WORKING PAPERS IN ECONOMICS

No.08/10

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WAITING TIMES AND SOCIOECONOMIC STATUS. EVIDENCE FROM NORWAY

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Waiting times and socioeconomic status. Evidence from Norway

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Abstract

We investigate whether socioeconomic status, measured by income and education, affects waiting time when controls for severity and hospital specific conditions are included. We also examine which aspects of the hospital supply (attachment to local hospital, traveling time, or choice of hospital) that matter most for unequal treatment of different socioeconomic groups, and how different behavior responses can create discrimination. The study uses administrative data from all somatic elective inpatient and outpatient hospital stays in Norway. The main results are that we find very little indication of discrimination with regard to income. This result holds both for males and females. We find some indication of discrimination of men with low education as these men have a lower probability of zero waiting time. We also find a pro-educational bias for women; as women with only primary education wait about 9 % (13 %) longer than women with upper secondary (tertiary) education.

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1. INTRODUCTION

Waiting times for elective treatment are a distinguishing feature of a public health care sector. The basic reason is that access to care is free, or copayments are low, so demand will exceed supply in terms of short run treatment capacity. Waiting times impose a deadweight loss since they are costly to patients, and entail few benefits for the providers. Still, waiting times might be preferred over rationing mechanisms based on co-payments. One important reason for this is that rationing by waiting times is supposed to be independent of socioeconomic status and thus considered more equitable than rationing by co-payments. This argument is significant in many National health care systems.

Whether rationing by waiting time is independent of socioeconomic status is an empirical question. The purpose of this paper is to contribute to this issue in four ways. First, we investigate whether socioeconomic status, measured by income and education, affects waiting time when controls for severity of illness are included. Second, we investigate whether any such inequalities are due to geographic variation in the supply of hospital services or by unequal treatment of different socioeconomic groups. Third, we examine which aspects of the hospital supply (attachment to local hospital, traveling time etc) that matter most for unequal treatment of different socioeconomic groups. Finally, we shed lights on two different mechanisms that may create discrimination: the first mechanism is that patients with higher socioeconomic status are able to circumvent waiting lists and obtain immediately access to care by attendance at emergence primary health care centers located at hospitals. The second mechanism is that patients with higher socioeconomic status can obtain quicker access to care by exerting pressure while waiting or by influencing the referral sent by the primary care physician to the hospital. [1]

We are able to investigate these issues since we have access to a rich data set from a country with the appropriate institutional settings. In Norway patients are required to see their primary care physician (GP) to obtain a referral to specialized care. However, when in need for immediate treatments, patients can visit emergency primary health care centers. Since 25 % of these centers are located at hospitals, patients might obtain direct access to specialized care by arguing the need for seeing a specialist when visiting these centers.

The data we use are patient level administrative data from the Norwegian Patient Register (NPR). This dataset includes all patients treated by Norwegian hospitals. We focus on elective care patients. Hence we exclude acute care patients, i.e., patients that are directly brought to hospitals emergency rooms. Patients referred from their GPs will show up with a waiting time of at least one day, while patients that are given access to specialized care through attendance at emergency primary health care centers will be given zero waiting time. Socioeconomic status is measured by small area level education or income.

When we investigate the sample of all elective patients, we find little evidence of discrimination with regards to income and with regards to education for men. We do however find a pro-

[1] We do not intent to explain whether any socioeconomic inequality in waiting time is caused by a person's socioeconomic status or any personal variables that are correlated with socioeconomic status. Such an endeavor requires a much richer dataset than we have access to.

educational bias for women; as women with only primary education wait about 9 % (13 %) longer than women with upper secondary (tertiary) education.

Turning to the analyses of the sub-samples according to zero/positive wait we find indication of discrimination of both male and female patients with only primary education: these patients have a lower probability of obtaining zero waiting time. With respect to patients with a strictly positive wait, we find that only women with secondary education obtain shorter waiting time. It thus seems that men and women with at least one year of tertiary education obtain access to care by attendance at emergency primary health care centers. Women with only secondary education obtain quicker access to care by exerting pressure while waiting, or by influencing the referral sent by the primary care physician.

We are not the only paper that investigates the relationship between waiting times and socio-economic status. Siciliani and Verzulli (2009) analyze whether patients with higher socio-economic status measured by educational attainment have lower waiting times for specialist consultation and non-emergency surgery using data from the Survey of Health, Aging and Retirement in Europe (SHARE). The main result is that higher socioeconomic status contributes to a significant lower waiting time in many European countries with a National Health Service type of health system. One limitation with this study is that is makes use of survey data. The sample size is relatively small and waiting time information is self-reported. In addition the SHARE data does not contain any information on supply-side factors, which excludes the possibility to control for any such differences in the empirical analysis.

Copper *et al*. (2009) and Laudicella *et al*. (2010) circumvent problems related to survey data and use administrative data to investigate whether socioeconomic status affects waiting time. Patient-level data from administrative databases are linked with small area socioeconomic variables. Cooper *et al*. (2009) investigate changes in waiting times for key elective procedures (hip replacement, knee replacement and cataract repair) in the English NHS between 1997 and 2007, and analyse the distribution of those changes between socioeconomic groups. A patient's socio-economic status is measured by the Carstairs index of deprivation, and the data used are from the Hospital Episode Statistics database in England.[2] The main conclusions are that waiting times went down, and the variation in waiting times across socioeconomic groups was reduced. Laudicella *et al*. (2010) do also make use of data from the Hospital Episode Statistics. They investigate whether waiting time for inpatient hip replacement differs according to socio-economic status measured by small area level income and skill deprivation from the indices of Multiple Deprivation 2004. Since small area level data are collected during the census in 2001, the analysis focuses on the year 2001/2002. The study does also include controls for severity (the type and number of diagnosis) and supply (hospital level fixed effects). The authors find evidence of inequality in waiting times favoring more educated individuals and, to a lesser extent, richer individuals: Compared with patients with least skill deprivation, patients in the second quintile wait about 22 days longer (9 %), and patients in the third-to-fifth quintiles wait about 32 days longer (13 %).[3]

