that exhibit significant SES gradients. * p<0.05, ** p<0.01, and *** p<0.001.

Table 4: Out-of-pocket medical spending regression by education level: Men, age 24-64

		Education level		
		College	High School	No High School
Medical Condition	Cost Rank			
Diabetes mellitus	1	264.7***	329.3***	332.1***
(ICD9-250; CCS-49)		(60.6)	(44.2)	(59.6)
Esophageal disorders	5	272.3***	172.5***	111.7
(ICD9-530; CCS-138)		(49.0)	(44.4)	(67.6)
Non-specific chest pain	7	216.6	124.3	-2.0
(ICD9-786; CCS-102)		(125.9)	(82.9)	(73.8)
Intervertebral disk disorders	17	402.1***	116.8	151.6*
(ICD9-722; CCS-205)		(89.3)	(67.8)	(77.3)
General health (base: Good)				
Fair		20.5	75.4***	65.9***
		(19.8)	(13.2)	(16.0)
Poor		152.9	241.3***	104.8
		(151.7)	(65.1)	(68.0)
Death		-133.9	-225.0	451.9
		(311.1)	(247.9)	(418.7)
Insurance status (base: Any private)				
Medicaid/SCHIP		-606.3***	-375.9***	-300.8***
		(124.3)	(54.4)	(38.4)
Other public		427.8	39.1	276.4**
		(227.8)	(73.8)	(86.2)
Uninsured		149.0**	81.7***	67.3**
		(47.5)	(20.0)	(22.1)
Race/ethnicity (base: White)				
Hispanic		-106.5***	-118.2***	-97.0***
		(28.9)	(15.3)	(21.2)
Black		-186.4***	-146.6***	-115.3***
		(23.7)	(20.0)	(34.7)
Asian		-66.5**	-120.8***	-88.6
		(22.2)	(23.6)	(47.3)
N		29648	58957	25886
Adjusted *R*-squared		0.237	0.190	0.555

Notes: Standard errors in parentheses. All regression models include dummies for 716 ICD-9-CCS conditions, age groups, marital and region dummies, a linear time trend and a constant term. When possible, ICD-9 codes are broken down into finer categories based on the Clinical Classification System (CCS). We present results only for conditions amongst the top 30 (in terms of cost) that exhibit significant SES gradients for total medical spending (see Table 3). * p<0.05, ** p<0.01, and *** p<0.001.

Table 5: Total medical spending regression by general health status: Coefficient estimates on education

	General Health		
	Good	Fair	Poor
Men, age 24-64			
College (4+)	207.4*	85.90	4135.3**
	(91.1)	(268.4)	(1580.5)
Some college	231.0**	-189.9	1718.9
	(86.24)	(233.5)	(901.5)
High school	134.5	255.5	1742.9**
	(95.55)	(210.4)	(656.9)
Women, age 24-64			
College (4+)	459.0***	809.2***	3990.5***
	(91.78)	(136.8)	(1137.8)
Some college	240.5*	272.3*	1564.5*
	(95.11)	(119.5)	(677.8)
High school	31.40	72.65	1273.1*
	(83.78)	(106.9)	(606.7)
Men, age 65+ (All)			
College (4+)	455.4	979.6	8192.0***
	(304.4)	(595.9)	(2100.1)
Some college	914.9*	914.4	7714.7***
	(357.6)	(595.6)	(2249.4)
High school	310.7	577.7	2701.9
	(287.5)	(496.5)	(1538.0)
Women, age 65+ (All)			
College (4+)	592.7*	1555.9**	-257.0
	(290.5)	(553.7)	(1389.3)
Some college	184.1	1074.9*	651.1
	(316.6)	(478.5)	(974.4)
High school	256.5	-178.8	71.35
	(285.7)	(333.1)	(818.1)
Men, age 65+ (Public Insurance only)			
College (4+)	723.7	1405.2	5477.6
	(539.6)	(952.8)	(3019.7)
Some college	1130.7*	452.6	6252.9
	(489.8)	(952.5)	(3209.9)
High school	283.3	177.0	834.4
	(386.9)	(596.4)	(2128.2)
Women, age 65+ (Public Insurance only)			
College (4+)	649.9	647.9	2385.3
	(397.2)	(639.5)	(1711.0)
Some college	261.8	407.8	1151.8
	(402.0)	(527.3)	(1265.5)
High school	-136.5	-335.7	559.9
	(359.6)	(394.7)	(1025.3)

