

ORIGINAL ARTICLE

Acute hospital admissions from nursing homes: predictors of unwarranted variation?BIRGITTE GRAVERHOLT^{1,2}, TROND RIISE², GRO JAMTVEDT^{1,3}, BETTINA S. HUSEBO² & MONICA W. NORTVEDT¹¹Centre for Evidence-Based Practice, Bergen University College, Bergen, Norway, ²Department of Public Health and Primary Health Care, University of Bergen, Bergen, Norway, and ³Norwegian Knowledge Centre for the Health Services, Oslo, Norway**Abstract**

Background: The geriatric nursing home population is frail and vulnerable to sudden changes in their health condition. Very often, these incidents lead to hospitalization, in which many cases represent an unfavourable discontinuity of care. Analysis of variation in hospitalization rates among nursing homes where similar rates are expected may identify factors associated with unwarranted variation. **Objectives:** To 1) quantify the overall and diagnosis specific variation in hospitalization rates among nursing homes in a well-defined area over a two-year period, and 2) estimate the associations between the hospitalization rates and characteristics of the nursing homes. **Method:** The acute hospital admissions from 38 nursing homes to two hospitals were identified through ambulance records and linked to hospital patient journals ($n = 2451$). Overall variation in hospitalization rates for 2 consecutive years was tested using chi-square and diagnosis-specific variation using Systematic Component of Variation. Associations between rates and nursing home characteristics were tested using multiple regression and ANOVA. **Results:** Annual hospitalization rates varied significantly between 0.16 and 1.49 per nursing home. Diagnoses at discharge varied significantly between the nursing homes. The annual hospitalization rates correlated significantly with size ($r = -0.38$) and percentage short-term beds ($r = 0.41$), explaining 32% of the variation observed ($R^2 = 0.319$). No association was found for ownership status ($r = 0.05$) or location of the nursing home ($p = 0.52$). **Conclusion: A more than nine-fold variation in annual hospitalization rates among the nursing homes in one municipality suggests the presence of unwarranted variation. This finding demands for political action to improve the premises for a more uniform practice in nursing homes.**

Key Words: Health services research, homes for the aged, hospitalization, nursing homes, practice variation**Background**

Nursing homes are important arenas for delivery and receipt of primary health services, and house elderly people that are particularly vulnerable to acute incidences that require adequate care. Population-based studies show that nursing home residents are frequently admitted to hospital for acute care; however, annual rates vary greatly in the range 16%–62% [1–5]. Under the assumptions that hospitalizations of frail nursing home residents represent an unfavourable discontinuity of care [6–12] and that up to 40% of them are considered potentially avoidable, high rates of hospitalizations may represent a quality concern [13–15].

Mapping of variation in health services addresses quality and equity of care in public health issues, and a high variation indicates a need to focus on the appropriateness of the service use [16,17]. Ideally, hospital transfers from nursing homes should be relatively unaffected by factors like market and facility characteristics. Nevertheless, several studies suggest that the propensity of being hospitalized from nursing homes varies with facilities rather than clinical factors [3,18,19].

In the Nordic countries, the nursing home sector is characterized by a greater uniformity than seen in

other parts of Europe and the US. In Norway, admission criteria, funding of services and physician time are fixed factors, making this nursing home setting particularly suitable for addressing variation as a proxy quality measure. Still, three characteristics that vary between facilities are number of beds, ownership and the allotment of long-term versus short-term beds. Size and ownership of nursing home facilities have previously been linked to quality of care, where larger facilities and proprietary nursing homes have more deficiencies in quality measures [20,21]. Thus, we wanted to study the association between these factors and the acute hospital admission rates in a well-defined setting where nursing homes operate under a uniform frame of conditions. The objectives of this study were to 1) quantify overall and diagnosis specific variation in acute hospital admission rates among nursing homes, and 2) estimate the association between the hospitalization rate and the following characteristics of the nursing homes: size, the number of short term versus long-term beds, ownership status and suburban area.

