Working Paper No. 09/07

Long Term Care and Hospital Length of Stay for Elderly Patients

by

Tor Helge Holmås
Egil Kjerstad
Frode Kristiansen
Hilde Lurås

SNF-prosjekt nr. 2718
Eldre sykehuspasienter og det kommunale pleie- og omsorgstilbudet

Prosjektet er finansiert av Norges forskningsråd

SAMFUNNS- OG NÆRINGSLIVSFORSKNING AS
BERGEN, April 2007
ISSN 1503-2140

Long Term Care and Hospital Length of Stay for Elderly Patients

Tor Helge Holmås[*]

Egil Kjerstad[**]

Frode Kristiansen[***]

Hilde Lurås[****]

Abstract

The proportion of elderly people in the population is increasing and old patients' bed occupancy rate in hospitals increases as a fraction of total bed occupancy. Because old patients, on average, are frailer than other age groups their length of stay (LOS) at hospitals is longer than average. In this paper we ask whether or not frailty and the need of more comprehensive hospital treatment are the only explanation behind a comparatively long LOS for elderly patients. Of particular interest is the fact that within health care for the elderly there may be conflicting interests between providers of hospital care and providers of long term care services. We study whether or not the organisation and use of resources at hospital level influence LOS for the elderly, but also whether or not resources spent by providers of long term care services are of significance. In accordance, we question whether or not formal contracts and certain coordination arrangements between hospitals and providers of care services matter for LOS. We conclude that hospital LOS for elderly patients strongly depends on the interaction with the long term care services and the organisation and resources utilized in this sector. The results point to the importance of seeing the organising and financing of hospitals and long term care in connection. We suggest that providers of hospital care and long term care are given stronger incentives to cooperate and coordinate their supply of services towards elderly patients than what is the case at present.

Keywords: length of stay, hospital care, long term care services, incentives
JEL classification: I11, I18

[*] Institute for Research in Economics and Business Administration (SNF) and Health Economics Bergen (HEB).
[**] Corresponding author, egil.kjerstad@snf.no, Institute for Research in Economics and Business Administration (SNF) and Health Economics Bergen (HEB).
[***] Institute for Research in Economics and Business Administration (SNF) and Health Economics Bergen (HEB).
[****] Helse Øst Health Services Research Centre, Akershus University Hospital, Lørenskog.

1. Introduction

The proportion of elderly people in the population is increasing. According to projections, the number of persons aged 67 and above will double in Norway in the next 50 years (Statistics Norway 2003). Corresponding development is prevailing in the rest of Europe and the USA (see, for instance, Reinhardt 2000 and Marshall et al., 2004). The growth rate of the elderly in the population implies that old patients' bed occupancy rate in hospitals increases as a fraction of total bed occupancy, and because old patients are on average frailer than other age groups and their length of stay (LOS) at hospitals are longer than average (Reiley and Howard 1995). Millard et al. (1998) have shown that hospital expenditures are greatly affected by patients who stay at the hospitals for a long period of time. Based on more recent UK data, Marshall et al. (2004) confirm the findings of Millard et al. (1998), and they conclude that elderly patients with long LOSs that are transferred to nursing home facilities spend a considerably longer period of time in hospitals than patients who are discharged to their home. According to Gertler (1992) bed blocking in hospitals, i.e., unnecessary postponement of discharge dates, may follow an inadequate number of long term care facilities. They conclude that hospital resources are used as a buffer for a general lack of long term care resources. Hence, a reduction in hospital LOS for the elderly is a complex issue that most likely also influences the long term care sector.

In Norway, the organisation of primary health care and long term care services (both institutional care and home based care) is the responsibility of the municipalities, which is the lowest governmental level, while providing hospital services is the responsibility of the state. So when an old patient is hospitalised and when he or she leaves the hospital, the medical and long term care responsibility is carried over to another governmental level. Norwegian health authorities are aware of the potential countervailing incentives between hospitals and the home municipalities to elderly inpatients. The authorities recognize that a smooth transfer of patients requires coordination and cooperation between hospitals and long term care services, and that the capacity and organisation of the long term care services influences hospitals activity and vice versa. According to administrative regulations, hospitals in Norway are expected to have a coordinating unit for transfers between hospitals and long term care services (HOD 2001). In accordance, hospitals are allowed to impose daily fines to local health authorities (municipalities) that cannot provide adequate nursing within 10 days after the discharge date set by the hospital (HOD 1998). This type of regulation has contributed to

the formalisation of contracts between hospitals and long term care providers of when and where elderly patients should be discharged from the hospital.

In a cross-national study on hospital LOS for selected pathologies Wiley et al. (1999) found substantial unexplained variation in LOS, and they suggest that future research in this field, in addition to standardising for case-mix, should include potentially influential factors like health system characteristics (see also Lee et al., 2001). In the current study, we standardize for case mix and explore additional factors - like variations in local health system characteristics and resources both at municipality and hospital levels - that may influence length of stay (LOS) at hospitals for the elderly (Lee et al., 2001). Our study is based on a Norwegian data sample including 207,478 observations of patients aged 80 and above within a selected diagnosis. According to our analysis, factors at the municipality level have a strong influence on hospital LOS. For example, patients that are transferred to a nursing home have considerably longer LOS than others. We also find a strong positive effect if there is a hospital located in the patient's home municipality or if the patient comes from an urban municipality. As expected, we find that more resources at hospitals and cooperation between hospitals and municipalities reduce LOS.

The rest of this paper is organized as follows: section 2 gives institutional background and comments on trends in health care for the elderly in Norway. In section 3 the data sources are presented and the sample of elderly patients used in the econometric study is discussed. The findings of the study are presented in section 4. Implications for policy and concluding remarks are gathered in section 5.

