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The impact of accessibility on the use of specialist health care in Norway

Tor Iversen & Gry Stine Kopperud

Center for Health Administration,

University of Oslo

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by

Tor Iversen & Gry Stine Kopperud

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Abstract

This paper presents a study of the factors that contribute to the utilization of specialist health care in Norway. The aim of the study is to explore to what extent the policy goal of allocating health care according to medical need is fulfilled. Hence, we are interested in studying the impact of a person's health relative to the impact of access to specialist care. We distinguish between services provided by public hospitals and services provided by private specialists financed by the National Insurance Scheme. Our data allow us to consider individual patient characteristics since we merge Survey of Living Conditions data with data on capacity and access to general practice and specialist care.

In accordance with our predictions, we find from the estimation of logit models and negative binomial models significant differences between the factors that influence contacts with private specialists and contacts with hospitals. While a person's self-assessed health plays a major role in the utilization of hospitals, we find no significant effect of this variable on the utilization of private specialists. The supply-side variables measured by GP density and the accessibility indices for specialist care have significant effects on the utilization of private specialists, but not on hospital visits and inpatient stays. A preliminary conclusion is that the utilization of hospital services is rationed according to patients' health status, and not influenced by patients' access. Hence, the utilization of hospital services seems to be in accordance with officially stated health policy. On the other hand, private specialists seem to function as an alternative to general practice. Moreover, the significant effect of chronic conditions on the utilization of private specialists suggests that regular check-ups of chronic patients are an important part of the services provided by private specialists. The challenge to policy makers is to consider measures that bring the utilization of publicly funded private specialists in accordance with national health policy.

1. Introduction

This paper presents an exploratory study of the factors that contribute to the utilization of specialist health care in Norway. In particular, we are interested in studying the impact of a person's health relative to the accessibility of specialist care. We distinguish between services provided by public hospitals and services provided by private specialists financed by the National Insurance Scheme. The aim of the study is to determine to what extent officially stated health policy goals are fulfilled. In Norway, the Act on Patient Rights states that the allocation of health services should be determined by a combination of the seriousness of a patient's illness, the expected health gain of treatment and the health effect relative to the cost of treatment. According to the law, one should therefore expect that patients who have been in contact with the specialist health service would be in a poorer health state than others. But other factors may also be of importance for the utilization. For instance, the density of general practitioners (GPs) influences patient's access to general practice and probably influences whether a patient is referred to the specialist sector. Two factors may be involved. On the one hand, a high GP density may imply that GPs handle problems that otherwise would have involved specialists. On the other hand, an increase in the number of GP consultations may increase the number of referrals because of symptoms that otherwise would have been undiscovered or handled by the patient himself.

The Norwegian health care system, as most other national health services, is based on the principle that all inhabitants should have equal access to health care, independent of social status, geographical location and income. However, it is unrealistic that all inhabitants should have the same travelling distance to advanced health care, particularly in a sparsely populated country like Norway. The interesting question is then whether differences in accessibility have an impact on differences in utilization. From Huseby (2000) we know that the provision of hospital services per inhabitant varies among the counties, and van den Noord, Hagen and Iversen (1998) show that this variation correlates with the variation in county council revenues. But there are no studies of whether this variation also exists when individual patient characteristics are taken into account. Our data allow us to consider individual patient characteristics since we use Norwegian Survey of Living Conditions data merged with data on capacity and access to general practice and specialist care. Hence, the present study takes account of a full range of factors that could potentially influence the variation in utilization rates between individuals. In this respect we aim at improving one of the shortcomings of many studies, summed up by Goddard and Smith (2001).

This study is related to Urbanos-Garrido (2001). She examines the factors contributing to differences in the use of public health care services among individuals with similar medical needs in Spain. Four types of medical services are considered: visits to a GP, visits to a specialist, visits to emergency services and hospital inpatient days. The study shows that the influence of demand factors of difference in use depends on the type of health care considered. The impact of supply factors is minimal.

Our study is limited to the use of specialist health care. Compared with Urbanos-Garrido (2001) we account for two additional variables. Firstly, by introducing capacity and distance, our supply-side variables measure accessibility more precisely. Secondly, in addition to publicly owned facilities we also include privately practicing specialists financed by the National Insurance Scheme. Hence, we are given the opportunity to study whether type of ownership has an impact on the factors that contribute to the use of the service.

We distinguish between hospital outpatient visits, hospital inpatient stays and visits to private specialists, and study the factors that contribute to at least one contact during the last twelve months. Effects of explanatory variables are estimated by means of logistic regression. Our main results are that a person’s self-assessed health contributes to the probability of outpatient visits and inpatient stays in the sense that poorer health increases the probability. The probability of visits to a private specialist is, however, not influenced by a person’s self-assessed health. The presence of a chronic illness contributes positively to all three types of contacts. The presence of a list patient system in general practice contributes negatively to the probability of visits to private specialists, and positively to hospital outpatient visits. A high density of GPs has a negative impact on the probability of visits to private specialists, but has no effect on hospital contacts. Access to hospital beds influences visits to private specialists and outpatient visits negatively, while no effect is found on inpatient stays. An unexpected result is that access to hospital physicians increases the probability of visits to a private specialist, while access to private specialists has no impact on the probability of a visit.

We also estimate the effect of explanatory variables on the *number* of visits to private specialists by means of Poisson regression and negative binomial regression. We still find no effect on self-assessed health on the number of visits, while the accessibility of private specialists has a significant impact on the number of visits.

Our conclusion is that the utilization of hospital services is rationed according to patients' health status, and not influenced by patients' access. This finding seems to be in accordance with health policy statements. But, contrary to Urbanos-Garrido (2001), we find significant supply-side effects, and in particular for practices that are publicly financed and privately owned. This difference in findings may be related to differences in type of supply-side data. While Urbanos-Garrido (2001) uses indicators of size of the area where an individual resides and number of public hospital beds, we distinguish between public and private ownership and include accessibility indicators that encompass both capacity and travel distance. Hence, our supply-side variables seem to be more detailed.

The paper proceeds as follows: in Section 2 we present our hypotheses. To explain the institutional setting of our hypotheses, we start off by including a short description of the Norwegian health care system. Data and descriptive statistics are presented in Section 3, and Section 4 contains the estimation procedure and results. In Section 5, the results are summed up and discussed, and suggestions for further work are outlined.

2. Institutional framework and predictions

Norwegian inhabitants are insured under the National Insurance Scheme. General taxation and out-of-pocket payments finance the provision of public health services[1].

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[1] Annual out-of-pocket payments are limited to NOK 1350 (2002).