Methods

We studied variation in acute hospital admission rates from all nursing homes ($n = 38$) in one municipality in Norway over a 2-year period (1 January 2007–31 December 2008). The admissions were identified through ambulance assignments from the addresses of the nursing homes. Nursing home residents often have a registered address in the National directory of residents other than that of the nursing home, and, as such, the ambulance assignments represent the most valid method of identifying hospital admissions from nursing homes. Elective hospital admissions, out-patient visits, cases involving nursing home residents < 65 years and lower levels of residential facilities were excluded. The personal identification number and date of ambulance assignment were linked to hospital patient records, where we collected main diagnosis at discharge, according to ICD-10. An aggregated data file was then set up, at the level of nursing home ($n = 38$), with variables characterizing the nursing home and the hospital admissions for each nursing home.

Study setting

The setting is a large urban-suburban municipality, Bergen, Norway, with a population of 247,746 (per 1 January 2008, Statistics Norway, Table 06913). At the time of data collection (January 2009), the 38 nursing homes offered a total of 2384 beds (range of beds 10–174). Short-term beds take up 18% of the

overall nursing home capacity, and these beds are distributed unevenly between the nursing homes, with a range from 0–100% of beds per nursing home. Short-term beds in nursing homes serve several intentions; they are used for clearing up the need for a long-term bed, for relieving family of the care burden, or in the acute course of an illness, usually admitted from hospital. The nursing homes affiliate to two local hospitals and there is geographic proximity between the hospitals and the nursing homes.

Norway has a tax-based, universal public long-term care scheme. The system is funded by national taxes but carried out at local level, and long-term care in nursing homes requires co-payments from the residents, currently 85% of their monthly pension. Norway has a relatively large proportion of elderly people receiving institutional long-term care. In the study setting the municipality offers a number of institutional beds equivalent to 22% of the population > 80 years in the given municipality, whereas 14% of the population >80 are in long-term care in institutions (Statistics Norway, table 06969). Norway encompasses a health care model designed to assure equity of availability of long-term care. Regardless of owner status, the source of finance is the municipality alone and involves a flat rate per bed. Beyond this, the autonomy of the nursing homes is high in regards to how they organize their nursing and medical care, given that legal requirements and norms are met. The local health authorities estimated the mean length of stay to be 2 years and 4 months for the included nursing homes during the study period.

Nursing home care is a civil right through the Municipal Health and Care Services Act from 2011 and is fully administered by the municipality administration. This right is however linked to several criteria, the most relevant here being that lower levels of care have proved unsuccessful for long-term care [5].

Statistical analysis

We divided the number of hospital admissions by the number of beds in the study period for each of the nursing homes, to determine the annual admission rate per bed. We used Pearson correlation to assess the consistency of the rates across the 2 years; the squared correlation coefficient indicates how much of the admission rates (nursing home level) in the second year could be explained by the rate in the previous year.

To test the overall variation in acute hospital admission rates between nursing homes, we used a chi-square test on the number of hospital admissions per bed-days. Additionally, we tested diagnosis-specific variation between the nursing homes for the six most

frequently prevalent diagnoses at discharge, aggregated at main chapter level ICD-diagnosis. To test the degree of variation for diagnoses, we used the Systematic Component of Variation (SCV). This measure of variation permits comparisons of the variability of hospitalization rates between nursing homes adjusting for varying levels of prevalence of the various diagnoses [22].

Multiple regression analysis was used to study the association between mean annual hospitalization rate as dependent variable and *size* of the nursing home, *percentage short-term beds* and *ownership status* as independent variables. Also, we did an analysis to test a possible difference in hospitalization rates between the nursing homes in the 8 suburbs of the municipality with analysis of variance (ANOVA).