Notes: The table shows coefficient estimates on education level dummies (omitted category "less than high school") in the healthcare spending regressions. Standard errors in parentheses. All regression models include dummies for ICD-9-CCS conditions, age group dummies (every five years), dummies for insurance status, marital dummy, region dummies, dummies for ethnicity/race, linear time trend and a constant term. Full results are available on request.
* $p<0.05$, ** $p<0.01$, and *** $p<0.001$.

Appendix

A.1 Description of the MEPS and Sample Selection

The Medical Expenditure Panel Survey (MEPS) contains nationally representative large-scale surveys of families and individuals in the U.S. providing comprehensive data on the cost of health care, insurance coverage, and many other health, socioeconomic, and demographic information of individuals. The MEPS is a rotating panel, in which each household is followed over the period of two years. A new cohort is sampled every year. For each household, five interviews are conducted over the period of two and a half years. In this study, we regard observations in each year as an independent sample and hence regard the data as repeated cross-sections. We use data from 2000 to 2014 drawn from each year's consolidated data file and medical conditions file. The survey years before 2000 are not used because some key variables of our interest are not available.

We conduct the analysis using MEPS respondents (both men and women) who are at least 24 years old in the first round of interview. Individual sampling weights are used in all the analysis. Individuals without a valid weight (e.g. those who were not eligible for the survey but responded) are excluded. Respondents with missing education information are also excluded. The data analysis is conducted separately for young women (24-64), young men (24-64), old women (65+), and old men (65+). The resulting sub-samples used in our analysis contain 132,327 young women, 114,491 young men, 30,509 old women, and 22,193 old men.

A.2 Variables

Most variables used in the regression analysis are directly drawn from the MEPS. This section provides more details of key variables and discusses how we constructed other variables of interest.

A.2.1 Health Expenditures

The dependent variable in our regression analysis is total annual health expenditures. Total health expenditures comprise annual total payments for all health services (i.e., office based visits, hospital outpatient visits, emergency room visits, inpatient hospital stays, prescription medicines, dental visits, home health care, and other medical expenses), regardless of the source of payment. We also run regressions of out-of-pocket total annual expenditures, and these results are available upon request. All expenditures are converted to 2010 dollars using Consumer Price Index provided by the Bureau of Labor Statistics (http://www.bls.gov/cpi/cpid1610.pdf, Table 27).

A.2.2 General Health

This section describes the construction of general health in detail. We construct health by performing factor analysis on five health related components available in the MEPS: (1) perceived health status, (2) perceived mental health status, (3) ADL screener, (4) IADL screener, and (5) a score of physical functioning limitations. (1) and (2) are five-categorical measures of physical and mental health status, respectively. These variables take the value of 5 for “excellent” health, 4 for “very good”, 3 for “good”, 2 for “fair”, and 1 for “poor”. (3) and (4) consist of one binary variable that indicates the presence of any ADL and IADL limitation, respectively.

We construct (5) from eight variables of limitations in physical functioning: "Lifting 10 Pounds", "Walking Up 10 Steps", "Walking 3 Blocks", "Walking A Mile", "Standing 20 Minutes", "Bending/Stooping", "Reaching Overhead", and "Using Fingers To Grasp." These are four or five categorical variables that indicate the degree of difficulty with the activity (e.g. some difficulty, a lot of difficulty, and completely unable). We take the sum of these eight variables and divide it by the maximum possible number so that this index ranges between 0 and 1.

The above five variables are then standardized. We do this standardization together for men and women, but separately for the young and old groups. The values are taken from the first round of interview of each year (2000 - 2014) (usually conducted in March). Hence, this measurement of health does not vary by gender or across interview years, but the measurement varies between the young and old groups.

We perform factor analysis on the five standardized variables, again separately for the young and old groups. Using the resulting factor loadings, we create our health variable for each individual. The factor loadings are reported in Table A1.