The health care system has three levels: The central government is responsible for national policy and for the income of the lower government levels. Each county council is responsible for the financing, planning and provision of specialized health care, and the local municipalities are responsible for the delivery of primary health care[2]. Hospitals are financed by a mix of fixed budget and per case funding of outpatient and inpatient treatments. A patient pays a fee for an outpatient treatment, but not for an inpatient stay.

Private specialists also provide specialist health care. About 10 per cent of physicians engaged in specialist health care are in private practice. Since 1 July 1998, funding from the National Insurance Scheme requires that a privately practicing physician have a contract with a county council. The practice income of a contract physician is partly from a practice allowance and partly from a fee-for-service component, where a patient copayment is included. The patient’s copayment is independent of whether he is treated at a hospital outpatient department or by a contract specialist. Specialists without a contract are mainly located in a few cities and receive their total practice income directly from their patients.

For non-emergency care, an individual with symptoms of a disease usually visits a general practitioner (GP). The GP may treat the patient himself or send a referral to a private specialist, a hospital outpatient department or admit the patient to an inpatient stay. The patient may also contact a specialist directly, since the role of the GP as a gatekeeper is not strictly adhered to[3]. After treatment in the specialist sector, the patient may be referred back to general practice or to self-care.

Our data are from 1998. By this time, primary care was provided by salaried GPs employed by a municipality (20%), by privately practicing GPs with a contract (66%) or without a contract with a municipality (8%), and by interns (6%). Contracted physicians were partly paid by a practice allowance from the municipality (on average 1/3 of the practice income) and partly by a fee for service from the patients directly

[2] In 2002 the state took over the ownership of hospitals and the responsibility for providing hospital care to all Norwegian residents. Since our data are from 1998, the institutions described in this paper are in accordance with institutions in this particular year.

[3] From 1 June 2001 patients without a referral have to pay the total fee out of pocket.

(1/3) and from the National Insurance Scheme (1/3).

Initiated by the central government, a trial using a list system for GPs started in May 1993 and lasted for three years. The trial included four municipalities with a total of 250000 inhabitants and 150 GPs. For the GPs in the trial, the remuneration system was changed, and consisted of a per capita component per listed person and a fee-for-service component. The four municipalities (Åsnes, Trondheim, Lillehammer and Tromsø) voluntarily kept the list system after the trial period ended. Our data contain a dummy variable for the residents of these municipalities. In 1997, the Norwegian Parliament approved a proposition to introduce the list system in general practice for the whole nation. The reform was introduced on 1 June 2001. The reform's intention is to improve the quality of care, improve cost control and improve the cooperation between the various parts of the health service by introducing the GP as a coordinator.

In this paper we are in particular interested in the factors determining the use of specialist services[4] and in how the specialist service interacts with general practice. The observed utilization pattern of specialist services is a result of an interaction between several decision-makers with differing objectives and constraints. Important distinctions are between demand for specialist services from patients directly and demand as a result of referrals, and between supply of specialist services from public hospitals and from private practices.

Visits to a hospital outpatient department and inpatient stays are rationed in the sense that a patient usually needs a referral to gain access to these services. A referral usually precedes a consultation with a private specialist too, but for a wide range of conditions a referral is not required. Some diagnostic and curative services are only provided by hospitals.

Since private specialists are self-employed and receive a fee for service, we expect their capacity to be more flexible than hospitals with employed personnel and a complex management. Hence, economic incentives are expected to have a stronger impact on

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[4] For studies of the equity of distribution in general practice, see Grytten, Rongen and Sørensen (1995) and Sørensen, Rongen and Grytten (1997).

private practices than public hospitals, and hence, they are more capable of accommodating an unexpected change in demand.

A GP is assumed to refer a patient if the GP's utility from a referral is greater than without. We suggest that three groups of variables contribute to the GP's utility, and hence to the referral decision:

The patient's health and type of medical problem

According to the Act on Patient Rights, the GP should consider the seriousness of the patient's illness, the expected health gain from further examination and treatment and the expected health effect relative to the cost of treatment when he/she decides on means of treatment. The GP's consideration of the patient's health status and potential for improvement is therefore crucial. Sometimes doctors need to reassure the patient or himself that the diagnosis is the right one. In this situation they can use specialists for a second opinion. Rutle (1983) found that the majority of referrals from his sample of Norwegian GPs took place because they assessed their own competence as insufficient. Nielsen and Sørensen (1987) found the same result among Danish physicians.

Capacity, organization and remuneration in general practice

Iversen and Lurås (2000) made the distinction between supplementary and alternative referrals. When the services provided by a specialist could just as well have been handled by the GP himself, the referral is "unnecessary" in medical terms. These referrals are called alternative referrals since the services alternatively could be provided by the GP. Examples of this kind of service are various types of consultations and examinations and minimal surgery. We suggest that GPs are more inclined to use alternative referrals the lower physician density in general practice in a local area is. The reason is that a low physician density implies a high opportunity cost of providing services in terms of fewer patients that can be seen. In accordance with Iversen and Lurås (2000), we would also suggest that a combined capitation/fee-for-service system encourages a higher referral rate than a combined practice allowance/fee for service in general practice. While the magnitude of a practice allowance depends on the inputs of the practice (time and equipment), the income from capitation depends on the number of people on a GP's list. Hence, there is an economic incentive for having long lists and high referral rates to regulate the total workload. On the other hand, the list patient system connected to the capitation fee is intended to encourage continuity in the relationship between a GP and his patient. Continuity eases the GP's access to information about his patient and hence, may reduce the need for referrals.

Capacity, organization and remuneration in the specialist sector

A low capacity in the specialist sector may imply a long waiting time for the patient or a high probability of having a referral rejected. A patient may therefore be better off by staying with the GP. Long travelling distances for seeing the specialist points in the same direction.

When the patient can initiate a consultation with a specialist directly, we expect that the factors mentioned above are also involved, but their relative weights will probably differ from the weights in the GP's utility function. Since our data do not contain information about referrals, we cannot distinguish between contacts and referrals in the empirical sections.

Since rationing[5] occurs to a greater extent in hospitals than in private practice, we would expect that patients' health status on average is better in private practice than in public hospitals. On the other hand, if GPs are worried about the waiting time patients may experience in hospitals, they may be likely to refer even patients with poor health to private specialists. A priori we therefore cannot conclude whether patients' health is expected to be better in private practice than in hospital outpatient departments. For both types of providers we can, however, predict that a decline in a person's health status should increase the likelihood of a visit if providers adhere to the national guidelines of prioritization. We would further predict that accessibility has less impact on actual utilization the poorer a person's health status is. The reason is that sick people are willing to accept huge costs[6], for instance in terms of travelling, to obtain necessary medical care.