Results

There were a total of 2451 acute hospital admissions from 38 nursing homes over the 2-year study period. The estimated mean age of the patients upon admission for the 38 nursing homes was 85.1 years (SD ± 2.2, range: 80.8–89.5). The overall un-weighted mean annual rate of hospital admission over the 38 nursing homes was 0.58 per nursing home bed (SD ± 0.30). The rate showed a marked and highly significant variation between the nursing homes (chi-square

test, $p < 0.0001$, $X^2 = 746.4$; 37 df) ranging from 0.16 to 1.49. The admission rates were rather consistent for each nursing home across the 2 years, with a correlation coefficient of 0.78, $p < 0.0001$ (Figure 1). When squared, this indicates that 61% ($r^2 = 0.613$) of the admissions in the second year could be predicted by the rate in the previous year.

Significant variation between nursing homes was found for all subgroups of diagnoses ($p < 0.0001$) (Table I). “Certain infectious and parasitic diseases” and “Diseases of the digestive system” showed the highest variation, while “Injury, poisoning and certain other consequences of external causes” showed the least variation (Table I).

We found significant correlations between variation in hospitalization rates and nursing home size ($r = -0.38$, $p = 0.02$) and percentage short-term beds ($r = 0.42$, $p = 0.009$, while no association was found for ownership status ($r = -0.18$, $p = 0.29$) or the estimated mean age of the admitted residents ($r = 0.06$, $p = 0.74$). No significant differences were found in hospitalization rates between the suburbs ($n = 8$) ($p = 0.52$).

In a multiple regression model size and percentage short term beds could significantly explain 32% ($R^2 = 0.319$) of the total variation in mean annual hospitalization rate with smaller nursing homes and nursing homes with a high percentage of short-term beds showing higher rates. The regression coefficient

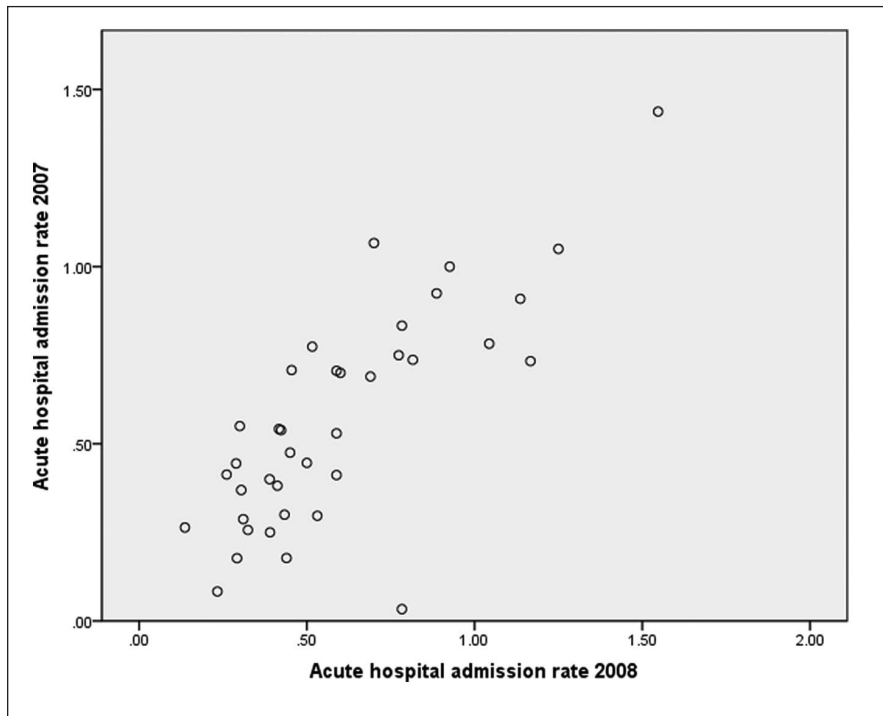


Figure 1. Mean annual admission rates (number of admissions per bed per year) for 2 consecutive years for all nursing homes in the municipality.