[2] The Carstairs index of deprivation is a composite deprivation index based on car ownership, unemployment, overcrowding, and social class within output areas. It is calculated by the Office of National Statistics, see e.g. Morgan and Baker (2006).
[3] There is a broad literature measuring equality in health care utilization, van Doorslaer and Wagstaff (2000). This literature tests whether individuals with higher socioeconomic status have higher utilization (as measured by number of visits), after controlling for need (self-reported health). The evidence broadly suggests pro-rich inequality for physician visits. When visits are split between specialist visits and family-doctor consultations in gatekeeping systems, the evidence suggests pro-rich inequity for the former and pro-poor inequity for the latter (van Doorslaer *et*

Our study differs from these studies in various ways. Most notable it differs from Siciliani and Verzulli (2009) since we use administrative data instead of survey data. With respect to the two latter studies our approach is different since it presents data and results from a different county than England. More importantly however is the fact that we cover the total somatic patient population, and not some specific procedures. We believe this is important since the socio-economic variables used in Copper *et al*. (2009) and Laudicella *et al*. (2010) are calculated based on the total population. If the population of patients receiving hip-replacement differs from the total population, say e.g. by age, selecting certain treatments might induce a bias in the analysis. Like Laudicella *et al*. (2010) we include controls for severity and controls for hospital specific conditions. Our controls for hospitals specific conditions are however more refined since we include controls both for local hospital, distance to the hospital, and whether treatment is given at the local hospital or a university hospital. Finally, we also investigate how socioeconomic status affects access to specialized care by attendance at emergence primary health care centers located at hospitals.

The paper is organized as follows. In section 2 we give a short description of the Norwegian specialized health care sector. Section 3 presents the data and the methodology, while section 4 contains the empirical analysis. Concluding remarks are given in section 5.

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al., 2004). Grasdal and Monstad (2009) analyze and compare inequality in use of physician visits in Norway based on survey data. For specialist services they find pro-rich inequality in the probability of seeing an outpatient specialist. There is a limited literature which makes use of administrative data to investigate inequalities in health and health care. On length of stay: Cookson and Laudicella (2009); on health care utilization: Propper *et al*. (2005); on prioritisation and patients' rights: Carlsen and Kaarboe (2010).

2. INSTITUTIONAL FEATURES

The Norwegian specialized health care sector is predominantly publicly owned and organized as state owned enterprises within five (north, mid, west, south, east) regional health authorities (RHAs). [4] The RHAs have the responsibility for providing specialist health care to all patients within the region. The RHAs receive an annual budget from the Norwegian Government, based on a weighted capitation formula. In addition, the RHAs receive an activity-based grant which size is proportional to the number and composition of hospital treatments. The activity-based component is about 40 % of the somatic budget.

Provision of specialist health care is organized through health enterprises (hospitals) owned and governed by the RHAs. These organizations can also contract with private suppliers for providing treatment. This outsourcing is in effect quite small compared to the overall treatment activity, and confined to a few diagnoses. Patients are free to choose hospital at the national level, but few patients receive treatment outside of the hospitals' natural catchment areas, Vrangbæk *et al.* (2007). There are substantial travel distances in Norway, and reluctance to travel is large, Monstad (2007).

With the exception of acute care patients, patients are referred to further treatment from a primary care physician. Thus, there is a gate-keeper system regulating access to planned treatment. When in need for immediate treatment, patients are visiting emergence primary health care centers. These are the responsibilities of the municipalities. About 25 % of the emergency

[4] Hagen and Kaarboe (2006) and Magnussen *et al*. (2007) provide for more detailed descriptions of the Norwegian hospital sector.

primary health care centers are located at hospitals (National Center for Emergency Primary Health Care, 2009).

3. DATA AND METHODOLOGY

The empirical analysis makes use of data merged from three data sets. The first data set is the Norwegian Patient Register (NPR) for the period 2004-05. This individual level register contains information about waiting time and patient characteristics such as age, gender, place of residence (municipality or part of city), main and secondary diagnoses, and surgical procedure codes for all elective inpatient and outpatient treatment in somatic hospitals. The waiting time is measured from referral until the patient meets with a specialist from the hospital. This indicates starts of treatment, even though further diagnosing of the patient may occur.

The second data set is compound from the tax and education registers of Statistics Norway. Since the NPR (at least so far) does not have a unique personal identifier, information about socioeconomic status cannot be linked at the individual level. However, since the register has information about each hospital stay according to gender, year of birth and resident municipality, patients can be uniquely assigned to population cells that combine gender, age and municipality. For each cell, Statistic Norway has computed average income in 2004 and the population shares with primary, secondary and tertiary education by the end of 2004.[5,6] This approach produces 43 989 data points for income and educational achievement.

[5] Income and education level are computed for patients aged 25 and older. For each gender and municipality, we have collapsed cells with birth year 1917 or earlier into one cell since a large share of these cells were empty. The same has been done for cells with birth year 1918-1922.

The third data set measures the distance from a municipality to be served to the municipality where the service is provided. Distance is measured in travel time by car from one municipality center to another.