Finally, we discretize the continuous health variable into three groups: Good, Fair, and Poor health based on two thresholds: the median value and the mean value minus one standard deviation in each group. Our final health variable is "Good" if its value is equal to or larger than the median, "Fair" if its value is smaller than the median but larger than the mean minus one standard deviation, and "Poor" if its value is smaller than the mean minus one standard deviation.

A.2.3 Education

We construct education dummy variables: College, Some college, High school degree, and Less than high school. In most of our analysis, we combine the College and Some college groups together. Our education variables are defined based on the highest degree completed rather than years of schooling. MEPS has several variables measuring education, and the precise definition and availability of each variable changes over time. Moreover, individuals do not always answer all the questions asked. When possible, we conduct imputation based on information available in order to minimize the loss of observations due to missing values.

A.2.4 Age groups

We control for age in our regressions by including age group dummies (for five year groups). The highest group is 80 years old and older because age is top-coded at 85 in the MEPS.

A.2.5 Death Year

The dummy for the year of death is constructed based on whether the individual died by the end of the survey year.

A.2.6 Health insurance status

For those under 65 the reference group in the regression analysis is those who had private insurance (employer provided or not) at any time during the calendar year. For those who did not have any private insurance, we include dummies for "Medicaid and SCHIP (State Children's Health Insurance Program)", "other public", and "uninsured". For those 65 and over, the health insurance status is coded as “Medicare only” (the omitted category), “Medicare plus any private insurance”, “Medicare plus other forms of public insurance”, “No Medicare but other forms of insurance (private or public)” and the small set of “uninsured” senior citizens. In addition we include in the regressions of those 65 and over a dummy for “Medicare Part D coverage” which became available after 2006.

A.2.7 Other Controls

In the regression analysis, we also control for region (Midwest, West, South, and Northeast), race/ethnicity (Hispanic, Black, Asian, and White), marital status, and linear time trend.

A.2.8 Medical Conditions

The MEPS public use medical conditions files contain information on respondents' medical conditions. These are coded according to the ICD-9 classification scheme, at the 3-digit level, and are also coded according to the Clinical Classification System (CCS). The CCS is developed by the Agency for Healthcare Research and Quality (AHRQ) to reclassify numerous ICD codes into a manageable number of clinically meaningful categories. Thus, the number of the CCS categories is much smaller than the total number of 3-digit level ICD-9 codes that appear in the MEPS data. Yet CCS codes sometimes provide further break-down of a 3-digit level ICD-9 code into multiple clinically different categories. In the 2000-2014 medical conditions files, there are 760 unique 3-digit ICD-9 conditions, and 1359 unique ICD9-CCS pairs.

Using the MEPS medical condition files, we construct a dummy variable for each ICD9-CCS condition, which indicates whether each respondent had the condition during the preceding reference period of any interview conducted throughout the survey year. ICD9 and CCS information is sometimes missing (or “unknown”) due to several potential reasons: (1) the respondent's answer is insufficient to determine the ICD9/CCS code; (2) the respondent's doctor cannot make a diagnosis; and (3) confidentiality policy of the MEPS (e.g., in the case of pregnancy for relatively old women).

The prevalence of “unknown” conditions is approximately 7.5% and these conditions account for 5-7% of total expenditures. Since they are relatively prevalent and costly, we control for them in our regression analysis by including a dummy variable equal to one when the respondent has an “unknown” condition.

Moreover, many ICD9-CCS conditions are extremely rare. In our analysis, we only include medical conditions with a frequency of at least 10 within each gender-age group (i.e., women <65, men <65, women >64 and men >64). For conditions with frequency lower than 10, we construct a “rare condition” dummy.

A.3 Selecting the Most Expensive Conditions

We do not report the estimated coefficients for all ICD9-CCS condition dummies due to length limitations. The results for non-reported conditions are available upon request. We select the most costly conditions to be reported in each regression results table. To determine these, we first run regressions of medical expenditures on all medical condition dummies only and save the coefficients. These coefficients represent the average annual spending per condition in each group. We then multiply these estimated coefficients with the prevalence rate of the corresponding condition in each age-education group. This gives the per person expenditures on each condition within each group, and we choose those with the highest per person costs. Thus, we determine the most costly conditions based on prevalence of condition and average treatment cost per case. The ranking of conditions is available upon request.