[5] By rationing we mean that some patients are turned down or offered a very long wait.

[6] Although, for some illnesses, discomfort and pain make it impossible to accept a long travel distance.

3. Data

The data set is obtained by merging data from the 1998 Survey of Living Conditions by Statistics Norway, selected data from the Commune Database complied by Norwegian Social Science Data Service (NSD) and an index for the accessibility of specialist health care. This merged data file combines data at the individual level with data describing the capacity of health care provision related to each person's municipality of residence.

The 1998 Survey of Living Conditions consists of 5000 respondents from the Norwegian population, aged 16 and older. The sample is representative with respect to sex, age, marital status and geographical region. An interview was obtained with 3449 persons. In addition to a major focus on health-related questions, the survey also included questions on various living conditions, education, income, employment, etc. The sample consists of 51.3 per cent women and the average age is 45.9 years.

The Commune Database contains statistics since 1796 for all 435 municipalities in Norway. The database covers demographic and occupational information, welfare-related statistics and data on provision of public services. More than 190 000 variables are available for each municipality unit.

Accessibility

Kopperud (2002) has made an index that describes the accessibility of specialized health care at the municipality level. The construction of the index is inspired by the work of Carr-Hill et al. (1994). The specialist care included is hospitals (outpatient and inpatient care) and privately practicing physician specialists with a contract with a county council. The index measures the availability of specialized health care in each municipality within each of the five health regions in Norway. Three elements are incorporated in the index: the capacity of the specialized health care[7] in each municipality where the service is provided, the distance from a municipality to be served to the municipality where the service is provided, and a discount factor that converts the distance to estimated access. The discount factor assumes that the marginal effect of distance on accessibility is declining in distance. The reason is that faster

[7] The capacity measures take the size of the population to be served into account.

modes of transportation are used for longer distances (airplanes) than for shorter distances (feet). Distance is measured in travel time by car from one municipality center to another[8]. The capacity is measured along three dimensions: hospital beds, hospital physicians and private specialists.

The joint accessibility A_{ikr} for the residents in municipality i in county k in region r is:

$$A_{ikr} = c\left[\frac{1}{P_k}\sum_{j=1}^{n_k} S_j^{(1)}\ f\left(d_{ij}\right) + \frac{1}{P_r}\sum_{j=1}^{n_r} S_j^{(2)} f\left(d_{ij}\right) + \frac{1}{P}\sum_{j=1}^{435} S_j^{(3)} f\left(d_{ij}\right)\right]$$

P_k is the population in county k. P_r is the population in region r, and P is the total population in Norway. There are n_k municipalities in county k, n_r municipalities in region r and 435 municipalities in Norway, where $n_k < n_r < 435$. $S_j^{(1)}$ is the capacity of the county level specialist health care in municipality j. $S_j^{(2)}$ is the capacity of the regional level specialist health care in municipality j. $S_j^{(3)}$ is the capacity of the national level specialist health care in municipality j. d_{ij} is the distance between a municipality j with a health care facility, and the municipality i to be served. $f\left(d_{ij}\right)$ expresses the effect of distance on access. Access is assumed to decline with distance at an increasing rate[9]. c is a constant. The accessibility index is further described in appendix A.

[8] The distance matrix was provided by InfoMap Norge AS.

[9] This means that the first order derivative is negative $f'\left(d_{ij}\right) < 0$, and the second order derivative is positive: $f''\left(d_{ij}\right) > 0$.

Table 1: Descriptive statistics - mean (standard deviation) of the variables

Variable	Definition	Private Specialist visit in an office setting N=659 (19%)	Hospital out-patient visit N=800 (23%)	Hospital inpatient stays N=351 (10%)	The whole sample N=3449 (100%)
Self assessed health	=1 if the person has very good or good health.	0.734 (0.442)	0.70 (0.45)	0.627 (0.484)	0.810 (0.39)
Very good health	=1 Very good health	0.302 (0.459)	0.266 (0.442)	0.202 (0.402)	0.367 (0.482)
Good health	=1 Good health	0.433 (0.496)	0.440 (0.497)	0.425 (0.495)	0.444 (0.496)
Fair health	=1 Fair health	0.165 (0.372)	0.178 (0.382)	0.140 (0.396)	0.128 (0.334)
Bad health	=1 Bad health	0.091 (0.288)	0.0912 (0.28)	0.140 (0.347)	0.055 (0.220)
Very bad health	=1 Very bad health	0.010 (0.095)	0.025 (0.156)	0.040 (0.196)	0.097 (0.097)
Chronic illness	=1 if the person has a chronic illness.	0.520 (0.500)	0.540 (0.500)	0.540 (0.500)	0.380 (0.48)
GP visits	=1 if the person has had GP visits during the last 14 days.	0.240 (0.430)	0.270 (0.440)	0.310 (0.460)	0.190 (0.39)
GPs per 10,000 residents	# of GPs per 10,000 residents in the municipality	7.696 (1.471)	7.638 (1.529)	7.663 (1.632)	7.692 (1.499)
Individual lists of patients	=1 if the person lives in a municipality where GPs have individual lists of patients.	0.049 (0.220)	0.076 (0.27)	0.068 (0.25)	0.057 (0.23)
Hospital for outpatient visits	=1 if the person has been at hospital for outpatient visits during the last 12 months.	0.340 (0.470)	1.000 (0.000)	0.510 (0.500)	0.230 (0.42)
Hospital for inpatient stays	=1 if the person has been in hospital for inpatient stay during the last 12 months.	0.150 (0.360)	0.220 (0.420)	1.00 (0.00)	0.100 (0.30)
Visit to a private specialist	=1 if the person has had at least one visit to a private specialist during the last 12 months.	1.000 (0.000)	0.280 (0.450)	0.280 (0.450)	0.190 (0.39)
Number of visits to privately specialists	The number of visits to privately specialists during the last 12 months	2.448 (3.138)			0.466 (1.673)
Access to hospital beds	Accessibility index estimated for hospital beds.	0.822 (0.919)	0.633 (1.007)	0.661 (1.000)	0.696 (0.970)
Access to hospital physician	Accessibility index estimated for hospital physicians	1.162 (1.083)	0.858 (1.166)	0.834 (1.153)	0.916 (1.133)
Access to private specialists	Accessibility index estimated for privately specialists	1.679 (2.230)	1.038 (1.931)	0.970 (1.910)	1.178 (2.038)

Table 1 shows the three estimated measures of the accessibility of specialized health care: one estimated accessibility index for *hospital beds*, one estimated accessibility index for *hospital physicians* and one estimated accessibility index for *privately practicing specialists*. In our sample, the access to specialized health care is on average higher than for the average municipality in the country, normalized to zero. The reason is probably that smaller municipalities with relatively poor access are underrepresented in the sample. The index is on average 0.70 for access to *hospital beds*, 0.92 to *physicians in hospitals*, and 1.18 to *private specialists in an office setting*. We see from table 1 that the accessibility index for those who have *visited a private specialist* is higher than for the other groups.