Table I. Variation in acute hospital admissions from nursing homes in one municipality, overall and according to most prevalent diagnoses at discharge. Nursing home is unit of analysis ($n = 38$).

Chapter of ICD-10 (ranked descending, according to number of admissions)	Elaboration on most common diagnoses in main chapter*, n (%)	Acute admissions N (%)	Annual rate, mean (SD)**	Annual rate, min-max	Coefficient of variation	Systematic component of variation (SCV)
Overall	–	2451 (100)	0.58 (\pm 0.30)	0.16–1.49	0.51	0.32
Diseases of the respiratory system (J00–J99)	Influenza, pneumonia and lower respiratory infections 381 (78)	486 (19.8)	0.12 (\pm 0.08)	0.02–0.33	0.65	0.47
Injury, poisoning and certain other consequences of external causes (S00–T98)	Falls related 345 (79), Fracture of femur 247 (57), T-diagnoses 77 (17)	437 (17.8)	0.10 (\pm 0.04)	0.04–0.20	0.45	0.10
Diseases of the circulatory system (I00–I99)	Ischemic heart disease 98 (24), Cerebrovascular disease 96 (16)	405 (16.5)	0.10 (\pm 0.06)	0.00–0.23	0.62	0.39
Diseases of the digestive system (K00–K93)	Diseases of oesophagus, stomach and duodenum 51 (21), GI bleed 41 (17), Constipation 32 (13)	243 (9.9)	0.05 (\pm 0.04)	0.00–0.21	0.82	0.52
Certain infectious and parasitic diseases (A00–B99)	Septicaemia 125 (72), Intestinal infectious diseases 26 (15)	173 (7.1)	0.04 (\pm 0.04)	0.00–0.16	0.96	0.68
Diseases of the genitourinary system (N00–N99)	Infections 100 (62), Renal failure 37 (23)	162 (6.6)	0.04 (\pm 0.03)	0.00–0.10	0.76	0.43
Aggregated level, remaining chapters	–	545 (22.2)	0.13 (\pm 0.08)	0.02–0.44	0.62	0.42

*Aggregated at block level (International Classification of Disease, ICD-10, WHO).

**Un-weighted mean and standard deviation over the 38 nursing homes.

for size in the multivariate analysis was -0.003 (95% CI: -0.06 – -0.001 , $p = 0.007$) implying that an increase of 10 beds to a nursing home follows by a risk reduction of hospitalization of 0.03 per bed. The regression coefficient for percentage of short-term beds was 0.005 (95% CI: 0.001–0.008, $p = 0.007$) implying that the risk of hospitalization for a nursing home with long-term beds only were estimated to be 0.5 lower compared to a nursing home with short-term beds only.

Discussion

We explored variation in acute hospital admission rates between all nursing homes within a perspicuous area; geographically, politically and administration-wise. Based on the homogeneity of the frame of conditions, theoretically, we would expect little variation in hospitalization rates between the nursing homes. On the contrary, we found a large and significant variation in mean annual hospital admission rates, ranging from 0.16–1.49 per bed. We also found a significant variation in the distribution of main diagnoses, studied at main level of the ICD-10. Further, we found that the size of the nursing homes and the percentage of short-term beds were characteristics of the nursing home highly predictive of hospitalization, with smaller nursing homes and nursing homes with a high percentage of short-term beds showing higher rates. No differences were found according to ownership status, or between suburbs.