A.4 Additional Tables

Tables A.2 - A.5 present the results from regressions of healthcare spending on medical conditions, health insurance, health, and other control variables for women and men aged 65+ (total and OOP). As discussed in the paper, we find no clear evidence of positive socio-economic spending gradients for women aged 65 and over. For men aged 65 and over, we find significant negative education spending gradients for several costly conditions (discussed in the text of the paper).

Table A.6 presents the coefficient estimates on education from regressions of out-of-pocket medical spending on various controls, by general health status.

Table A.1 Factor Loadings for Health, Principal Component Factor Analysis

	Age 24 - 64	Age 65+
Perceived Health	0.677	0.675
Perceived Mental Health	0.601	0.636
ADL Screener (binary)	0.661	0.748
IADL Screener (binary)	0.718	0.780
Physical Functioning Limitations	0.772	0.816
Eigenvalue	2.368	2.694
Number of observations	246,088	52,430

Table A.2: Total medical spending regression by education level: Women, age 65 and over

		Education level		
		College	High School	No High School
Medical Condition	Cost Rank			
Diabetes mellitus	1	-106.1	1503.2***	2450.4***
(ICD9-250; CCS-49)		(701.9)	(332.9)	(415.6)
Neck Fracture	16	12176.6***	11985.0***	4663.3**
(ICD9-820; CCS-226)		(2919.9)	(1941.1)	(1607.8)
Digestive disorders	25	904.4	1112.1	3926.1**
(ICD9-564; CCS-155)		(1119.1)	(794.4)	(1294.6)
General health (base: Good)				
Fair		1565.4**	632.9*	80.65
		(537.0)	(270.2)	(339.8)
Poor		3246.3*	3903.6***	3811.0***
		(1322.2)	(588.2)	(558.3)
Death		9551.8**	7301.0***	5748.9***
		(3694.8)	(1451.1)	(1518.5)
Insurance status (base: Medicare only)				
Medicare + private		1125.7*	943.4***	968.8*
		(442.1)	(245.3)	(397.6)
Medicare + other public		471.1	1750.8***	1380.9**
		(1010.6)	(496.5)	(426.0)
No Medicare but insured		-2707.2	-1308.3	1094.1
		(1741.0)	(1086.1)	(1655.9)
Uninsured		-3883.3*	-2419.2*	-977.4
		(1634.6)	(1071.5)	(1093.7)
Medicare Part D		331.9	288.4	652.1
		(934.0)	(482.4)	(654.1)
Race/ethnicity (base: White)				
Hispanic		358.5	-685.8	1353.5**
		(1015.4)	(379.6)	(472.6)
Black		1510.8	904.6*	1568.9***
		(905.0)	(418.8)	(430.1)
Asian		530.2	881.1	971.9
		(724.8)	(957.0)	(655.4)
N		4225	15656	10628
Adjusted *R*-squared		0.370	0.276	0.351

Notes: Standard errors in parentheses. All regression models include dummies for 528 ICD-9-CCS conditions, age group dummies (every five years), marital dummy, region dummies, linear time trend and a constant term. We present results only for conditions amongst the top 30 (in terms of cost) that exhibit significant SES gradients. * p<0.05, ** p<0.01, and *** p<0.001.

Table A.3: Out-of-pocket medical spending regression by education level: Women, age 65 and over