Utilization

Data on utilization of health care are taken from the Survey of Living Conditions and hence, are the figures provided by the respondents. Both *visits to general practitioners* and *use of specialist care* are included. We consider three measures of utilization of specialist care: *visits to privately practicing specialists*[10], *hospital outpatient visits* and *hospital inpatient stays*. From table 1 we see that during the last 12 months, 19% of the sample have had one or more *visits to a private specialist*, 23% of the sample have had at least one *outpatient hospital visit*, and 10% of the sample have had at least *one hospital inpatient stay*.

In the sample, 19% have had *at least one GP visit* during the last 14 days shown by a dummy variable. Compared with the whole sample, we find that a higher proportion among individuals who have *used specialized health care* have also *used primary care during the last 14 days*. The density of general practitioners at the municipality level is measured by the ratio *GPs per 10,000 residents*, and is a measure of the capacity in primary care in the municipality. A person who lives in a *municipality with a list patient system* in general practice is indicated by a dummy variable. The average *GP ratio* is 7.69 per 10,000 residents and 5.7% of the sample have a *list-based GP relationship*. Among the 19% of the sample who have had at least one *visit to private specialists* during the last 12 months, the *average number of visits* is 2.5. The distribution is skewed to the right (skewness=12.377) and contains 81% zeros. A rather small proportion of the sample consumes a large number of health services. The maximum

[10] These physicians are privately practising and may or may not have a contract with the county council that entitles them to a practice allowance.

number of visits is 25. Unfortunately, our data do not contain data on the number of hospital contacts during the observation period.

Because of the long recall period (12 months), the reported number of visits to private specialists may contain recall bias. In addition, the data contain no information on the total number of visits according to completed illness spells. It is likely that the data include incomplete spells. Some of the visits may be the result of an illness spell that started before the observation period, and counts may therefore be misinterpreted as first contacts. Some of the visits may also continue after the observation period. As a result, the distribution of the number of visits may be mixed with left, right and no truncation. Furthermore, contacts during the observation period may also be the result of several illness episodes and accordingly several first contacts.

Health status

Our indicator of health care need is *self-assessed health* and *chronic illnesses*[11]. *Self-assessed health* is measured as a five-point health status scale: *very good*, *good*, *fair*, *bad* and *very bad*. For the whole sample, 81% state that they have *very good* or *good* health, although 38% of the sample also reported that they suffered from a *chronic illness*.

4. Results

The analysis of specialized health care utilization is divided into two parts. First, we estimate *the probability of at least one contact* for each of the three types of specialized health care: *visits to private specialists, hospital outpatient visits and hospital inpatient stays.* We present the estimation method and the results from the estimation of the logit model. Next, we examine what determines *the number of visits to private specialists*. We give an account of the presented count models and the results derived from the estimation.

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[11] Due to insufficient data we do not take the capacity to benefit into consideration, and in general expose ourselves to criticism raised, for instance, by Goddard and Smith (2001). In the concluding remarks we comment on the relationship between need and self-assessed health.

In the literature it is usual to distinguish between the first contact during an episode of illness and subsequent contacts. While the patient initiates the first contact, the physician (agent) in agreement with the patient (principal) initiates subsequent contacts. Hence, there may be different types of factors that influence the first contact compared with subsequent contacts. Recent contributions to the literature have aimed at distinguishing between the two kinds of decisions in the estimation procedure[12]. As a consequence of the rejection of the single spell assumption in our data set, we are not able to distinguish between the contact decision and the follow-up decision in our analysis. Hence, our data do not allow us to interpret the first contact as the patient's decision and subsequent contacts as a provider's decision. The analysis is therefore confined to estimating the factors that influence the utilization of specialist services without distinguishing between patients' and providers' decisions.

When examining the factors that contribute to at least one contact, we consider a binary dependent variable, Y, that shows whether an individual is a "user" ($Y=1$) or a "non-user " ($Y=0$) of specialist health care services. Assuming a logistically distributed error term, the probability of being a "user" is $\text{Prob}(Y=1)=L(x\beta)=\frac{e^{x\beta}}{1+e^{x\beta}}$, while the probability for "no use" is $\text{Prob}(Y=0)=1-L(x\beta)=\frac{1}{1+e^{x\beta}}$. The vector x contains explanatory variables and β are coefficients to be estimated. The joint probability distribution of n independent and identical Bernoulli trials is $L=\prod_{i=0}^{n}\left[1-L(x\beta)\right]^{1-y_i}\bullet L(x\beta)^{y_i}$, where L is the sample likelihood. The log likelihood function for the observed sample of independent observations is then: $\text{LogL}=\sum_i\left\{(1-y_i)\log\left(1-L(x\beta)\right)+y_i\log\left(L(x\beta)\right)\right\}$. The estimated β's are found from the maximization of the log likelihood function.

In model 1 we focus on the effect of self-assessed health on the use of specialist health

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[12] This literature contains the hurdle model (Pohlmeier and Ulrich (1995) and Gerdtham (1997)) and the two-part model (Grootendorst (1995) and Häkkinen et. al (1996)).

care. The individuals' self-assessed health is a dummy variable for each of the health conditions *very good*, *good*, *fair* and *bad*. The reference individual has *very bad health*. In model 2 we add a dummy variable for *chronic illness*, a dummy variable for individuals who *live in a municipality where GPs have individual lists of patients*, and variables describing *access to GPs* and *to specialized health care*[13]. In model 2, the reference individual has *very bad self-assessed health*, does not have a *chronic illness* and does not *live in a municipality where GPs have individual lists of patients*.

[13] I.e. access to hospital beds, access to physician hospitals and access to private specialists. See appendix A for details.

Table 2. The estimated effect of independent variables (standard deviation in parenthesis) on the probability of at least one contact with specialist health care during the last 12 months.