2. The organisation of hospitals and long term care services in Norway

LOS is an important component of hospitals costs. Given a prospective remuneration system like the one in Norway (see, for instance, Hagen and Kaarbøe (2004) and Kjerstad (2003)), the risk of bed blocking is not only a risk of high costs but also foregone additional net earnings. After the introduction of the Diagnosis Related Group (DRG) based payment system in 1997 there has been a considerable reduction in LOS for all patients in Norway. This development is as expected, given the incentives to curb costs and increase bed turn-over as such a remuneration system gives rise to. Looking at the trend in LOS for elderly patients, it is important to notice that the organisation of primary health care and long term care is the responsibility of the 433 municipalities, which is the lowest governmental level. The

municipalities are responsible for financing long term care services, while primary health care is partly financed by the municipalities and partly by the state (via the national insurance system). Nursing home capacity measured as beds per citizen of age 80 and above is higher in rural than in central municipalities. The trend in nursing home capacity is a slow decay in cities and other urban areas, contrasted by steady growth in rural communities (figure A in the appendix). Regardless of the municipalities' locations, rising levels of home care service (measured as home based care receivers per citizen age 80 and above) is evident (figure B in the appendix).

Figure 1 illustrates how mean LOS for patients older than 80 has developed over this time period. We distinguish between patients living in municipalities categorised as City, Urban, or Rural, and notice that the overall picture is a decline in LOS. However, the most interesting result from figure 1 is the differences in LOS between patients from municipalities of different levels of centrality. It is possible that some of the differences in LOS can be explained by differences in patient characteristics, thus illustrating the importance of correcting for case-mix in the analysis. Another explanation is that the more central municipalities have a less adequate supply of long term care services.

(Figure 1 about here)

3. Data

The data set was established by merging patient, hospital, and municipality data from four different data sources for the period 1999 to 2004[1] (table A in appendix). Hospital stays data are supplied by the Norwegian Patient Register (NPR). From these individual level records we include patients' length of stay (LOS), and patient characteristics such as age (Age), gender (Male), and main diagnoses. Variables indicating the patients' crave for hospital resources (DRG-weight), their number of co-morbidities (Co-morbid), and whether or not the admission was planned (Plan_adm) are also taken from NPR.

Ideally, we should have included variables accounting for the patient's functional status before and after the admission to the hospital, but this kind of data are not available. To get an indication on whether discharged patients are in need for long term care services or not, we

[1] We are not able to follow patients from one year to the next. On the patient level, our sample consists of cross sectional data for the period 1999 to 2004.

apply information describing the patient's place of residence before and after hospitalization. Hence, we construct two variables: a dummy variable that equals one if patients are admitted from an institution (From_inst), and a dummy variable that equals one if the patients are admitted from home and discharged to an institution after hospitalisation (Home_inst). We expect that patients admitted from an institution (nursing home) will, ceteris paribus, have shorter LOS since these patients already have a bed available at a nursing home. In line with Marshall et al. (2004) we expect patients admitted from home and discharged to an institution will have longer LOS than other patients. Unfortunately, we have no information on whether a patient receives home based care or not after discharge from the hospital.

Data describing the municipalities' long term care services are from Statistics Norway. We include variables on the number of nursing home beds (Nurs_home), the number of short term nursing home beds (Short_stay), and the number of institutional care receivers (Home_care) relative to the number of the population aged 80 and above in each municipality. These variables give an indication of resources spent on long term care at the municipality level, but are not indicators of capacity in relation to the need for services in the population. We also include indicators of the centrality[2] of the patient's home municipality (City, Urban, and Rural) and whether or not there is a hospital in the municipality (Hospital_loc). As other unobserved factors in the largest cities are expected to influence LOS, we include dummy variables for the four largest cities (Oslo, Bergen, Trondheim, and Stavanger). By 2004, 13% of the population in Norway lived in the 202 rural municipalities of average population size 3,060. Thirty-two percent lived in 127 urban area municipalities of an average population of 11,732 and 54% lived in 104 city municipalities with a mean of 24,021 inhabitants.

Data on hospital characteristics are taken from the Samdata register (SINTEF Health Services Research). We use three variables: the number of doctors per bed (Doctors_bed), the number of nurses per bed (Nurses_bed), and a variable indicating the hospital's outpatient activity in relation to total hospital activity (Outpatient).

[2] The centrality indicator is developed by Statistics Norway and captures the size of the population, population density, and the distance to the nearest city of a certain size.

We have also included two variables indicating the nature of cooperation between the hospital and the municipalities in the catchments area, respectively, whether or not the hospital has a formal contract with the municipalities (Contract) and whether or not there is a dedicated hospital coordinator assigned to co-operate with the municipalities care units (Coordinator). These variables are from a bi-annual survey of Norwegian hospitals[3].

In addition to variables from these four data sources we have applied a matrix of distances between all 434 Norwegian municipalities. This variable (Dist_hospital) measures the distance from a patient's home municipality to the admitted hospital.

The data set is limited to 15 of the most frequent diagnoses among inpatients of age 80 and above. These diagnoses are also among the more severe in terms of relative long average LOS and high DRG weight (see table B in the appendix). In the years 1999 to 2004, admissions related to these diagnoses amounted to 327,363, which is 49.1% of all stays for inpatients within this age group. We exclude patients who die at the hospital, and, together with missing hospital survey observations, this limits our dataset to a total of 207,478 valid observations.

In the analysis we split this sample into two sub-samples. The first sub-sample consists of two types of patients; patients who are admitted from and discharged to an institution and patients who are admitted from their ordinary home and discharged to their ordinary home. Only 5.6% of the total sample is patients admitted from another institution (From_inst). These patients are most likely in need of further care, but we expect that they are already cared for as nursing home residents, and they should not represent a challenge in the discharge process. The largest group of patients are admitted from their ordinary home and discharged to their ordinary home. Some of these patients will receive home care, but this is not observable in our data. We also expect that the municipality home based services are more flexible, in the sense that capacity is not limited to a fixed number of beds, as in nursing home care. Home based services are more easily distributed to a larger number of receivers. Potential bed blockers are thus more likely to be found in our second sub sample, i.e., the sample consisting

[3] The hospital survey was performed in the years 1999, 2001, and 2003. For the missing year we assigned the values of the previous year's observations.

of patients that are admitted from their home and discharged to an institution after hospitalisation.