Not all observations are included in the analysis. First, we focus on patients with a date of referral during the first eight months of 2004 that got treatment during 2004 or in 2005.[7,8] During this period 1 471 317 hospital episodes took place. Second, we drop prenatal care visits (73 375 observations dropped). Third, we drop 22 072 observations from one hospital since 98 % of the patient episodes are missing waiting time information. Finally, to avoid serial hospital admissions we only include the first hospital stay for each patient (496 467 observations are dropped). Since NPR doesn't have unique personal identifier, we assume that all hospital episodes where a patient is given the same date of referral, and has the same sex, age, main diagnosis, and place of residence (municipality or part of city) refers to one and only one patient.[9] After excluding these observations we are left with a total of 879 403 patient episodes at 74 different hospitals.

[6] Our income variable is annual pre-tax income from employment, self-employment and transfers (pensions, social assistance benefits, etc). Capital income is not included since the administrative registers of Statistics Norway lack data about capital gains.

[7] The data period is chosen to match the data on income and education. Some patients will wait longer than 15 months, and receive treatment in 2006. But since only 4 % of the patients referred in this period wait longer than one year, we believe that only a few patient stays are excluded by design.

[8] Our rational for focusing on patients with a referral date between 1. January 2004-31. August 2004 is a change in the law of Patients' Rights introduced 1. September 2004. The Law may have changed the prioritisation practice of the hospitals. Askildsen *et al.* (2010a; 2010b) and Januleviciute *et al.* (2010) analyse the effects of the reform. The authors find very little effect of the reform.

[9] In section 4.1 we check whether the results are sensitive to this assumption.

Table I presents our data set. We first notice that the distribution of waiting time is skewed, as average waiting time is about 81 days, while the median waiting time is 36 days. 20,7 % (24,4 %) of the female (male) patients have zero waiting time, while 4 % of the patients waited longer than one year (not shown in the table). Table I shows that men experience shorter waiting time than women. Average waiting time for women is about 5 days longer than for men. Waiting time is also shorter for elderly patients (not shown in Table I). We also notice that the mean number of diagnoses (main and secondary) is 1.24 and that the corresponding number of procedures is 2.51. Turning to the socioeconomic data we see that the average earning (less capital income) of the population is NOK 239 000 ($40 000), and about 72 % (18 %) of the population has completed upper secondary education (at least one year of tertiary education). Average male income is about NOK 90 000 higher than female income, and a larger share of males has upper secondary education. When it comes to tertiary education, more women than men have reached this education level (about 3 percentage points). Finally, we note that the sample includes 43 989 data points. Hence, there is much variation in the socioeconomic variables.

[Table I about here]

To check whether the relationship between income and waiting time is non-linear we include dummy variables for sex- and age-specific income quintiles. That is, a male (woman) is placed in the highest income quintile if s/he belongs to a cell[10] in which average income is among the 20 % highest income relative to all men (women) born the same year.

[10] A cell is a combination of gender, age, and place of residence.

From the NPR data set we have detailed information about patients' medical conditions. The data set contains information about patients' main diagnosis, the number of secondary diagnoses (up to seven), and if any surgical procedure codes (up to ten). To identify the relationship between waiting time and socioeconomic status we include fixed effects for medical conditions to analyse variations in waiting times for patients with the same medical condition.

In the analyses we include three alternative specifications of medical conditions. The idea is to check whether the effects of socioeconomic status are sensitive to how well the seriousness of illness is controlled for. The first specification includes fixed effects for ICD-10 main diagnosis.[11] There are 6 812 (6 162) different main diagnoses for females (males) patients in the sample. The second specification includes fixed effects for combinations of main and secondary diagnoses. This way of specifying medical conditions gives 48 910 (40 043) different combinations for female (male). The third alternative includes fixed effects for all combinations of main diagnosis, secondary diagnoses, and surgical procedure codes. This specification of medical conditions gives rise to 125 990 (106 464) different groups of female (male) patients.[12]

In addition to controlling for severity (medical condition) we include controls for the following hospital specific conditions. First we include fixed effects for local hospitals. A local hospital is defined as the hospital that has the highest number of treatments for a given municipality, sex

[11] The International Statistical Classification of Diseases and Related Health Problems (ICD) provides codes to classify diseases and a wide variety of signs, symptoms, abnormal findings, complaints and external causes of injury or diseases. Norway uses the ICD-10 version to classify all hospital stays.

[12] Some of the groups only include one patient so the effective number of observations that are used to identify the relationship between waiting time and socioeconomic status is lower, but still above 300 000 (400 000) for males (females).

and main diagnosis (first letter in the ICD-10 code).[13] Second, we include a variable describing the distance from the hospital to the municipality center. This variable is interacted with age (10-years cuts) since the effect of travel distance might vary with age. Our rationales for including this variable are i) that people living closer to the hospital might fill open slots on short notice and hence obtain lower waiting time, and ii) that people living close to the hospital might also show up at the hospital without a referral, but still get elective treatment, for instance by seeing a specialist during a visit to an emergency primary health care center. Finally, we include a dummy variable that captures whether treatments are given at the local hospital and dummy variables for the university hospitals. The rational is that patients in Norway have free choice of hospitals[14], but patients cannot choose to receive treatment at university hospitals.

4. EMPIRICAL ANALYSIS

To analyze how socioeconomic status affects waiting time we first estimate the following OLS-model.

$$\mathrm{wt_i} = \delta_0 + \vec{\delta}_1\mathrm{AGE1} + \vec{\delta}_2\mathrm{MC} + \vec{\delta}_3\mathrm{HC} + \vec{\delta}_4\mathrm{AGE2}\cdot\mathrm{D} + \vec{\delta}_5\mathrm{Choice} + \vec{\delta}_6\mathrm{SES} + \varepsilon_\mathrm{i}\text{, where}$$

wt_i is the log of the number of days (plus one) between the days of referral and admission, AGE1 is an age-vector, MC is a vector of medical conditions, HC is a vector related to the hospital supply, AGE2 is a vector of 10-years age-cuts, D is the traveling time to the closest hospital, CHOICE is a dummy variable indicating whether treatment took place at the local hospital, SES is the patient's socioeconomic status (personal income or education level) and ε_i is an error term. The scalars δ_0, δ_5 and the vectors $\vec{\delta}_1 - \vec{\delta}_4, \vec{\delta}_6$ are parameters to be estimated.