Variable	PSPV Model 1	PSPV Model 2	HOV Model 1	HOV Model 2	HIS Model 1	HIS Model 2
Constant	-1.504** (0.451)	-1.6966*** (0.527)	0.431 (0.356)	-0.00024294 (0.427)	-0.305 (0.352)	-0.563685 (0.475)
Very good health	-0.176 (0.458)	0.170609 (0.466)	-2.030*** (0.364)	-1.54659*** (0.372)	-2.518*** (0.373)	-2.27573*** (0.384)
Good health	0.030 (0.456)	0.27115 (0.462)	-1.639*** (0.361)	-1.32691*** (0.368)	-1.921*** (0.362)	-1.75422*** (0.369)
Fair health	0.384 (0.465)	0.508482 (0.469)	-1.182*** (0.371)	-1.09434*** (0.375)	-1.402*** (0.376)	-1.37899*** (0.379)
Bad health	0.836* (0.478)	0.832548* (0.483)	-0.785** (0.388)	-0.781591** (0.392)	-0.655* (0.390)	-0.643007 (0.392)
Chronic illness		0.621577*** (0.098)		0.70614*** (0.091)		0.326742** (0.130)
Individual lists of patients		-0.595579** (0.249)		0.534105** (0.209)		0.27587 (0.292)
GPs per 10,000 residents		-77.04** (34.339)		-19.8803 (28.486)		-0.568742 (38.878)
Access to hospital beds		-0.217592** (0.0969)		-0.166351* (0.0918)		0.0860949 (0.131)
Access to hospital physician		0.400283*** (0.127)		0.060018 (0.117)		-0.111942 (0.164)
Access to privately specialists		0.0482874 (0.044)		-0.0104442 (0.042)		-0.0142308 (0.0584)
N	3449	3447	3449	3447	3449	3447
-2 log likelihood	3325,20	3214.57	3637.97	3559.41	2157.89	2140.452
McFadden LRI[14]	0.0118	0.0435	0.0264	0.0458	0.0493	0.0528
LR[15]	39.86***	146.3364***	98.67***	170.86***	111.433***	119.5067***
($\hat{Y}^2$) Ramsey's reset-test		-0.1728 (0.14223)		-0.0762 (0.1956)		0.2097 (0.3163)
LR for model 2 and model 3		1.490		0.1517		0.4451

*, (**), ((***)) indicates that the estimated parameter is significantly different from zero at the 10, (5), ((1)) % level with a two-tailed test.

We see from table 2 that only *bad* is found to influence *the use of private specialists* at a statistically significant level (significant at 10%) in model 1, and this effect has the opposite sign of the expected. *Bad health* contributes positively to *the probability of a*

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[14] McFadden's likelihood ratio index $LRI = 1 - \frac{\ln L}{\ln L_r}$ is a measure of goodness of fit. The log-likelihood functions are evaluated at the restricted estimates ($\beta = 0$) and unrestricted ($\beta \neq 0$) estimates, $\ln L_r$ and $\ln L$ respectively. The measure is bounded between 0 and 1. LRI increases as the fit improves.

[15] The likelihood ratio test is $LR = -2\left[\ln L_r - \ln L\right]$ where the restricted model consists of a constant term only.

visit compared with *very bad health*.

For the use of *hospital outpatient visits*, model 1 shows that the worse the *self-assessed* health is, the higher is the probability of a *hospital outpatient visit* compared with the reference individual. The estimated coefficients for *very good*, *good* and *fair* are all significant at 1%; *bad* is significant at 5%.

Furthermore, for the probability of a *hospital inpatient stay*, model 1 shows that the worse the *self-assessed health* is, the higher is the probability of a *hospital inpatient stay* compared with the reference individual. The estimated results for *very good*, *good* and *fair* are significant at 1%; *bad* is significant at 10%.

We now consider the model where additional factors are taken into account. In model 2, *self-assessed health* still has no influence on the probability of *a visit to a private specialist*. The exception is that *bad health* contributes positively compared with *very bad health*, as in model 1. People suffering from a *chronic illness* have a higher probability of *a visit to a private specialist* (significant at 1%). People living in a municipality where *GPs have individual lists* of patients have a significant (5%) lower probability of *a visit to a private specialist*. The higher the *GP per resident* ratio, the lower is the probability of a *visit to a private specialist*, (significant at 5%). The effect of the *accessibility index for hospital beds* shows that better access lowers the probability. The estimated coefficient is significant at 5%. The estimated effect of *access to hospital physicians* is, however, positive, indicating that better access to hospital physicians increases the probability of a *visit to a private specialist*. This result is significant at the 1% level. The effect of *private specialist accessibility* is not statistically significant.

Regarding *hospital outpatient visits*, model 2 shows similar effects of *self-assessed health* as model 1. We also find that people suffering from a *chronic illness* have a higher probability of *hospital outpatient visits* (significant at 1%). People living in a municipality where *GPs have individual lists of patient* have a significant (5%) higher probability of *hospital outpatient visits*. The effect of *GP density* is not significant. The variables that describe *access to specialist care* show that the better the *access to hospital beds* is, the lower is the probability of *hospital outpatient visits*. The estimated coefficient is significant at 10%. Neither of the other two accessibility indices is significant.

In model 2, there is no change from model 1 regarding the estimated effect of self-assessed health on the probability of a *hospital inpatient stay*. People suffering from a *chronic illness* are found to have a higher probability of a *hospital inpatient stay*. The estimated effect of *chronic illness* is positive and significant at 5%. Neither the effect of *GPs having individual lists* of patients nor *GP density* is found to be statistically significant. This also applies to all three accessibility indices.

We tested model 2 for mis-specification and omitted variables by means of Ramsey's reset-test[16] and the likelihood ratio (LR) statistic[17]. From table 2 we see that the reset-test fails for each of the three models, and we cannot reject the null hypothesis. The LR-test shows for each of the three models that the hypothesis $\beta_2 = 0$ cannot be rejected at the 5 % level of significance[18]. Based on the reset-test and the LR statistics, model 2 for *visit to a private specialist*, *hospital inpatient stay* and *hospital outpatient stay* shows no evidence of mis-specification or omitted variables. Hence, there is no indication that model 2 for any of the three dependent variables should be rejected.

The dependent variable in the second part of the analysis measures the number of visits to a privately practicing physician during the last 12 months. Count data regression models (Cameron and Trivedi (1998)) are used since the dependent variable is measured as non-negative integer counts $(y_i = 0,1,2,3,...)$. The natural starting point is the standard Poisson distribution: $P^P(y_i) = \frac{e^{-\lambda_i}\lambda^{y_i}}{y_i!}$, where $\lambda_i = E(y_i|x_i) = \exp(x_i\beta)$. This is the probability of observing a count of y_i events during a fixed time period. An

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[16] The hypothesis to be tested is $H_0: y^* = \beta x + \varepsilon$ against $H_1: y^* = \beta x + \beta_2\hat{Y}^2 + \varepsilon$. $\hat{Y}$ is the estimated value of the dependent variable from model 2. (From now on $y^* = \beta x + \beta_2\hat{Y}^2 + \varepsilon$ will be called model 3.)