Table 1 presents descriptive statistics for the data used in the analysis. In column one the total sample statistics are presented, column two presents the subset of patients that experience a change of residence after being discharged, while column three includes patients with unaltered residence conditions after hospitalisation. As can be seen from table 1, patients transferred to an institution after hospitalisation, on average, stay 12.8 days in hospital, while the other patients stay 8.1 days. Their mean age, DRG-weight, and number of co-morbidities are also higher, which is in accordance with the hypothesis that they are frailer and have a lower functional status than patients discharged from the hospital directly to their home. Among the patients transferred to an institution we also find a lower proportion of planned admissions and a higher proportion of weekend admissions.

(Table 1 about here)

4. Econometric analysis and results

Because we are not able to follow individuals over time, our dataset is cross-sectional where each individual observation belongs to a municipality, a hospital, and a year. The outcomes within each municipality, each hospital, and each year are likely to be correlated. To correct for this we estimate the following fixed effect model:

$$\ln Y_{imht} = \alpha + \beta_1 X_{imht} + \beta_2 X_{mt} + \beta_3 X_{ht} + \gamma_m + \eta_h + \mu_t + \varepsilon_{ihmt}$$

Here, Y_{imht} is the log of the length of stay for individual i at time t. X_{imht}, X_{mt} and X_{ht} are explanatory variables at the individual level, the municipality level, and the hospital level, respectively, while β_1, β_2, and β_3 are the corresponding vectors of estimated coefficients. The unobserved cluster effects are η_h, γ_m, and μ_t, while ε_{ihmt} is an error term. We estimate models with a hospital fixed effect, γ_m, and to control for γ_m (the municipality effect) and μ_t (the time effect) we include municipality and time dummies in the regressions. The

analysis is performed both on the total sample, the sample "from home to institution", and the sample consisting of patients with unaltered residence conditions.[4]

The results from our analysis are presented in table 2. Starting out with the municipality specific variables, we first notice that resources spent on long term care services (Nurs_home, Home_care, and Short_stay) have only small or non-significant effects on LOS. These results are surprising and we do not believe that they should be interpreted as if municipalities have no influence on hospital LOS. On the contrary, most of our other results point in the opposite direction. For example, patients admitted to the hospital from home and discharged to an institution (Home_inst) have *longer* LOS. This effect is quite dramatic: compared to patients discharged to their home, these patients stay approximately 25% longer at hospitals. It seems that long term care services, already under pressure, cope badly when "unplanned" admissions to nursing homes occur. Next, patients admitted to the hospital from a nursing home (From_inst) have *shorter* LOS compared to patients admitted from home. This effect is also reasonable given that patients in this category already are admitted to a nursing home.

(Table 2 about here)

Another interesting result is that patients living in municipalities in which there is a hospital (Hospital_loc) stay longer at the hospital compared to patients from municipalities with no hospital. Municipalities in which there is a hospital seem to be able to exploit the hospital as a "care buffer" and the result may also reflect the municipalities' reliance on the nursing qualifications available at hospitals rather than acquiring adequate skills on their own. Municipalities without a hospital are probably better prepared to take care of their elderly patients both in terms of coverage (flexibility) and the 'portfolio' of nursing skills. The care providers in such municipalities probably feel a strong pressure (from patients, relatives, hospitals, and professional ethics) to find adequate care. As one would expect, the effect of this variable is stronger for patients transferred to a nursing home (sample 2) compared to patients discharged to home (sample 3).

[4] We have also split the sample into emergency patients and planned admissions, keeping the sample distinctions as above. Either way, we find that the estimates are well aligned. The sign of the important variables capturing coordination and cooperation between levels of government; the resource variables and patient specific variables, e.g., whether there is a hospital located in the home municipality or not, are the same compared to the using an identifying variable indicating whether a patient is a planned admission or not. For ease of representation, we have chosen the latter approach

Patients living in cities (City) do stay longer at hospitals compared to patients living in rural areas. (Patients belonging to other urban municipalities (Urban) than cities do not have a significantly longer LOS compared to rural communities, though). Oslo and Trondheim have substantially longer LOS, approximately ten and seven percent, compared to rural municipalities. It is fair to conclude that there is a city effect on LOS probably reflecting both differences in coverage and organisational flexibility compared to rural communities. Notice, however, these effects are only prevalent for patients discharged to an institution, not for patients discharged from the hospital to their home. These results fit the general impression from the discussion of figure 1 in section 2.

Of the hospital specific variables, the indicator of cooperation (Contract) is not significant, but the indicator of coordination (Co-ordinator) is for the "from home to institution" sample. The reason for the first result may be the way the regulatory scheme is designed. As mentioned above, central health authorities have introduced a scheme that makes it possible for hospitals to fine local authorities if adequate long term care services are not delivered in time. The aim is to motivate long term care providers to facilitate early transfer to nursing homes for patients that need such care after hospitalisation or to provide home care services quickly. The scheme is based on the discharge date that hospitals decide, but the daily fines do not start adding up before an additional ten days have elapsed. We believe this fact dilutes the incentives to respond quickly and for this reason LOS is not significantly shorter in municipalities with contracts compared to municipalities without contracts. The latter result is also interesting. Patients admitted from home and discharged to a nursing home is here interpreted as constituting a demand shock on the long term care services in general and nursing homes in particular. Having a co-ordinating unit at hospital level to facilitate transfer to another institution pays of in terms of reduced LOS (approximately 8%) compared to hospitals without such services. It is also worth noting that that the co-ordinator variable is non-significant for the sample of patients that are discharged home: coordinating effort is not as required as with patients in need of nursing home care.