		Education level		
		College	High School	No High School
Medical Condition	Cost Rank			
Diabetes mellitus	1	183.9	261.7***	191.6*
(ICD9-250; CCS-49)		(241.4)	(54.7)	(74.5)
Neck Fracture	16	-246.0	465.0	-91.74
(ICD9-820; CCS-226)		(676.5)	(416.7)	(292.0)
Digestive disorders	25	112.5	66.3	54.7
(ICD9-564; CCS-155)		(325.7)	(145.1)	(119.9)
General health (base: Good)				
Fair		180.7	19.5	189.7***
		(198.3)	(42.5)	(55.2)
Poor		571.3	580.9***	340.7**
		(736.4)	(106.1)	(122.4)
Death		918.2	-344.6	-211.4
		(1314.6)	(184.1)	(196.2)
Insurance status (base: Medicare only)				
Medicare + private		-152.2	-97.7*	-318.7***
		(181.8)	(45.3)	(66.5)
Medicare + other public		-1143.6***	-890.3***	-943.5***
		(279.4)	(69.7)	(66.8)
No Medicare but insured		-981.0*	-231.0	-337.5
		(479.0)	(228.9)	(209.0)
Uninsured		-963.7**	-667.6***	-455.0***
		(355.4)	(135.1)	(103.0)
Medicare Part D		-324.6	-437.1***	-283.4**
		(242.1)	(84.7)	(91.3)
Race/ethnicity (base: White)				
Hispanic		-505.7	-191.2	-168.7**
		(319.8)	(69.1)	(64.1)
Black		217.5	-363.3***	-172.6*
		(461.0)	(56.6)	(80.2)
Asian		-67.9	-164.5	-161.5
		(157.5)	(85.5)	(86.6)
N		4225	15656	10628
Adjusted *R*-squared		0.094	0.175	0.186

Notes: Standard errors in parentheses. All regression models include dummies for 528 ICD-9-CCS conditions, age group dummies (every five years), marital dummy, region dummies, linear time trend and a constant term. We present results only for conditions amongst the top 30 (in terms of cost) that exhibit significant SES gradients for total medical spending (see Table A.2). * p<0.05, ** p<0.01, and *** p<0.001.

Table A.4: Total medical spending regression by education level: Men, age 65 and over

		Education level		
		College	High School	No High School
Medical Condition	Cost Rank			
Acute myocardial infarction	5	561.6	2369.0*	6446.4***
(ICD9-410; CCS-100)		(1687.8)	(931.5)	(1204.8)
Heart failure	8	2215.5	6311.2***	7146.9***
(ICD9-428; CCS-108)		(1659.8)	(1811.8)	(1526.3)
Back disorder	19	2018.6**	609.3	-144.6
(ICD9-724; CCS-205)		(760.5)	(581.9)	(834.8)
General health (base: Good)				
Fair		1465.3*	779.1*	238.6
		(601.7)	(375.2)	(368.7)
Poor		8344.0***	6334.0***	1886.8*
		(2458.7)	(1192.3)	(824.0)
Death		10205.0***	8977.4***	4929.4***
		(2704.9)	(1954.6)	(1271.4)
Insurance status (base: Medicare only)				
Medicare + private		256.9	710.0	269.0
		(537.3)	(374.5)	(412.4)
Medicare + other public		-1121.7	-363.1	924.4
		(1077.3)	(731.3)	(559.2)
No Medicare but insured		-1857.5	3559.7	-208.5
		(2529.9)	(2060.1)	(2178.6)
Uninsured		-5081.9*	-1364.0	-2008.7
		(2503.1)	(1288.6)	(1083.4)
Medicare Part D		-1116.8	537.3	929.9
		(934.3)	(626.8)	(683.3)
Race/ethnicity (base: White)				
Hispanic		210.2	-19.59	1305.5*
		(1182.7)	(562.8)	(543.4)
Black		-672.1	490.8	962.6
		(939.5)	(541.1)	(529.2)
Asian		-689.0	863.1	293.3
		(765.6)	(940.1)	(867.0)
N		5340	9453	7400
Adjusted *R*-squared		0.305	0.322	0.359

Notes: Standard errors in parentheses. All regression models include dummies for 478 ICD-9-CCS conditions, age group dummies (every five years), marital dummy, region dummies, linear time trend and a constant term. We present results only for conditions amongst the top 30 (in terms of cost) that exhibit significant SES gradients. * p<0.05, ** p<0.01, and *** p<0.001.