[17] The log likelihood ratio (LR) = $-2[\ln L_r - \ln L]$. The log-likelihood functions are evaluated at the restricted (model 2) and unrestricted (model 3) estimates respectively. The LR-test checks whether model 3 increases the log likelihood significantly compared with model 2.

[18] The 5 % critical value from the chi-squared distribution with 1 d.f. is 3.841.

important feature of the Poisson model is the equidispersion property: $E(y_i|x_i) = Var(y_i|x_i)$. But this assumption is sometimes too restrictive (Mullahy (1997)), and the negative binomial model, which allows for over-dispersion, may then be useful. The negative binomial model has $E(y_i) = \lambda_i$ and $Var(y_i) = \lambda_i + \alpha\lambda_i^{2-k}$, where the variance is exceeding the mean. When *k=0*, the variance will be a quadratic function of the mean, and specifies a negative binomial 2 model (Cameron and Trivedi (1998)). The negative binomial 2 model reduces to a Poisson model when $\alpha = 0$. The density of a negative binomial 2 model is: $f(y_i|\lambda_i,\alpha) = \left\{\frac{\Gamma(y_i + \alpha^{-1})}{\Gamma(\alpha^{-1})\Gamma(y_i + 1)}\right\}\left(\frac{\alpha^{-1}}{\lambda_i + \alpha^{-1}}\right)^{\alpha^{-1}}\left(\frac{\lambda_i}{\lambda_i + \alpha^{-1}}\right)^{y_i}$. In our case with a dependent variable skewed to the right and containing a large proportion of zeros, the negative binomial model may be the appropriate one. We use the software Limdep 7.0 in estimating the negative binomial model 2. Table 3 presents the estimation results.

Table 3: The estimated effect of independent variables (standard deviation in parenthesis) on the number of visits to private specialist health care during the last 12 months.

Variable	Poisson Model 1	Negative Binomial Model 2	Poisson Model 3	Negative Binomial Model 4
Constant	-1.052*** (0.284)	-1.409** (0.572)	-1.260*** (0.500)	-1.553 (0.957)
Very good health	-0.289 (0.251)	-0.199 (0.540)	-0.305 (0.252)	-0.117 (0.582)
Good health	0.182353 (0.246)	0.235 (0.535)	0.192 (0.267)	0.330 (0.575)
Fair health	0.398 (0.249)	0.420 (0.541)	0.443* (0.250)	0.506 (0.581)
Bad health	0.612** (0.254)	0.670 (0.567)	0.646** (0.255)	0.759 (0.612)
Chronic illness	0.602*** (0.0558)	0.655*** (0.100)	0.602*** (0.056	0.678*** (0.123)
Individual lists of patients	-0.585*** (0.146)	-0.526** (0.244)	-0.576*** (0.186)	-0.342 (0.352)
GPs per 10,000 residents	-37.453** (18.811)	-3.422 (25.544)	17.652 (21.451)	48.702 (34.921)
Access to hospital beds	-0.207*** (0.054)	-0.205** (0.089)	-0.667* (0.402)	-0.469 (0.738)
Access to hospital physician	0.371*** (0.072)	0.350*** (0.124)	0.440 (0.405)	0.119 (0.756)
Access to privately specialists	-0.010 (0.024)	0.011 (0.049)	1.022*** (0.279)	1.238** (0.595)
Østfold County			-1.327** (0.666)	-1.702 (1.530)
Akershus County			-2.259** (0.914)	-2.366 (1.811)
Oslo County			-6.322*** (1.711)	-7.194* (3.723)
Vestfold County			-1.743** (0.734)	-2.161 (1.651)
Aust Agder County			-1.278** (0.595)	-1.627 (1.350)
Sogn og Fjordane County			1.414*** (0.468)	1.152 (0.749)
Alpha		5.957*** (0.327)		5.788*** (0.332)
-2 Log likelihood	-7975.154	-5296.450	7880.168	5274.104
LR	455.016***		550.002***	
-2($LR^{Poisson}$-$LR^{negative\ binomial}$)		2678.703***		2606.064***
N	3445	3445	3445	3445

*, (**), ((***)) indicates that the estimated parameter is significantly different from zero at the 10, (5), ((1)) % level with a two-tailed test.

We test the Poisson model for over-dispersion according to Cameron and Trivedi (1991). The likelihood ratio test, when testing the negative binomial model against the Poisson model, is 2678.703 (model 2 against model 1) and 2606.064 (model 4 against model 3) (see table 3). The negative binomial models (model 2 and model 4) increase the log likelihood significantly, and this leads to rejection of the Poisson models (model 1 and model 3). The over-dispersion parameter *alpha* in the negative binomial models is positive and significant. Hence, there is strong evidence of over-dispersion. When comparing the estimated coefficients in model 1 and model 3 with model 2 and model 4, we see that they are almost identical in the Poisson model and in the negative binomial model. But the estimated standard deviations are in general greater in the negative binomial model than in the Poisson model. Due to the rejection of the Poisson model, the description of the coefficient estimates that follows are confined to the negative binomial model[19].

Model 4 differs from model 2 in the sense that 18 dummy variables for residential county are included. Since the county councils are responsible for organizing specialist health care, county dummies are supposed to capture effects not accounted for by the included explanatory variables. They serve as a kind of control variable. From table 3 we see that the presence of a *chronic illness* contributes to a higher *number of visits*. *Chronic illness* is significant at the 1% level. Living in a municipality where *GPs have an individual list of patients* and high *access to hospital beds* has a negative impact on *the number of contacts with private specialists*. From model 2 in table 3 we also see that *access to hospital physicians* has a positive impact on the *number of visits to a private physician*. The supply-side effects are not stable with respect to the introduction of county dummies in model 4. The *access to private specialists* now has a significantly, at 5%, positive impact while the other accessibility measures become insignificant. In table 3 we have excluded the coefficients of the county dummies that are insignificant at the 5% level in the Poisson model[20]. In the negative binomial model we see that none of the dummies are statistically significant at the 5% level. Only the *county of Oslo* has a significantly negative impact at the 10% level compared with the reference *county Finnmark*, the most northern county.

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[19] As Green (2000) notes, testing the zero inflated negative binomial model against the negative binomial model allows us to make statements as to whether any excess zeros are a consequence of the splitting mechanism or are due to unobserved heterogeneity. The zero inflated negative binomial failed to converge when the splitting model was a function of all the regressors.