Based on these results, we think that the lack of economic and statistical significance of the resource variables (Nurs_home, Home_care, and Short_stay) might be interpreted as a confirmation of excess demand for long term care in Norwegian municipalities. Nursing home coverage, as the two other resource variables, gives an indication of resources spent at municipality level relative to the population 80 years and above and is not an indicator of

capacity in relation to the need for services in the population. Hence, changes in resources have a limited effect on bed blocking given the magnitude of the excess demand. Notice that there is a stronger negative effect on LOS of an increase in nursing home coverage (Nurs_home) for the "from home to institution" sample compared to the whole sample. This seems reasonable since a higher coverage makes the long term care service better equipped to handle demand shocks.

We will not comment on all variables in table 2; just notice that resources at the hospital level reduce LOS. Doctors per bed (Doctors_bed) reduces length of stay, in particular for patients belonging to sample 2. An increase in doctors per bed by 0.1 reduces LOS by approximately 7%. An increase in nurses per bed (Nurses_bed) also contributes to lower LOS, but only for patients in sample 3.

5. Implications for policy and concluding remarks

LOS is an important component of hospital costs, and given an activity based payment system like the one in Norway, the risk of bed blocking is not only a risk of high costs but also a risk of foregone additional earnings for the hospitals. Hence, reducing LOS is an important health policy issue. In this analysis we have identified factors that influence LOS for elderly patients and we have shed light on the interdependence between hospitals and long term care service providers. Our findings have potential implications for how a policy directed towards reducing LOS and, hence, bed blocking, should be designed.

Surprisingly, we do not find strong significant effects of the coverage of long term care services on hospital length of stay (LOS). These results may follow both from low reliability and low validity: low reliability due to inadequate data from the municipalities and low validity since our variables only measures coverage, not the excess demand for services. Still, we believe our results indicate that resources and resource utilisation at the municipality level influence LOS. Having controlled for case-mix, we find that patients transferred from a hospital to an institution stay much longer at the hospital than other patients. Further, municipality specific covariates, such as distance to nearest hospital, whether or not there is a hospital in the municipality, the large city dummies, and the city dummy, are highly significant and have much stronger effect on LOS for the sample of patients that are discharged to institutions compared to the other sub sample. Hence, it seems that regardless

of resource use, municipalities in different degrees are prepared to meet the needs of an elderly patient after hospitalisation. In general, it seems that rural municipalities far from a hospital have more medical and care skills and expertise and are better prepared to take over the responsibility for the elderly after hospitalisation.

In light of this finding one important health policy question is how a health policy directed against the municipalities should be designed. One major challenge is that municipalities are not internalising the cost of unnecessary hospitalisation while they are internalising the benefits of access to a 'portfolio' of nursing skills and flexible bed capacity at hospitals. Priorities regarding capacity in the long term care sector, conversely, are based on decisions made by local health authorities in the municipalities, not the hospitals that serve these municipalities. Hence, within healthcare for the elderly there may be conflicting interests between providers of hospital care and providers of long term care services.

To contribute to a smooth transfer of patients between hospitals and municipalities, Norwegian health authorities have introduced different administrative regulations. In the analysis we find that hospitals that have followed the request of having a coordinating unit for transfers have shorter LOS than hospitals without such coordinating efforts. The other policy instrument directed against cooperation and coordination is the possibility for hospitals to fine local authorities if adequate long term care services are not delivered on time. Our analysis indicates that existing contracts between hospitals and municipalities probably are too weak in terms of giving the municipalities incentives to contribute to lower LOS. When it is possible to extend stays up to ten days after the hospital finds the patient fit for being discharged, the municipality interprets the period before the daily fine starts to run as a waiting period in the hospital. Hence, incentives should be made stronger. Obviously, the hospitals must also commit to a sufficient coordinating effort when discharge time approaches. Otherwise, hospitals might set the discharge date too early for the long term care services to find adequate care alternatives in time.

The literature on integrated care points to different ways of organising health care for frail patients with comprehensive needs (Paulus et al., 2000; Hudson, 2002; Kodner et al., 2000; 2002; Burns et al., 2002). Analyses show that such programs contribute to better functional ability and more well-being for patients, lower total costs for providers organising the program, and also that patients included in such programs are enabled to stay in their own

homes with less home care (Sheppherd et al., 1998; Wilson et al., 1999; Leff et al., 2005; Coast, 1998). In the next turn this effect will contribute to a reduced pressure on the long term care service providers. The current analysis shows that the organisation and resource use in the long term care sector influence hospital LOS and this indicates a potential for further cooperation between the two government levels. This finding points in the direction of organising medical and care services for frail patients in new ways in Norway. But because integrated models require coordination between two government levels with separate organisation and financial models, barriers against new ways of organising medical and care services for frail patient groups exist. It follows that the Norwegian health authorities should have a particular focus on how integrated models can be implemented given the prevailing financial and organisational models.

The issues addressed in this study are important. The interdependence between different providers of health care and long term care services for the elderly is present in many countries. The way long term care services are financed and organised are linked to hospital costs and the cost of hospital care is a major concern for most health authorities. It has not been the purpose of this study to quantify the cost increment due to differences in long term care service coverage and lack of coordination and cooperation between providers, but that issue raises interesting problems for future research. Due to lack of reliable data we have not managed to study the effect of quality differences in care or the consequences for length of stay at both hospital and community long term care facilities. This is a natural next step in the study of interdependence between hospitals and long term care service providers.

References

Burns, L.B. and Pauly M., 2002, Integrated Delivery Networks: A Detour On the Road to Integrated Health Care?, Business of health, July/August 2002, 128-143.