Table A.5: Out-of-pocket medical spending regression by education level: Men, age 65 and over

		Education level		
		College	High School	No High School
Medical Condition	Cost Rank			
Acute myocardial infarction	5	-116.7	35.0	201.8
(ICD9-410; CCS-100)		(134.8)	(123.0)	(117.1)
Heart failure	8	-128.8	219.3	345.1*
(ICD9-428; CCS-108)		(281.7)	(193.9)	(175.0)
Back disorder	19	306.2*	202.6	-71.3
(ICD9-724; CCS-205)		(126.6)	(113.2)	(76.2)
General health (base: Good)				
Fair		203.1*	72.5	112.4*
		(85.7)	(54.2)	(45.0)
Poor		1191.5	280.2	90.1
		(653.7)	(171.6)	(91.0)
Death		-404.4	-171.3	-92.9
		(307.4)	(157.4)	(146.8)
Insurance status (base: Medicare only)				
Medicare + private		-150.0	-64.5	19.3
		(96.4)	(53.6)	(56.0)
Medicare + other public		-1269.9***	-427.2***	-583.5***
		(213.7)	(126.2)	(60.8)
No Medicare but insured		-418.4	-72.3	-254.7
		(337.1)	(252.6)	(172.5)
Uninsured		-699.7**	-146.9	-253.0
		(236.3)	(253.9)	(147.9)
Medicare Part D		-110.2	-153.5	-134.0
		(158.0)	(103.2)	(92.9)
Race/ethnicity (base: White)				
Hispanic		-269.9	-142.3	-23.59
		(192.3)	(165.3)	(59.1)
Black		-307.5	-211.7*	-67.6
		(129.5)	(82.5)	(69.5)
Asian		-272.9**	-132.1	352.8*
		(88.4)	(220.9)	(177.2)
N		5340	9453	7400
Adjusted *R*-squared		0.274	0.151	0.183

Notes: Standard errors in parentheses. All regression models include dummies for 478 ICD-9-CCS conditions, age group dummies (every five years), marital dummy, region dummies, linear time trend and a constant term. We present results only for conditions amongst the top 30 (in terms of cost) that exhibit significant SES gradients for total medical spending (see Table A.4). * p<0.05, ** p<0.01, and *** p<0.001.

Table A.6: Out-of-Pocket medical spending regression by general health status: Coefficient estimates on education

	General Health		
	Good	Fair	Poor
Men, age 24-64			
College (4+)	158.4***	189.1***	655.2***
	(13.6)	(38.6)	(159.0)
Some college	60.9***	74.4*	292.4*
	(13.2)	(33.2)	(114.0)
High school	33.1**	29.2	126.6
	(11.8)	(36.1)	(87.9)
Women, age 24-64			
College (4+)	233.2***	316.4***	942.3***
	(17.5)	(29.2)	(181.1)
Some college	121.1***	162.7***	262.3*
	(16.9)	(28.7)	(116.7)
High school	50.80***	50.0*	108.5
	(15.1)	(25.3)	(64.3)
Men, age 65+ (All)			
College (4+)	332.5***	370.4***	1441.2*
	(50.3)	(78.3)	(594.8)
Some college	207.5***	253.8*	1131.6**
	(51.3)	(100.9)	(438.2)
High school	133.8**	14.0	136.3
	(46.2)	(63.8)	(220.1)
Women, age 65+ (All)			
College (4+)	385.7***	467.4***	790.4
	(61.8)	(88.3)	(508.2)
Some college	243.5***	235.0**	771.0**
	(51.1)	(79.3)	(276.9)
High school	160.2***	-7.4	300.0
	(45.3)	(49.5)	(177.1)
Men, age 65+ (Public Insurance only)			
College (4+)	356.8***	303.9*	1723.6*
	(80.3)	(124.2)	(722.0)
Some college	162.7*	363.3***	508.6
	(76.4)	(102.1)	(544.4)
High school	150.8*	21.3	97.2
	(67.6)	(76.2)	(250.0)
Women, age 65+ (Public Insurance only)			
College (4+)	444.5***	355.8**	356.6
	(117.2)	(112.1)	(358.3)
Some college	231.7**	60.2	755.7**
	(75.5)	(89.2)	(290.1)
High school	138.4*	1.7	58.0
	(65.9)	(67.5)	(214.6)

Notes: The table shows coefficient estimates on education level dummies (omitted category "less than high school") in the OOP medical spending regressions. Standard errors in parentheses. All regression models include dummies for ICD-9-CCS conditions, age group dummies (every five years), dummies for insurance status, marital dummy, region dummies, dummies for ethnicity/race, linear time trend and a constant term. Full results are available on request.
* p<0.05, ** p<0.01, and *** p<0.001.