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[13] 64 hospitals are local hospital for at least one combination of diagnosis, sex and municipality.
[14] Since 2001, patients have the right to choose which hospital to get treatments.

Secondly, we estimate how socioeconomic status affects the probability of zero wait and waiting time given it is strictly positive. Due to the large number of fixed effects, the zero wait regressions are estimated by linear probability models (OLS).

We first consider the effects of income on waiting time. Persons in the highest income quintile are the reference category. The results are presented in Table II. We present the results for men and women separately.

First we present the result when only fixed effects for birth year are included. The next three columns include the three alternative fixed effects for medical specifications. In regression (2) we control for main diagnosis, regression (3) controls for combinations of main and secondary diagnoses, while regression (4) in addition controls for procedures.

[Table II about here]

Income has a strong and significant negative effect on waiting time for males. Notice that the results are not much affected by whether and how we control for medical condition. But the effect of income becomes more linear the more extensive the control for medical condition is; the relationship between income quintile and waiting time is almost linear in regression (4). Patients in the lowest income quintile wait about 26 % longer than patients in the reference category. For women the results are less uniform. Now it matters how we control for medical condition. Without such control the relationship between income and waiting time is U-shaped, regression (1); highest and lowest income quintile wait longest. But when maximal medical controls are included, regression (4), we see a clear pro-rich bias. Women in the lowest income quintile wait about 10 % longer than women in the highest and third highest quintile, and about 18 % longer than women in the second highest income quintile.

In regression (5) we include dummy variables for local hospitals. For both sexes local hospitals basically explain the income gradient. Only men in the lowest income quintile have a waiting time that is significantly different from the waiting time of the reference group (3.6 % higher). For women, only those in the second highest income quintile have significantly lower waiting time (6.3 %).

When we in addition include the travel distance to the closest hospital (interacted with 10-years age-cuts) there is no significant difference in the waiting time for males with different income, see regression (6). For women we see a slight pro-poor bias; those in the highest income quintile wait about 4-6 % longer compared to all other women. Finally we include the choice variables to check whether persons with higher income are more prone to use patient choice to obtain lower waiting time. The results are presented in regression (7). We see that introduction of the choice variables does not significantly affect the results.

We now turn to the analysis of the sub-samples according to waiting time. The results are presented in Table III. We first comment on the results for men. From Table II we know that the relationship between income quintiles and waiting time is approximately linear when no controls for hospital supply were included (Table II, regressions 1 and 4). When waiting times are split according to zero and strictly positive wait we notice that most significant results are obtained for the probability of zero waiting times (Table III, regressions 1a, 4a). Waiting time, given a strictly positive wait, is however significantly shorter for those with highest income (same table, regressions 1b, 4b). When hospital effects are included, we obtain similar results as for the full sample: there are only small differences in the probability of zero wait/waiting time and no indications of discrimination (Table III, regressions 7a, 7b).

[Table III about here]

For women, waiting times differences showed up only when hospital supply variables were excluded, and when extensive controls for medical conditions were included (Table II, regression 4). The result is that women with lower income wait longer. When we split the sample we see that this result is caused by a lower probability of zero wait for women with low income (Table III, regression 4a, 4b). Waiting time, given a strictly positive wait, does show a weak pro-poor bias as women in the three lowest income quintiles wait about 2,6-4 % shorter. When hospital controls are included most results are insignificant. The exception is for women in the 3^{rd}-4^{th} income quintiles. These women have about one percentage point higher probability of obtaining zero wait (Table III, regressions 7a, 7b).

We then turn to the effects of educational achievement on waiting time. The results are presented in Table IV.

[Table IV about here]

First we notice that there is no clear pattern between the coefficient of tertiary education and the different ways of including fixed effects for medical conditions for men; the estimated effect of tertiary education is between -0.34 and -0.41 and significant. Waiting time for men with higher education is thus about 40 % lower than the waiting time for men without upper secondary education. Furthermore, and in contrast to the result we obtained for income, the effect is still significant when we include fixed effects for local hospital, regression (5). The effect is however reduced by about 40 %. When distance is included in addition to fixed effects for local hospitals, the effect becomes small and insignificant, regression (6). Hence, local hospital and distance explain each about half of the educational gradient. We also notice that the coefficient for upper secondary education is insignificant and small in all regressions. The main separation is between males with higher education and the rest of the male population.

Turing to the regression results for women, we see that the results are sensitive to choice of empirical specification. When we include maximal controls for medical condition (regression (4)), the coefficients for upper secondary and tertiary education are almost identical (-0.23). Women with only primary education thus wait about 23 % longer than their sisters with at least upper secondary education. In regression (5) dummies for local hospitals are included. The effects are not uniform; the coefficient of upper secondary (tertiary) education decreases (increases). When we in addition include distance (regression (6)), we see that the effect of education becomes smaller. The same pattern occurs when choice and university hospital are included as dummies, but the change in the coefficient is relatively small, see regression (7). The effect of education, however, is still significant and relatively large; women with upper secondary (tertiary) education wait about 9 % (13 %) shorter than women with only primary education. The average waiting time for women is about 83 days, so women with at least upper secondary education wait about 8-11 days shorter. From this we conclude that distance, choice of hospital and discrimination seem to explain a pro-educational bias for women, but that the explanatory effect of choice of hospital is relatively small.