Coast, J., 1998, Hospital at Home or Acute Hospital Care? A Cost Minimisation Analysis, BMJ, 318: 1802-1806.

Gertler, P.J. ,1992, Medicaid and the Cost of Improving Access to Nursing Home Care, The Review of Economics and Statistics, Vol. 74, No.2 (May), 338-345.

Hagen T.P., O.M. Kaarbøe, 2004, The Norwegian Hospital reform of 2002: Central government takes over ownership of public hospitals, Working paper 2004:1, Health Organization Research Norway, University of Oslo.

Helse og omsorgsdepartementet (HOD), 1998, Forskrift om kommunal betaling for utskrivningsklare pasienter (in Norwegian).

Helse og omsorgsdepartementet (HOD), 2001, Forskrift om habilitering og rehabilitering (in Norwegian).

Hudson, B., 2002, Integrated Care and Structural Change in England: The Case of Care Trusts, Policy Studies, Vol. 23, No 2: 77 – 95.

Kjerstad, E., 2003, Prospective Funding of General Hospitals in Norway – Incentives for Higher Production?, International Journal of Health Care Finance and Economics, Vol. 3 (2003), 231-251.

Kodner, D.L. et al., 2000, Fully integrated care for frail elderly: Two American models, International Journal of Integrated Care, 1 Nov.

Lee, A.H. et al., 2001, Determining the Effects of Patient Case mix on length of Hospital Stay: A proportional Hazards Frailty Model Approach, Method Inform Med 2001; 40: 288-92.

Leff, B. et al., 2005, Hospital at Home. Feasibility and outcomes of a programme to provide hospital care at home for acutely ill older patients, Annals of Internal medicine, 143:798-808.

Marshall, A.H., S.I. McClean and P.H. Millard, 2004, Addressing Bed Costs for the Elderly: A New Methodology for Modelling Patients Outcomes and Length of Stay, Health Care Management Science 7, 27-33.

Millard, P.H., G. Christodoulou and S.I. McClean, 1993, Survival in long term care – Discussion document on the interactions and costs between health and social care, submitted to the Royal Commission on Long Term Care, Department of Geriatric Medicine, St. Georges's Medical School, London, 1-30.

Paulus, A. et al., 2000, Integrated health care from an economic point of view, Journal of Economic Studies, 27, 3: 200-209.

Reinhardt, U.W., 2000, Health Care for the Aging Baby Boom: Lessons from Abroad, Journal of Economic Perspective, Volume 14, Number 2, Spring, 71-83.

Reiley, P. and E. Howard (1995), Predicting hospital length of stay in elderly patients with congestive heart failure, Nursing Economics 13(4): 210-6.

SAMDATA Somatikk, 2005. Sammenligningsdata for den somatiske spesialisthelsetjenesten 2004. SINTEF Health Services Research, Trondheim. (In Norwegian).

Sheppherd et al., 1998, Randomised controlled trial comparing hospital at home care with inpatient hospital care. I: Three months follow up of health outcomes, BMJ, 316:1786-1791.

Statistics Norway/Statistisk sentralbyrå, 2003, Framskriving av folkemengden 1999-2050, Nasjonale og regionale tall, *NOS* C 693.

Wiley, M.M., R.Tomas and M. Casas, 1999, A cross-national, case mix analysis of hospital length of stay for selected pathologies, European Journal of Public Health, Volume 9, Number 2, 82-92.

Wilson et al., 1999, Randomised controlled trial of effectiveness of Leicester hospital at home scheme compared with hospital care, BMJ, 319:1542-1546.