[20] Although they are of course estimated.

5. Concluding remarks

The purpose of this paper has been to study the factors that influence the population's utilization of specialist health care in a National Health Service. Distinctions are made between visits to private specialists, hospital outpatient visits and hospital inpatient stays. The factors that contribute to at least one contact during the last twelve months are estimated by means of binomial logistic regression models. We find that a person's self-assessed health contributes to the probability of an outpatient visit or an inpatient stay in the sense that poorer health increases the probability of at least one visit. The probability of a visit to a private specialist is, on the other hand, not influenced by a person's self-assessed health. The presence of a chronic illness contributes positively to all three types of contacts. The presence of a list patient system in general practice contributes negatively to the probability of a visit to a private specialist, but positively to a hospital outpatient visit. A high density of GPs has a negative impact on the probability of a visit to private specialists, but has no effect on hospital contacts. Access to hospital beds influences visits to private specialists and outpatient visits negatively, while no effect is found on inpatient stays. An unexpected result is that access to hospital physicians increases the probability of a visit to a private specialist, while access to private specialists has no significant impact on the probability of a visit.

Hence, different factors influence contacts with private specialists and with hospitals. While a person's self-assessed health plays a major role in the utilization of hospital services, we find no significant effect of this variable on the utilization of private specialists. On the other hand, the supply-side variables measured by GP density and the accessibility indices for specialist care have significant effects on the utilization of private specialists, but not for hospital contacts, and in particular inpatient stays. A preliminary conclusion is that the utilization of hospital services is rationed according to patients' health status, and not influenced by patients' access. Hence, the utilization of hospital services seems to be in accordance with officially stated health policy and with our prediction that accessibility has a smaller effect on utilization the worse a patient's health status is. On the other hand, the utilization of private specialists is to a large extent influenced by the accessibility of specialist care relative to GPs and hence, seems to function as an alternative to general practice. The positive effect of chronic conditions on the utilization of private specialists suggests that regular check-ups of chronic patients are an important task in a private specialist practice. The challenge to policy makers is to consider measures that bring the utilization of publicly funded private specialists in accordance with national health policy.

This preliminary conclusion is in accordance with Iversen and Kopperud (2001) who found that patients' self-assessed health has a major impact on their access to hospital waiting lists. The conclusion is also in accordance with Finnvold (2001), who found that 13% of the population consider themselves to have a specialist as their permanent physician, and hence, can be interpreted as using a specialist as an alternative to a GP.

Two effects are unexpected according to our hypotheses and previous empirical findings. Iversen and Lurås (2000) found in an exploratory study that capitation seems to increase the referral rate to private specialists, but not to hospitals. The results were interpreted as an elastic supply of private specialist services and inelastic supply of hospital services. In the present study we find the opposite result: The presence of a capitation system increases the probability of a hospital outpatient visit, but contributes to a decline in the probability of a visit to a private specialist. In the present study we would also have expected that access to a private specialist would have influenced the probability of a visit positively. We find this effect in relation to the number of visits, but not in relation to the probability of at least one visit. In this case we find that the better the access to hospital physicians is, the higher is the probability of a visit to a private specialist. The instability of significant effects suggests multicollinearity between private and public accessibility as a possible reason for the result. We find that the effect of access to private specialists becomes significant when access to hospital physicians is disregarded. Among other things, this multicollinearity indicates that some hospital physicians also have a part-time private practice. Another reason is that private specialists without a contract with a county council are not included in the accessibility index, and there may have been a positive relationship between the number of hospital physicians and the number practicing privately part-time without a contract. A third reason is probably that utilization data are from 1998 while the accessibility index uses capacity data from 1999-2000. There has probably been a reduction in the number of private practices from 1998 to 2000, in particular in the cities. The index underestimates access to private specialists in the cities in 1998.

In our analysis we have not taken into account the possible mutual dependencies of hospital outpatient visits, hospital inpatient stays and visits to private specialists. For example, a hospital outpatient visit is often required before a hospital inpatient stay. Or, after a hospital inpatient stay, the patient can be referred to a private specialist. Unfortunately, data are insufficient to study these potential interactions.

Our study is based on self-assessed health, while access to specialist care also depends on the physician's assessment of the patient's health, the "objective" need for health care. Moum (1991) finds that the presence of illness and disability are important predictors for a patient's self-assessment of his health. Maddox and Douglas (1973) found that self-assessed health was stable over time, and in accordance with "objective health" in about 60% of their cases. Smith et al. (2001) tested whether longevity expectations matched actual mortality at the individual level, and found consistent individual survival patterns. Longevity expectations turned out to be a fairly accurate index of a person's survival probability. Bjorner et al. (1996) review a number of studies on mortality and self-assessed health, and conclude that the relationship between self-assessed health and mortality has been convincingly shown to be independent of sex, age groups and cultural background. But self-assessed health is associated with other measures of health, such as symptoms and functional ability. We interpret this result as an indication of a close correspondence between the patient's and the physician's assessment.

In supplementary analyses we also included a person's education and income as explanatory variables without finding any significant effects. This may be contrary to what Steen Carlsson (1999) found. From the analysis of Swedish data describing the treatment of patients with two common acute diagnoses and two common elective diagnoses, she found that income, education and marital status affect treatment for some diagnoses. She concludes that these results may indicate inequality of treatment in hospital or inequality of access to hospital care. According to Fylkesnes (1992), high education does not have any effect on an individual's decision to contact a GP, but has a positive effect on the probability that an individual will be referred to specialized health care.

Although socio-economic variables were not found to have any direct impact, an indirect impact through self-assessed health may be suggested. Angel and Gronfein (1988) showed that better self-assessed health is significantly correlated with socio-economic variables like high education and high income among others. Angel and Guarnaccia (1989) found significant correlation between low education and low income and self-assessed health. High income and high education were also found to have a significant relation to better self-assessed health in Johnson et al. (1991). By performing similar analyses of our data, we find positive and statistically significant effects of education and income on self-assessed health. Our results are then in accordance with the officially stated goal that socio-economic variables should not have any direct impact on accessibility although they may have an indirect impact through the health assessment.

Additional characteristics of our data should be mentioned. The first is that consultations and inpatient stays related to pregnancy and delivery are included, thereby weakening the impact of health status on utilization of health services. To examine the importance of this point, we excluded females 20-45 years old and re-estimated the models. No change in the qualitative results occurred. Moreover, the questionnaire did not distinguish between visits related to one's own disease and visits related to other people's (for instance own children's) disease. If it is more common to accompany someone to a private specialist than to a hospital outpatient department, this could contribute to an explanation of why a person's health has no impact on the use of private specialists. However, we find this potential difference as unlikely and are not aware of any empirical studies that shed light on the phenomenon.