When we split the sample and consider the results without controls for hospital supply, we notice that the probability of zero wait is higher for men with tertiary education. This result holds both without and with controls for severity (Table V, regressions 1a, 4a). When we look at men who experience a strictly positive wait, we find that men with higher education wait shorter. But this result is significant only when no controls for severity are included. When hospital controls are included, we see that the result of no discrimination (Table IV, regression 7) is caused by two opposite effects; men with tertiary education experience a higher probability of zero wait, but given a positive wait these men actually wait longer (Table V, regressions 7a, 7b). Hence there is some indication of discrimination for men with zero wait.

Table V, regressions 4a, 4b show that women with only primary education experience both a lower probability of zero wait and longer waiting time given a strictly positive wait. When controls for hospital supply are included these women are still worst off (Table V, regressions 7a, 7b). It thus seems that these women are discriminated against. Notice however that the mechanisms of discrimination are different for women with only secondary education and women with higher education: the latter group has a higher probability of obtaining zero wait, while the former group experiences shorter waiting time given a strictly positive waiting time. It thus seems that women with higher education are able to circumvent the waiting list by attendance at emergency primary health care centers. Women with only secondary education seem to obtain shorter wait either by influencing the referral from the primary physician or by contacting hospitals while they are waiting.

4.1. Sensitivity analyses

To check the robustness of the conclusions we have looked into three possible sources that might bias the estimates. The sensitivity analyses are shown for regressions (4) and (5) for income (Table VI) and regressions (4), (5) and (7) for education (Table VII).[15] The first column of Table VI and VII replicates the results of Table II and III. Again we present the results for men and women separately.

[Tables VI and VII about here]

The first sensitivity check we perform is whether treatments with exceptionally long waiting time affect the results. In the sensitivity analysis we change the date of referral to include *all* treatments with up to 18 months waiting time. The results are presented in column (b) in Table IV and V. We notice that the estimated effects of income in regression (4) become slightly stronger when the referral period is shortened. Since the number of excluded patient episodes is higher the longer the time of referral, this may indicate that the results presented in Table II underestimate the effect of income. Quantitatively there are however no reasons to believe that the bias is large. Concerning education we observe different effects of changing the referral period for men and women. For men the coefficients are slightly smaller, while the opposite is the case for women. The main conclusion is still that the results are not very sensitive to the choice of the period of referrals.

[15] The sensitivity analyses for the sub-samples according to waiting time are similar to what is presented in Table VI and VII. These results are available upon request.

Since we cannot follow patients over time and patients that move between hospitals, we have assumed that two patient episodes with the same i) date of referral, ii) sex, iii) age, iv) place of residence (municipality or part of city), and v) main diagnosis relate to the same patient. The consequences of this assumption are that some patient episodes that are included might be following up-consultations for patients that already are treated, and that some patient episodes are excluded from the data set even if they are the initial treatment. In the sensitivity analyses we remove patients from the five largest municipalities/parts of city that have the highest number of treatments (since the problem will be more severe in large municipalities).[16] We also add the criterion that two patient episodes also must include the same secondary diagnoses (in addition to criteria i)-v) above before a patient episode is dropped). These results are presented in columns (c) and (d) in Table VI and VII. We conclude that the results are not sensitive to the way patient episodes are defined.

We also check whether the results are sensitive to the way patients are admitted to hospitals. The issue is that differences in the medical conditions of patients may be correlated with the way patients are admitted, even though we control thoroughly for diagnoses and procedures. Hence, we include separate fixed effects for medical conditions for the three different ways of admitting patients; inpatient treatment, day treatment, and outpatient treatment. The results are presented in column (e) in Table VI and VII. In these regressions we thus control for all possible combinations of the way patients are admitted, main diagnosis, secondary diagnoses and

[16] The average number of inhabitants per municipality in 2006 is 8296 when the five largest municipalities/parts of city are excluded.

procedures. We notice that the results are not sensitive to the way patients are admitted to hospitals.

Finally, and as an alternative to the OLS-specification we have estimated some simple duration models of the relationship between socioeconomic status and waiting time. Including a full set of fixed effects for medical condition (either of the three fixed effects alternatives) in a duration analysis would require computer resources that vastly exceed ours. However, comparison of OLS and duration analyses with parsimonious specifications indicate that the results are very similar. This is to be expected since the combination of LOG waiting times and OLS is approximately equivalent to a basic duration model (proportional exponential hazard rate). [17,18]

5. CONCLUDING REMARKS

In this paper we have investigated whether socioeconomic status, measured by income and education, affects waiting time when we control for patients' medical condition (severity of illness) and hospital specific effects like local hospital and distance to hospital. We find very little indication of discrimination with regard to income. This result holds both for males and females. We find some indication of discrimination of men with low education as these men have a lower probability of zero waiting time. We also find a pro-educational bias for women; as women with only primary education wait about 9 % (13 %) longer than their sisters with upper secondary (tertiary) education. The analyses of the subsamples show that different mechanisms

[17] We thank Luigi Siciliani for pointing out this result.
[18] The results are available upon request.

are behind this result: Women with at least one year of tertiary education obtain access to care by attendance at casualty wards/clinics, while women with only secondary education obtain quicker access to care by exerting pressure while waiting, or by influencing the referral sent by the primary care physician. The results are insensitive to the robustness checks we perform.