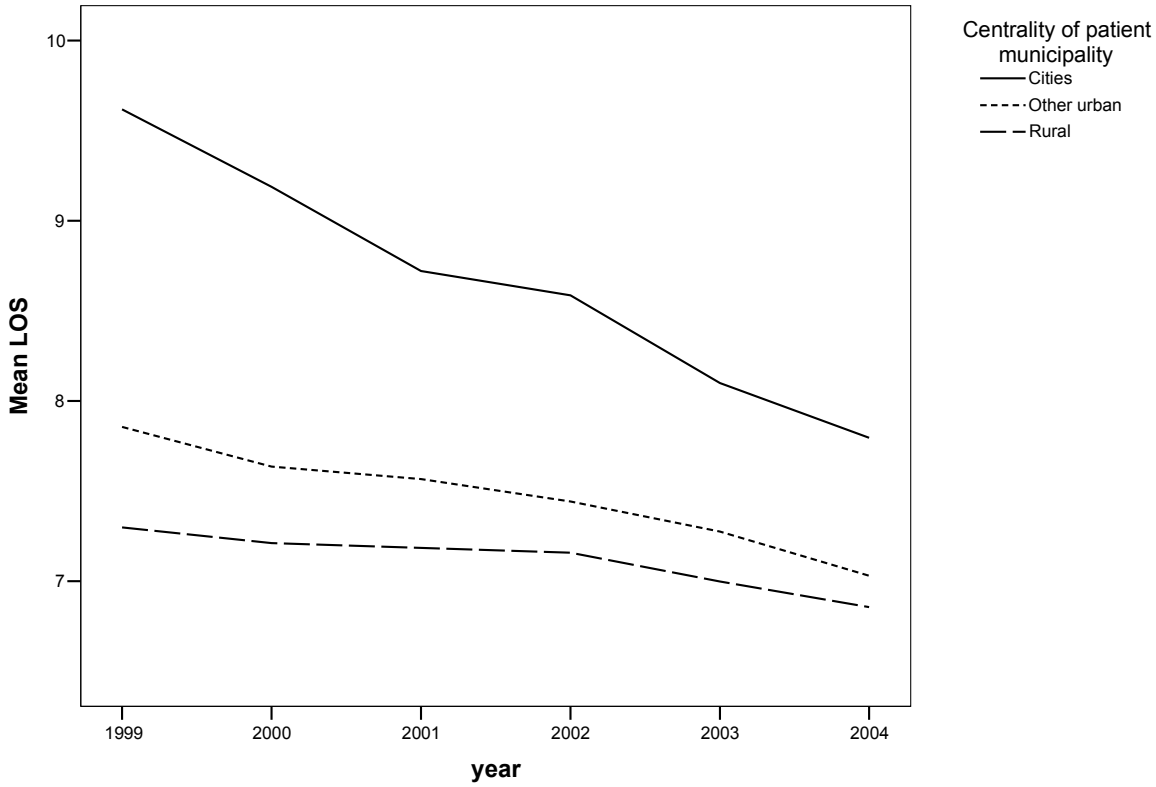

Figure 1. Mean LOS for all inpatients aged 80 years and above, by municipality category and year.

Table 1. Descriptive statistics.

	Full sample (1)	From home to institution after hospitalisation (2)	Unaltered residence conditions after hospitalisation (3)
	Mean (stdev)	Mean (stdev)	Mean (stdev)
Patient specific variables			
LOS	9.15 (10.47)	12.80 (13.16)	8.08 (9.28
Age	85.09 (4.10)	85.86 (4.35)	84.86 (3.99)
Male	0.41 (0.49)	0.33 (0.47)	0.43 (0.50)
Co-morbid	3.11 (1.72)	3.40 (1.86)	3.03 (1.67)
DRG-weight	1.44 (0.88)	1.83 (0.99)	1.33 (0.81)
Weekend	0.35 (0.48)	0.37 (0.48)	0.35 (0.48)
Plan_adm	0.15 (0.35)	0.13 (0.34)	0.15 (0.36)
From_inst	0.06 (0.23)	0.00 (0.00)	0.07 (0.26)
Home_inst	0.23 (0.42)	1.00 (0.00)	0.00 (0.00)
Dist_hospital	30.52 (82.06)	30.46 (75.13)	30.53 (83.98)
Municipality specific variables			
Nurse_home	18.11 (4.15)	18.22 (4.23)	18.07 (4.13)
Home_care	23.81 (6.16)	23.69 (6.29)	23.84 (6.13)
Short_stay	2.73 (1.46)	2.78 (1.53)	2.71 (1.44)
Hospital_loc	0.54 (0.50)	0.53 (0.50)	0.54 (0.50)
Oslo	0.15 (0.35)	0.19 (0.39)	0.13 (0.34)
Bergen	0.09 (0.28)	0.05 (0.25)	0.09 (0.29)
Stavanger	0.04 (0.18)	0.03 (0.18)	0.04 (0.19)
Trondheim	0.05 (0.22)	0.04 (0.19)	0.05 (0.22)
City	0.27 (0.44)	0.27 (0.44)	0.27 (0.44)
Urban	0.30 (0.46)	0.28 (0.45)	0.30 (0.46)
Hospital specific variables			
Contract	0.75 (0.44)	0.77 (0.42)	0.74 (0.44)
Co-ordinator	0.47 (0.50)	0.50 (0.50)	0.46 (0.50)
Doctors_bed	0.55 (0.17)	0.56 (0.19)	0.55 (0.16)
Nurses_bed	1.77 (0.29)	1.78 (0.31)	1.77 (0.29)
Outpatient	0.27 (0.09)	0.27 (0.09)	0.27 (0.09)
Observations	207 441 100%	46 879 22.6%	160 562 77.4%

Table 2. Fixed effect analysis of log of hospital length of stay[a].

	Full sample (1)	From home to institution after hospitalisation (2)	Unaltered residence conditions after hospitalisation (3)
Municipality specific variables			
Nurs_home	-0.0015** (0.0006)	-0.0048** (0.0013)	-0.0004 (0.0007)
Home_care	0.0002 (0.0004)	-0.0006 (0.0009)	0.0004 (0.0004)
Short_stay	0.0005 (0.0014)	0.0028 (0.0028)	-0.0000 (0.0015)
Dist_hospital	-0.0071** (0.0027)	-0.0282** (0.0067)	-0.0040 (0.0030)
Hospitall_loc	0.0523** (0.0061)	0.0916** (0.0131)	0.0405** (0.0068)
Oslo	0.1029** (0.0245)	0.3077** (0.0456)	-0.0167 (0.0292)
Bergen	0.0159 (0.0155)	0.0721 (0.0394)	-0.0035 (0.0169)
Stavanger	-0.0261 (0.0175)	0.0584 (0.0402)	-0.0559** (0.0196)
Trondheim	0.0714** (0.0176)	0.2726** (0.0402)	0.0221 (0.0194)
City	0.0339** (0.0096)	0.1228** (0.0207)	0.0020 (0.0108)
Urban	0.0175 (0.0085)	0.0221 (0.0181)	0.0136 (0.0096)
Hospital specific variables			
Contract	0.0024 (0.0063)	0.0072 (0.0135)	-0.0007 (0.0070)
Co-ordinator	-0.0104 (0.0056)	-0.0819** (0.0134)	0.0075 (0.0061)
Doctors_bed	-0.2771** (0.0535)	-0.6997** (0.1083)	-0.1166** (0.0616)
Nurses_bed	-0.1027** (0.0207)	-0.0075 (0.0433)	-0.1345** (0.0236)
Outpatient	0.1935* (0.0991)	-0.0976 (0.2171)	0.2164** (0.1119)
Patients specific variables			
Age	-0.0027** (0.0005)	-0.0051** (0.0010)	-0.0023** (0.0005)
Male	-0.0428** (0.0039)	-0.0272** (0.0087)	-0.0460** (0.0043)
Co-morbid	0.1430** (0.0012)	0.1578** (0.0024)	0.1347** (0.0014)
DRG weight	0.2710** (0.0027)	0.2263** (0.0055)	0.2883** (0.0031)
Weekend	0.0485** (0.0039)	0.0247** (0.0083)	0.0561** (0.0044)
Plan_adm	-0.1721** (0.0067)	-0.1235** (0.0184)	-0.1796** (0.0071)
From_inst	-0.1167** (0.0083)		-0.1429** (0.0082)
Home_inst	0.2575** (0.0049)		
2000	-0.0360** (0.0069)	-0.0493** (0.0155)	-0.0350** (0.0076)
2001	-0.0972** (0.0069)	-0.0728** (0.0155)	-0.1037** (0.0077)
2002	-0.1433** (0.0071)	-0.1315** (0.0156)	-0.1441** (0.0079)
2003	-0.1835** (0.0087)	-0.2027** (0.0192)	-0.1711** (0.0097)
2004	-0.2340** (0.0089)	-0.2512** (0.0194)	-0.2238** (0.0100)
Constant term	1.7200** (0.0588)	2.4287** (0.1250)	1.6396** (0.0664)
Number of observations	207441	46879	160562
Number of hospitals	39	39	39