The major strength of this study is the inclusion of all nursing homes in a well-defined setting over a two-year period. Examining variation in health care services warrants for population-based data of high quality. Although observational data has limitations, linked to known and unknown confounders we believe that the two-year sample forming the base of this study provides a sound foundation to discuss the variation observed in acute hospital admission rates. The fact that the nursing homes studied operate in the same health market rules out the effect of supply-sensitive variation, which is known to affect differently in various health districts [16,17,23]. Cautiousness must be shown when considering the generalizability of findings. Definitions of what constitutes a nursing home vary from one country to another. Also, great differences in how nursing home beds are financed in different nations exist. Consequently, nursing home populations in different countries may not be as similar as one might anticipate. For instance, in Norway, nursing home residents represent the very frailest of the elderly population, with clear applicant criteria applying to all nursing homes. This may not be the

case elsewhere, where recruitment may be based on applicants' financial status, which in itself will introduce differences resulting in variance in hospitalization rates. The publicly funded and unitary health care setting in Norway makes it especially suitable for research on phenomena like variation. In particular, the complex influence of private health care is not an issue concerning nursing home care in Norway significantly at current.

The main shortcoming of the study is the lack of possibility to adjust for patient characteristics, other than the estimated mean age at the hospitalized residents between the nursing homes. Our hospital-based data neither provide circumstantial information about the decision to hospitalize, nor the patients' underlying diseases and functional levels prior to hospitalization. In the study setting, however, the allocation of new residents to the various nursing homes is essentially random, based on a process with clear criteria for admission in the municipality administration. As such, we anticipate that the characteristics of the nursing home population are distributed evenly across the nursing homes studied. We found little variation in the estimated mean age of the hospitalized nursing homes residents between the nursing homes, and there was no correlation between mean age and the hospitalization rate. This is compatible with resident characteristics being randomly distributed to the nursing homes. This finding is also compatible with the interpretation that the marked and significant variation in the mean annual hospitalization rates between the nursing homes is only to a little degree explained by differences in patient characteristics. This interpretation is supported by the following; firstly, if there were differences in patient characteristics, this would be evident by overall differences at suburb level, which we found not to be the case. Secondly, this interpretation is supported by the high correlation found between the rates for each of the 2 years separately; that is, that the nursing homes producing high rates in 2007 were the same nursing homes having high rates the following year. Having in mind the high turnover of residents, this suggests that differences in professional culture and style and organizational factors between the nursing homes may be major contributors to the variation in hospitalization rate, suggestive of unwarranted variation. In fact, this is underpinned by the consistency that we found, where the studied nursing homes had similar rates across 2 years, despite a known high turnover of residents. As such, we acknowledge that the characteristics we have studied may represent proxies or markers of other characteristics closer to the problem, like composition of staffing, management and culture.

As the geriatric nursing home population is expected to have similarity in underlying chronic diseases, we anticipated that the distribution of diagnoses causing hospitalization would be similar between nursing homes, which we found not to be the case. Because the decision to hospitalize is complex and involves discretion, some degree of variation is expected [24]. Still, ideally, variation should be low and linked to patient characteristics and severity of disease rather than different professional styles at the nursing homes [16,17]. This underscores a main point in this article, namely that if clinicians are lacking support for identifying and managing acute flares, variation will occur, according to professional discretion and style, and influence on the decision to hospitalize. In this case, our findings indicate that hospitalization of nursing home residents may be arbitrary, depending on which nursing home we are looking at. This is a well-described contributor in research upon variation, and is linked to the level of professional discretion in decision-making and how this will create variation [16,17]. This is often referred to as the professional uncertainty principle and refers to situations where professional discretion largely makes up the final decision, in lack of decision support such as guidelines. To support these assumptions, our findings show that for some diagnoses, variation is less profound, such as for "Injuries [. . .]". This finding is in line with the established view that incidences of falls involve the least discretion in the decision to hospitalize. In contrast, the diagnoses involving the most variation are "Infectious diseases [. . .]", "Digestive diseases" and "Diseases of the respiratory system", indicative of there being differences in the way prevention and ongoing chronic care are being carried out.