One of the novelties of our analysis is that the data allows us to include very extensive controls for patients' severity. This is important since, according to the prioritisation guidelines often used in many health systems of the National Health Service type, more severely ill patients should have shorter waiting times (Sicililani and Hurst, 2005; Gravelle and Siciliani, 2008). From the results we see that controlling for severity seems to be more important for women than for men. This holds true both for income and education. One reason why controlling for severity is more important for women might be that women with higher socioeconomic status have better ability to communicate with the medical providers and argue for the need of lower waiting time. Men on the other hand, might not be so active "complainers".

The fact that a socioeconomic gradient might give unacceptable equitable consequences raises the question why individuals experience relatively longer waiting time. What we have done is to examine whether hospital factors explain the socioeconomic differences in waiting time, or if the socioeconomic gradient still remain when factors like attachment to local hospital and distance to hospital are controlled for. That is, we do not try to explain inequalities with patient level variables. Such an approach would not only require that we include income and education in the same regression[19], but also that we have access to data on other variables that describe a patient's personal resources and that are correlated with income and/or education. Candidates for such variables are attachment to the labor force, (employed, unemployed, or on social security) and family relations, just to mention two. In addition one has to tackle the problem of reversed causality; the more treatment one gets, the healthier one is and the easier it is to obtain income and, for students, education. Instead our approach is to focus on two variables that are commonly used to describe inequality, check how they are related to waiting time, and try to explain any differences by hospital specific conditions relative to where patients' live.

A limitation with the approach we have used in this paper is that we cannot match socioeconomic status at individual level with administrative patient data.[20] Instead we are linking patients' level data from administrative databases with data on income and education from population cells that combine gender, age and municipality. In this respect we follow a recent trend that makes use of administrative data to investigate inequalities in health or health care. To make the match between the cell averages and the administrative data as good as possible, we have chosen to focus on all elective care, and not some specific common procedures. However we have not included acute care in our analyses. This might potentially bias out results. Especially if it is the case that patients with lower socioeconomic status are more likely to get acute treatment. One reason for this might be that these patients have longer waiting time, and thus may become acute ill while waiting. But since we do not find much evidence of discrimination, we do not think our results are sensitive to the exclusion of acute care treatment.

[19] The correlation between income and education is 0.63 (0.7) for men (women).
[20] We are not aware of any study that has access to such data.

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Table I. Variable description and summary statistics. 879 403 patient episodes. Income and educational achievement: 43 989 cell data points.

		Mean	St.d.	Median	Max	Min
All patients (N = 879 403)						
Waiting time	Days	80.9	113.4	36	729	0
Age		56.8	17.5	57	93	26
Diagnoses	Number of diagnoses (main + secondary)	1.24	0.72	1	8	0
Procedures	Number of operation procedures	2.51	1.15	2	10	0
Income	Average earnings less capital income of cell population (2004, in 10^5 NOK)	2.39	0.84	2.26	12.1	0.16
Secondary education	Share of cell population with upper secondary but not tertiary education (2004)	0.544	0.173	0.556	1	0
Tertiary education	Share of cell population with at least one year of college/university educ. (2004)	0.176	0.130	0.167	1	0
Male (N = 386 665)						
Waiting time	Days	78.2	113.0	34	720	0
Age		57.7	58	58	93	26
Diagnoses	Number of diagnoses (main + secondary)	1.24	0.72	1	8	1
Procedures	Number of operation procedures	2.50	1.21	2	10	0
Income	Average earnings less capital income of cell population (2004, in 10^5 NOK)	2.88	0.85	2.93	12.1	0.92
Secondary education	Share of cell population with upper secondary but not tertiary education	0.570	0.174	0.582	1	0
Tertiary education	Share of cell population with at least one year of college/university educ. (2004)	0.160	0.111	0.156	1	0
Female (N = 492 748)						
Waiting time		83.0	113.8	38	729	0
Age		56.0	18.0	56	93	26
Diagnoses	Number of diagnoses (main + secondary)	1.24	0.72	1	8	0
Procedures	Number of operation procedures	2.52	1.10	2	10	0
Income	Average earnings less capital income of cell population (2004, in 10^5 NOK)	1.92	0.50	1.95	6.76	0.16
Secondary education	Share of cell population with upper secondary but not tertiary education	0.518	0.168	0.533	1	0
Tertiary education	Share of cell population with at least one year of college/university educ. (2004)	0.191	0.145	0.174	1	0

Table II Effect of income on log (1+waiting time). t-statistics (absolute values) clustered at cell level reported in parentheses

Male	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Top income quintile		Reference	category				
4th income quintile	0.124	0.095	0.094	0.081	0.007	0.010	0.009
	(3.17)	(3.84)	(3.95)	(5.23)	(0.51)	(0.75)	(0.74)
3rd income quintile	0.071	0.097	0.098	0.142	-0.013	-0.015	-0.014
	(2.04)	(4.75)	(4.92)	(9.95)	(0.96)	(1.15)	(1.02)
2nd income quintile	0.136	0.129	0.130	0.184	0.004	-0.009	-0.006
	(4.32)	(6.79)	(6.96)	(12.85)	(0.27)	(0.63)	(0.45)
Lowest income quintile	0.273	0.231	0.236	0.264	0.036	-0.001	0.001
	(9.35)	(12.82)	(13.26)	(18.92)	(2.45)	(0.05)	(0.07)
R^2	0.007	0.297	0.379	0.615	0.631	0.631	0.632
Female							
Top income quintile		Reference	category				
4th income quintile	-0.222	-0.165	-0.158	-0.081	-0.063	-0.057	-0.054
	(5.46)	(5.64)	(5.75)	(4.38)	(3.17)	(2.95)	(2.86)
3rd income quintile	-0.161	-0.128	-0.107	-0.011	-0.033	-0.044	-0.040
	(4.66)	(5.02)	(4.34)	(0.66)	(1.62)	(2.23)	(2.08)
2nd income quintile	-0.031	-0.032	-0.014	0.046	-0.020	-0.044	-0.040
	(0.96)	(1.34)	(0.62)	(2.75)	(0.98)	(2.18)	(2.03)
Lowest income quintile	0.045	0.019	0.041	0.097	0.005	-0.041	-0.036
	(1.48)	(0.83)	(1.84)	(5.90)	(0.26)	(2.00)	(1.83)
R^2	0.008	0.272	0.358	0.582	0.598	0.599	0.600
Fixed effects:							
Birth year	x	x	x	x	x	x	x
Main diagnosis		x					
Main diagnosis x 2dary diagnoses			x				
Main diagnosis x 2dary diagnoses x procedures				x	x	x	x
Local hospital					x	x	x
Travel dist. x age cuts						x	x
Choice variables:							
Other hospital than local hospital							x
University hospital fixed effects							x