[a] Diagnoses dummies are included in the regressions. Results are available upon request.
**: significant on 1% level of significance. *: significant on 5% level of significance.

Appendix

Table A. Variable definitions

Patient level	
LOS	Length of stay, in days
Age	Age of patient, in years
Male	Gender indicator, male=1
Co-morbid	Co-morbidities, count across single hospital stay record.
DRG-weight	Diagnosis related group cost weight according to Norwegian DRG-system.
Weekend	Admission day indicator, Friday, Saturday or Sunday =1.
Plan_adm	Admission type indicator, planned=1.
From_inst	Before admission residence indicator, institution=1.
Home_inst	Change in residence indicator, home before and institution after stay =1.
Dist_hospital	Distance from patient's home to hospital location, in kilo meters.
Hospital level	
Outpatient	Outpatient treatments as ratio of total number of patient treatments.
Contract	Contract between hospital and municipalities indicator, presence=1.
Co-ordinator	Co-ordinator of hospital and municipalities co-operation indicator, presence=1.
Doctors_bed	Doctors per hospital bed.
Nurses_bed	Nurses per hospital bed.
Municipality level	
Nurs_home	Nursing home beds per citizen age 80 years and more, per cent.
Home_care	Home care receivers per citizens age 80 years and more, per cent.
Short_stay	Short-stay nursing home beds per citizens age 80 years and more, per cent
Hospital_loc	Hospital (all levels) in patient's home municipality indicator, presence=1
Oslo	Capitol and largest city indicator, patient's home Oslo=1.
Bergen	Second largest city indicator, patient's home Bergen=1.
Trondheim	Third largest city indicator, patient's home Trondheim =1.
Stavanger	Fourth largest city indicator, patient's home Stavanger=1.
City	Centrality of patient's home indicator, city = 1.
Urban	Centrality of patient's home indicator, other urban areas = 1

Table B. Inpatients 80 years and older. Mean LOS, DRG weight, and age. Percentage males and planned admissions. By diagnoses. Years 1999 – 2004.

	LOS days	DRG weight	Planned adm. percent	Males percent	Age years	Sum adm.	Percent of total adm.
1. Malignant neoplasms	10.25	1.57	43.34	51.37	84.24	39695	19.1
2. Pneumonia	9.73	1.49	1.61	48.90	85.71	24877	12.0
3. Fracture of femur	11.48	2.13	2.52	22.64	86.44	24299	11.7
4. Cerebrovascular diseases	12.22	1.38	3.30	38.17	85.20	20425	9.8
5. Acute and subsequent myocardial infarction	8.63	1.39	1.99	44.55	85.22	17808	8.6
6. Heart failure	7.98	1.17	3.52	40.42	85.71	17483	8.4
7. Unspecified pain. syncope and collapse	3.29	0.45	1.92	34.14	84.85	10384	5.0
8. Angina pectoris	3.63	0.68	8.09	36.75	84.85	9914	4.8
9. Atrial fibrillation and flutter	4.48	0.66	6.29	34.01	84.63	7826	3.8
10. Chronic obstructive pulmonary disease	6.92	1.00	2.82	48.12	83.75	7225	3.5
11. Arthrosis	11.42	2.98	85.51	24.28	83.41	5996	2.9
12. Infectious and parasitic diseases (excluding Septicaemia)	8.47	0.92	3.12	35.12	85.21	6290	3.0
13. Atherosclerosis	9.78	2.04	40.76	43.31	84.78	6026	2.9
14. Cholelithiasis	7.34	1.27	13.98	34.43	85.01	4621	2.2
15. Septicaemia	12.45	2.03	2.54	47.30	85.48	4609	2.2
Totalt	9.15	1.44	14.51	40.59	85.08	207478	100.0