The health assessment is carried out at the time a person is interviewed, while the registration of medical care use relates to the twelve months preceding the interview. Hence, a person in good health now may previously have had poor health and recovered after treatment. This indicates an insignificant relationship between health status and use of specialist care, according to the sequence of data registration. We cannot rule out that our missing relationship between health and utilization in the private sector is caused by a higher probability of gaining health in the private sector compared with the public sector. We therefore need data that also show self-assessed health prior to the use of health services. A closer study of this question requires panel data where health assessment and health care utilization are registered at certain intervals. Panel data will be available from the Norwegian Survey of Living Conditions and used in future studies. With the experience of the present exploratory study, we are also aiming at a more careful modeling of the interaction between the demand for specialist care and the private and public sector supply.

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Appendix: Measuring accessibility

Norwegian health policy aims at providing equal access to health care, independent of economic status or geographical location. As a part of this project of examining variations in the utilization of specialist health care, we needed a measure of the perceived access to specialized health care. The perceived access to health care was estimated at the municipality level. As indicators of health service provision we used the number of effective beds available in hospitals, the number of physician man-years in hospitals, and the number of man-years of privately practicing specialists in an office setting. Since the perceived accessibility is estimated according to the number of beds and man-years, the index is intended to capture the capacity and not the actual need in the population.

An indicator of access to specialist health care at municipality level should contain both a measure of the capacity in the municipality in question, and a measure of the supply in nearby municipalities, and the travelling distance to health care. Wilson (1974) described a spatial interaction model in developing a measure of the perceived accessibility: $T_{ij} = gP_iS_j f\left(c_{ij}\right)$, where T_{ij} is the number of health care interactions between residential zone i and destination j. P_i measures the effective population in zone i and S_j measures the attractiveness of destination j. c_{ij} is a measure of the distance between residential zone i and destination j. $f\left(\cdot\right)$ is a distance decay function and g is a gravitational constant. Our estimation of the perceived accessibility index is based on Wilson (1974).

In order to estimate the perceived accessibility of specialized health care for each municipality (j ; $j = 1, 2, ..., 435.$), we first needed to calculate the size of the capacity in each municipality. The health care supplied in Norwegian hospitals can roughly be divided in three: supply at county level, supply at regional level and supply at national level. $S_j^{(1)}$ is the supply of health care at the county level estimated for each municipality (j , $j = 1, 2, ..., 435.$). $S_j^{(2)}$ is a measure of the supply at the health region level, estimated for each municipality (j). Finally, $S_j^{(3)}$ measures the supply at the national level estimated for every municipality j in Norway. Since we were interested in the relative size of the estimated supply, the capacity measure had to take into account the related population size. Therefor, we divided $S_j^{(1)}$ by P_k, the population in county k , $S_j^{(2)}$ by P_r, the population in region r , and $S_j^{(3)}$ by P , the total population in Norway, and obtained the estimated ratio "supply per head".

A distance measure was also needed when modeling the attractiveness of health care. InfoMap Norge AS calculated the distance (c_{ij}) between residential zone i and destination j , measured as travel time by car. $f\left(c_{ij}\right)$ expresses the effect of distance on access. The first order derivative is assumed to be negative $f'\left(c_{ij}\right) < 0$, and the second order derivative is positive: $f''\left(c_{ij}\right) > 0$. We found it troublesome to choose the decay function $f\left(\cdot\right)$. Haggett et al. (1977) describe among others the possible functional form: $f\left(c\right) = e^{-\beta c^{\alpha}}$, where c is the estimated distance, and α and β are parameters to be estimated. With high values of β we will obtain high elasticity with respect to distance, while low values of β will give higher weights to longer distances. The chosen values of the two parameters are $\alpha = 0$ and $\beta = 0.2$, and equal to the assumptions in Carr-Hill et al. (1994). We assume $f\left(c_{ij}\right) = e^{-0,2c_{ij}}$, where $\frac{\partial f\left(d_{ij}\right)}{\partial d_{ij}} = -0,2e^{-0,2d_{ij}} < 0$ and $\frac{\partial^2 f\left(d_{ij}\right)}{\partial d_{ij}} = 0,04e^{-0,2d_{ij}} > 0$.

The joint accessibility A_{ikr} for the residents in municipality i in county k in region r can be expressed as:

$$A_{ikr} = c\left[\frac{1}{P_k}\sum_{j=1}^{n_k} S_j^{(1)}\ f\left(d_{ij}\right) + \frac{1}{P_r}\sum_{j=1}^{n_r} S_j^{(2)} f\left(d_{ij}\right) + \frac{1}{P}\sum_{j=1}^{435} S_j^{(3)} f\left(d_{ij}\right)\right].$$

As the workingpaper by Kopperud (2002) shows, the goal of equal access to health care is still not reached. The accessibility index shows access to health care is superior in high population density areas.

The index is standardized with mean 0 and standard deviation 1, and is interpreted as the number of standard deviations from the mean. Comparing the perceived accessibility measured as physician man-years in hospitals, we find that the cities of Oslo, Tromsø and Trondheim are the three municipalities with the best-perceived accessibility. Compared with the average municipality, Oslo has 2.9 standard deviations better access to specialized care. The population density is 1192.5 persons per km^2 in Oslo. The estimated accessibility is 2.6 for Tromsø and 2.5 for Trondheim. The index ranges from the capital Oslo, with the best-perceived access to hospital care, to Loppa, a municipality far north in Finnmark County where the population density is only 2.1 persons per km^2. Loppa has a perceived access to hospital care that is 2.7 standard deviations lower than the average accessibility in Norway. The perceived access to specialized care in hospitals, measured as the number of hospital beds, is best for Trondheim, Skien and Førde. The index is respectively 2.1, 2.0 and 1.9. Again, Loppa is the municipality with the lowest perceived accessibility. The estimated accessibility in Loppa is 2.8 standard deviations lower than the average accessibility. The third accessibility index measures access to private specialist care in an office setting. Oslo obtained the best-perceived access to private specialized health care. The estimated accessibility is 6.3 standard deviations higher than the average accessibility. The estimated accessibility for both Tønsberg and Bærum is 2.1. The worst perceived access to specialized health care is again estimated for a municipality in Finnmark County, this time Hasvik. The estimated accessibility in Hasvik, with a population density at 2.2 persons per km^2, is 1.5 standard deviations lower than the average municipality accessibility.