Table III Effect of income on zero waiting time (1a, 4a, 7a) and log (waiting time | waiting time > 0) (1b, 4b, 7b). t-statistics (absolute values) clustered at cell level reported in parentheses

Male	(1a)	(4a)	(7a)	(1b)	(4b)	(7b)
Top income quintile						
4th income quintile	-0.023	-0.015	-0.001	0.046	0.032	0.015
	(2.40)	(4.17)	(0.28)	(4.05)	(3.57)	(1.65)
3rd income quintile	-0.015	-0.032	0.000	0.020	0.018	-0.007
	(1.70)	(10.00)	(0.10)	(1.77)	(2.02)	(0.72)
2nd income quintile	-0.032	-0.044	-0.001	0.011	0.015	-0.005
	(4.14)	(13.65)	(0.34)	(0.98)	(1.63)	(0.44)
Lowest income quintile	-0.061	-0.063	-0.004	0.043	0.027	-0.004
	(8.44)	(20.22)	(1.20)	(4.02)	(2.93)	(0.35)
R^2	0.007	0.644	0.664	0.002	0.501	0.511
Female						
Top income quintile						
4th income quintile	0.054	0.017	0.011	-0.003	-0.010	-0.014
	(6.40)	(4.72)	(2.84)	(0.15)	(0.86)	(1.10)
3rd income quintile	0.029	-0.006	0.010	-0.059	-0.026	-0.000
	(4.35)	(1.41)	(2.31)	(2.88)	(2.26)	(0.02)
2nd income quintile	-0.006	-0.023	0.008	-0.069	-.040	-0.009
	(0.98)	(7.27)	(1.84)	(3.40)	(3.55)	(0.69)
Lowest income quintile	-0.022	-0.033	0.005	-0.057	-0.026	-0.016
	(4.11)	(10.90)	(1.19)	(2.82)	(2.30)	(1.16)
R^2	0.008	0.600	0.621	0.003	0.493	0.502
Fixed effects:						
Birth year	x	x	x	x	x	x
Main diagnosis x 2dary diagnoses x procedures		x	x		x	x
Local hospital			x			x
Travel dist. x age cuts			x			x
Choice variables:						
Other hospital than local hospital			x			x
University hospital fixed effects			x			x

Table IV Effect of educational achievement on log (1+waiting time). t-statistics (absolute values) clustered at cell level reported in parentheses

Male	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Secondary education	0.097	0.054	0.043	0.028	-0.060	0.002	-0.001
	(0.96)	(0.90)	(0.72)	(0.61)	(1.49)	(0.05)	(0.02)
Tertiary education	-0.429	-0.337	-0.406	-0.409	-0.241	-0.035	-0.044
	(3.89)	(4.97)	(6.07)	(8.41)	(4.97)	(0.65)	(0.81)
R^2	0.005	0.296	0.378	0.614	0.631	0.631	0.632
Female							
Secondary education	-0.050	-0.223	-0.197	-0.237	-0.164	-0.110	-0.094
	(0.49)	(3.34)	(3.15)	(5.22)	(4.33)	(2.80)	(2.41)
Tertiary education	0.160	0.125	0.068	-0.230	-0.375	-0.135	-0.129
	(1.38)	(1.63)	(0.93)	(4.29)	(7.54)	(2.55)	(2.46)
R^2	0.005	0.271	0.357	0.582	0.598	0.599	0.600
Fixed effects:							
Birth year	x	x	x	x	x	x	x
Main diagnosis		x					
Main diagnosis x 2dary diagnoses			x				
Main diagnosis x 2dary diagnoses x procedures				x	x	x	x
Local hospital					x	x	x
Travel distance x age cuts						x	x
Choice variables:							
Hospital not local hospital							x
University hospital fixed effects							x

Table V Effect of educational achievement on zero waiting time (1a, 4a, 7a) and log (waiting time | waiting time > 0) (1b, 4b, 7b). t-statistics (absolute values) clustered at cell level reported in parentheses

Male	(1a)	(4a)	(7a)	(1b)	(4b)	(7b)
Secondary education	-0.022	-0.004	0.004	0.012	0.010	0.009
	(0.90)	(0.37)	(0.49)	(0.33)	(0.32)	(0.26)
Tertiary education	0.092	0.105	0.032	-0.090	-0.034	0.078
	(3.49)	(9.81)	(2.87)	(2.35)	(1.00)	(1.81)
R^2	0.007	0.643	0.664	0.002	0.501	0.511
Female						
Secondary education	-0.036	0.028	0.008	-0.254	-0.151	-0.067
	(1.67)	(3.06)	(1.08)	(5.19)	(4.65)	(2.06)
Tertiary education	-0.040	0.055	0.029	-0.003	-0.069	-0.021
	(1.49)	(4.93)	(2.80)	(0.06)	(1.76)	(0.49)
R^2	0.004	0.599	0.621	0.003	0.493	0.502
Fixed effects:						
Birth year	x	x	x	x	x	x
Main diagnosis x 2dary diagnoses x procedures		x	x		x	x
Local hospital			x			x
Travel dist. x age cuts			x			x
Choice variables:						
Other hospital than local hospital			x			x
University hospital fixed effects			x			x