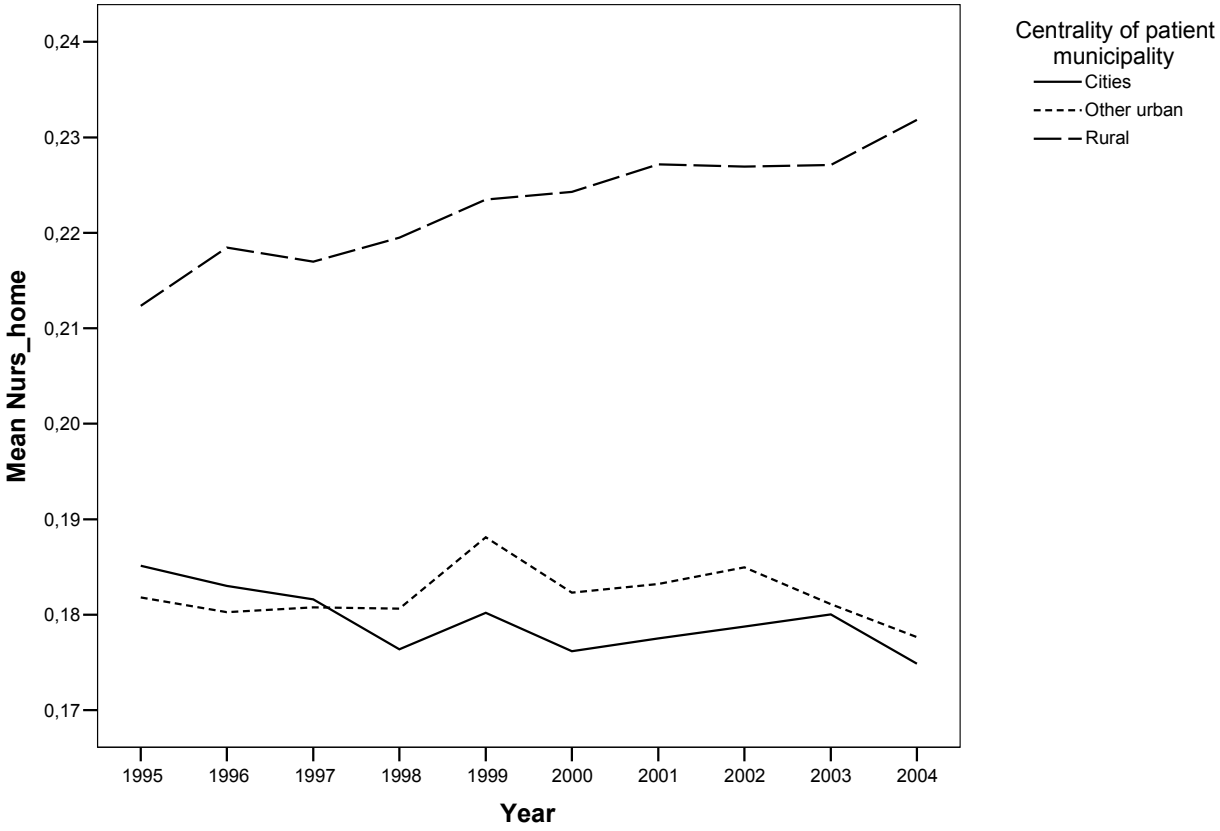

Figure A. Coverage of nursing homes, by centrality and year.

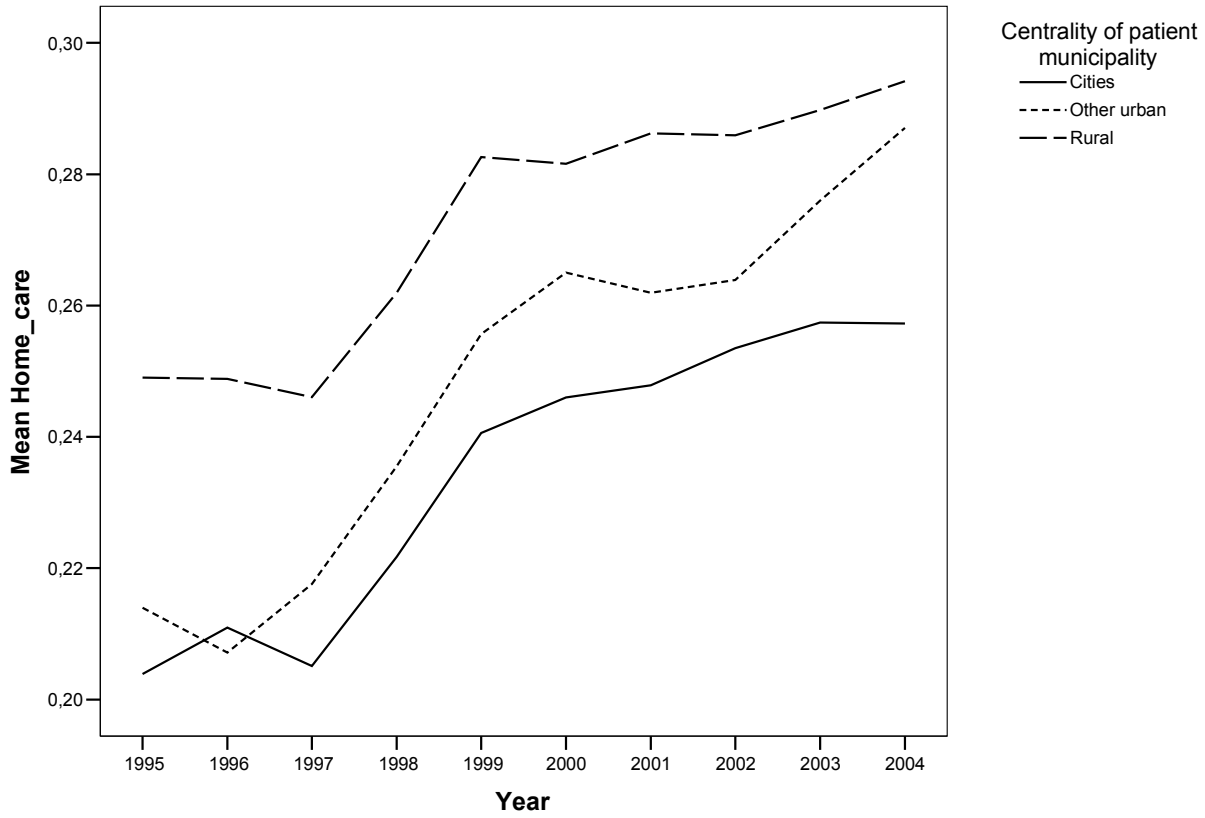

Figure B. Coverage of home care, by centrality and year.