We found a marked association between larger nursing homes and lower hospitalization rates. This finding is compatible with an advantage of larger economy of scale, resulting in a more robust and stable professional platform for larger nursing homes. For instance, the key economic variable for the nursing homes are number of beds. For smaller nursing homes, this implies that consulting visits from physicians only occur on a weekly or even fortnightly base, whereas larger nursing homes have medical staff present on a full-time basis. The consequence may be variation in the lack of readiness for acute incidences, as a result of diseconomy of scale, affecting the smaller nursing homes harder than the larger. This anticipation is based on the consistency of evidence pointing at reduced hospitalizations with better nurse staffing [25]. Such an association is likely to operate in small nursing homes, where there is generally less presence of medical staff and nurses, compared to

larger homes. Our findings are compatible with the observations in two previous studies also showing an association between smaller nursing homes and higher hospitalization rates, although their results did not reach statistical significance [26,27]. A further note on this association is that whereas our nursing homes span runs between 10 and 174 beds, with a mean of 63, the mentioned studies included a different span with a mean of 146 [27] and 179 [26] and are as such operating on a different scale.

We also found a positive association between high hospitalization rates and high percentage of short-term beds. This implies that short-term beds in nursing homes seem to generate more hospitalizations than long-term beds. Many residents are assigned a short-term bed in the course of an acute illness, often as an extension of an acute hospital stay. Our finding is therefore in line with some previous studies suggesting that the first period of a nursing home stay, as well as previous and recent hospitalizations, both are predictors of hospitalization [28]. Both of these previously introduced theories fit our findings; however, when the short-term beds generate markedly high rates of hospitalizations we question whether they compromise their intention.

As it appears in this Norwegian setting, variation in hospitalization rates is not associated to whether nursing homes are private or public, but rather size and number of short term beds. In fact, the private nursing homes (ideal and profit) had a slightly lower hospitalization rate than the government run; however, this finding was statistically non-significant. This is in line with the intention of the government policy aiming at assuring equity in access to uniform nursing home services, regardless of financial status but exclusively based on a criteria-based need for it.

Politically, the findings of this study have implications. At the time of the study, few incentives were in place to support the nursing homes in withholding the residents in case of acute incidences. However, a major health reform is gradually implemented from 1 January 2012, where coordination, continuity and relief of specialist care are major goals [29]. Owing to this, the current study may serve as an important baseline for assessing the effects of the new reform on future hospitalization rates from nursing homes. Furthermore, in the current and fundamental discussion about placing more responsibility in primary care, there is a need to clear up what support is needed in the nursing homes to shape the health care services that can meet this. As it appears, size of the nursing home and short-term residents need to be a part of this discussion.

This study of practice variation might hold examples of both over- and underutilization of hospital

services. However, there are few clinical guidelines that address ongoing chronic care and acute incidences in institutional aged care, supporting clinicians in their decisions. We believe that future efforts in nursing home medicine and care ought to be synthesizing the scientific work of specific clinical areas in nursing homes and develop high quality guidelines based on this. This is a premise for higher quality of care, but does obviously not go without saying: the implementation of new guidance is challenging and requires support, resources and follow-up. There is a need to map the supportive needs of the nursing homes for withholding acutely ill residents where this will reduce harm. Additionally, several quality improvement efforts to reduce avoidable hospitalizations have shown promising results [25,30]. Future efforts should build on the experiences of existing evidence as the clinical problems requiring hospitalization are similar, despite differences in the health care settings.

Conclusion

A more than nine-fold variation in annual hospitalization rates among the nursing homes in one municipality suggests the presence of unwarranted variation. The variation was strongly associated with characteristics of the nursing homes and the same nursing homes had consistent rates from one year to the next. As such, this study documents what appears to be an inconsistency in the provision and delivery of health care to acutely ill nursing home residents in the same municipality. However, as long as the area of interest suffers lack of evidence-based guidance, variation is an expected outcome of investigation. Politically, these findings warrants for a twofold effort; one is to improve the research base specifically aiming at common clinical areas often resulting in hospitalization, and secondly to develop a framework of incentives and support to withhold the nursing home resident in the primary care setting when acutely ill and when possible.

Conflict of interest

None declared.

Funding

Bergen University College is funding the PhD scholarship of the first author.

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