Table VI Effect of income on log (1+waiting time). Sensitivity analysis

Regression	Male	a	b	c	d	e
4	4th income quintile	0.081	0.078	0.057	0.085	0.083
		(5.23)	(4.53)	(2.92)	(5.45)	(5.33)
	3rd income quintile	0.142	0.156	0.158	0.143	0.140
		(9.95)	(9.79)	(9.29)	(9.98)	(9.84)
	2nd income quintile	0.184	0.199	0.197	0.182	0.180
		(12.85)	(12.58)	(11.97)	(12.68)	(12.59)
	Lowest income quintile	0.264	0.281	0.278	0.263	0.263
		(18.92)	(18.08)	(17.41)	(18.94)	(18.95)
5	4th income quintile	0.007	0.001	0.005	0.008	0.008
		(0.51)	(0.05)	(0.35)	(0.60)	(0.60)
	3rd income quintile	-0.013	-0.015	-0.019	-0.013	-0.014
		(0.96)	(0.97)	(1.25)	(1.01)	(1.05)
	2nd income quintile	0.004	0.001	-0.002	0.001	0.000
		(0.27)	(0.09)	(0.14)	(0.04)	(003)
	Lowest income quintile	0.036	0.029	0.031	0.036	0.036
		(2.45)	(1.73)	(1.85)	(2.48)	(2.47)
	Female					
4	4th income quintile	-0.081	-0.071	-0.122	-0.084	-0.086
		(4.38)	(3.67)	(5.68)	(4.57)	(4.62)
	3rd income quintile	-0.011	0.005	-0.029	-0.017	-0.018
		(0.66)	(0.27)	(1.50)	(0.93)	(1.03)
	2nd income quintile	0.046	0.076	0.030	0.044	0.041
		(2.75)	(4.39)	(1.66)	(2.59)	(2.41)
	Lowest income quintile	0.097	0.119	0.078	0.090	0.090
		(5.90)	(7.05)	(4.46)	(5.49)	(5.43)
5	4th income quintile	-0.063	-0.060	-0.062	-0.058	-0.058
		(3.17)	(2.79)	(3.16)	(2.94)	(2.96)
	3rd income quintile	-0.033	-0.032	-0.048	-0.028	-0.028
		(1.62)	(1.47)	(2.38)	(1.41)	(1.42)
	2nd income quintile	-0.020	-0.013	-0.036	-0.014	-0.015
		(0.98)	(0.61)	(1.78)	(0.71)	(0.76)
	Lowest income quintile	0.005	0.006	-0.011	0.008	0.009
		(0.26)	(0.26)	(0.52)	(0.42)	(0.44)

a) Replication of results in Table II
b) Patient episodes referred to hospital treatment 1/1 2004 - 30/6 2004
c) Without patients from five largest municipalities/parts of city
d) Alternative identification of follow-up treatment
e) Separate diagnoses/procedures fixed effects for inpatient treatment, day treatment and outpatient treatment

Table VII Effect of educational achievement on log (1+waiting time). Sensitivity analysis

Regression	**Male**	a	b	c	d	e
4	Secondary education	0.028	0.044	-0.015	0.029	0.022
		(0.61)	(0.87)	(0.31)	(0.65)	(0.50)
	Tertiary education	-0.409	-0.388	-0.378	-0.401	-0.405
		(8.41)	(7.24)	(7.09)	(8.27)	(8.39)
5	Secondary education	-0.060	- 0.057	-0.119	-0.058	-0.057
		(1.49)	(1.23)	(2.83)	(1.46)	(1.48)
	Tertiary education	-0.241	-0.196	-0.163	-0.235	-0.233
		(4.97)	(3.53)	(2.96)	(4.90)	(4.85)
7	Secondary education	0.002	0.003	-0.057	-0.001	0.002
		(0.05)	(0.06)	(1.29)	(0.01)	(0.04)
	Tertiary education	-0.035	0.008	0.016	-0.039	-0.035
		(0.65)	(0.13)	(0.27)	(0.72)	(0.65)
	Female					
4	Secondary education	-0.237	-0.196	-0.264	-0.244	-0.245
		(5.22)	(4.02)	(5.65)	(5.40)	(5.42)
	Tertiary education	-0.230	-0.213	-0.106	-0.226	-0.226
		(4.29)	(3.70)	(1.86)	(4.23)	(4.23)
5	Secondary education	-0.164	-0.136	-0.176	-0.168	-0.166
		(4.33)	(3.25)	(4.50)	(4.49)	(4.44)
	Tertiary education	-0.375	-0.381	-0.301	-0.383	-0.384
		(7.54)	(6.81)	(5.66)	(7.81)	(7.84)
7	Secondary education	-0.110	-0.091	-0.129	-0.118	-0.115
		(2.80)	(2.09)	(3.20)	(3.02)	(2.94)
	Tertiary education	-0.135	-0.152	-0.090	-0.148	-0.147
		(2.55)	(2.57)	(1.72)	(2.85)	(2.84)

a) Replication of results reported in Table III
b) Patient episodes referred to hospital treatment 1/1 2004 - 30/6 2004
c) Without patients from five largest municipalities/parts of city
d) Alternative identification of follow-up treatment
e) Separate diagnoses/procedures fixed effects for inpatient treatment, day treatment and outpatient treatment

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