

Acute hospital admissions from nursing homes

Rates and characteristics; unwarranted variation and effects of
interventions to reduce them

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In grateful memory of my 'Mormor'

Scientific environment

The studies undertaken for this dissertation, was carried out under the main supervision of Professor Trond Riise, Head of the research group on Lifestyle Epidemiology, Department of Global Public Health and Primary Care, University of Bergen. Co-supervisors were Professor Monica Wammen Nortvedt, Head of Centre for Evidence-Based Practice and Vice Dean at Faculty of Health and Social Sciences, Bergen University College, and Professor Gro Jamtvedt, Department Director, The Norwegian Knowledge Centre for Health Services and Professor at the Centre for Evidence-Based Practice, Bergen University College.

Foreword

In 2002 I left for Flinders University, Adelaide, Australia, to obtain a clinical degree in critical care nursing. Early in my studies, Professor Sally Borbasi introduced me to Evidence-Based Practice (EBP), which changed how I viewed my foundations for clinical decisions. Not only was this an eye-opener to me, a missing link that empowered me to critically view what I based my nurse interventions upon and how patients were viewed in the decision making. More importantly, it was a tool-box that enabled me to find, critically appraise and use research evidence in my everyday clinical work. My clinical reasoning was enhanced to include research findings. For the first time in my nursing career, the importance of research to nursing stood clear to me. I extended the stay in Australia, continued my studies and obtained a Master's degree in clinical nursing.

When I returned to Norway two years later, I was ready to use my EBP toolbox in clinical practice. I was disappointed to learn that EBP was hardly heard of in my department and yet fewer were really interested. In 2005, I met Monica Wammen Nortvedt, who happened to be as enthusiastic as myself. At the time she was building a Centre for Evidence-Based Practice at Bergen University College and by using her gift of persuasion; I was convinced to join her team.

Over several years the Centre collaborated with former Løvåsen Teaching nursing home and led to the conceptualisation of this ph.d. project. I view my opportunity to participate in this study as serendipity, and my enthusiasm for the geriatric field has grown during these years as a ph.d. student. Nursing home residents are among society's frailest citizens, and I feel privileged to contribute in an area of research where it is really needed.

I hope that this study reflects 'where I come from', that my interests for quality in health care and evidence-based practice are visible and underpin this study on *Acute hospital admissions from nursing homes*.

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A very special thank you to Monica W Nortvedt. I am not sure how she does it, but she makes me do things that I did not know I was capable of. Her continual support and belief in me has been of utmost importance to me during this period. Her strategic, efficient and constructive input has been invaluable to the study.

It has been an incredible good fortune of mine to have so generous colleagues at Centre for Evidence-Based Practice during this work. A warm thank to all of them, for the discussions, support, fellowship and friendship.

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Friends and family have shown interest, support and encouragement during the years of working with this study and this has been very important to me. Monika Sæbbe has been my faithful partner up Mt. Ulriken three times every week.

Finally, I owe a big and warm thank to Terje and our children Håvard, Lars and Ulla, for their love and support. You have reminded me that life is more than work. In some periods, though, I believe that you have paid the highest price. Thank you for putting up with me – you are the best.

Bergen, November 2013,

Birgitte Graverholt

Summary

Background: The geriatric nursing home population is vulnerable to acute incidences in their health condition, due to longevity, multiple chronic illnesses and a low level of physical and mental function.

Aims: The overall aims of this study were to describe acute hospital admissions from nursing homes in Norway; investigate and explain the variation in admission rates between nursing homes, and systematically review the effects of interventions to reduce hospitalisations from nursing homes.

Methods: Population-based observational data were used for papers I and II, with electronic patient journals as the main source of data. For two consecutive years (01.01.2007-31.12.2008), acute admissions from 38 nursing homes were identified through ambulance records ($n=2\ 451$). Paper I reports annual incidence rates of hospitalisation, describe characteristics of hospital stays and reports mortality. Paper II describes variation in hospitalisation between all nursing homes in one municipality and explores explanatory associations. Paper III is a systematic review of the effects of interventions to reduce hospitalisations from nursing homes.

Results: The mean annual hospital admission incidence rate was 0.62 admissions per person-year. Of all admissions 55% were related to falls and respiratory and circulatory diseases. Length-of-stay was median 3 days. In-hospital and 30-days mortality rates were high; 16% and 29%, respectively. A nine-fold variation in admission rates were found among the nursing homes. Annual rates correlated significantly with size and percentage short-term beds of the institutions, but no associations were found between rate and ownership, suburb or age of the residents. There was a strong correlation between nursing homes' admission rates two years in a row. The literature search generated 6 250 individual records. Four systematic reviews of high quality and five primary studies were included, evaluating 11 different interventions. The overall quality of the evidence was graded low or very low.

Conclusions: Nursing home residents are hospitalised at a very high rate in this setting, and a more than nine-fold variation suggests the presence of unwarranted variation. Some interventions to reduce hospitalisations show promising results, but the evidence is of too low quality to provide clear recommendations.

List of publications

Graverholt B, Riise T, Jamtvedt G, Ranhoff AH, Krüger K, Nortvedt MW (2011): 'Acute hospital admissions from nursing homes. A population-based observational study', *BMC Health Services Research*, Vol. 11:126.

Graverholt B, Riise T, Jamtvedt G, Husebo BS, Nortvedt MW (2013): 'Acute hospital admissions from nursing homes: predictors of unwarranted variation?', *Scandinavian Journal of Public Health*, Vol. 41;4:359-365.

Graverholt B, Forsetlund L, Jamtvedt G (2014): 'Reducing hospitalisations from nursing homes. A systematic review', *BMC Health Services Research*, Vol. 14:36.

Abbreviations and definitions

- LTC** Long-term care includes a range of personal care services to help disabled people with basic activities of daily living, as well as basic medical services, nursing care, prevention, rehabilitation or palliative care.
- Nursing homes** Geriatric care facilities which provide supervision and assistance in activities of daily living with medical and nursing services when required.
- Acute hospital admission** Admissions to hospital requiring immediate intervention to avoid serious adverse results.

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1. BACKGROUND

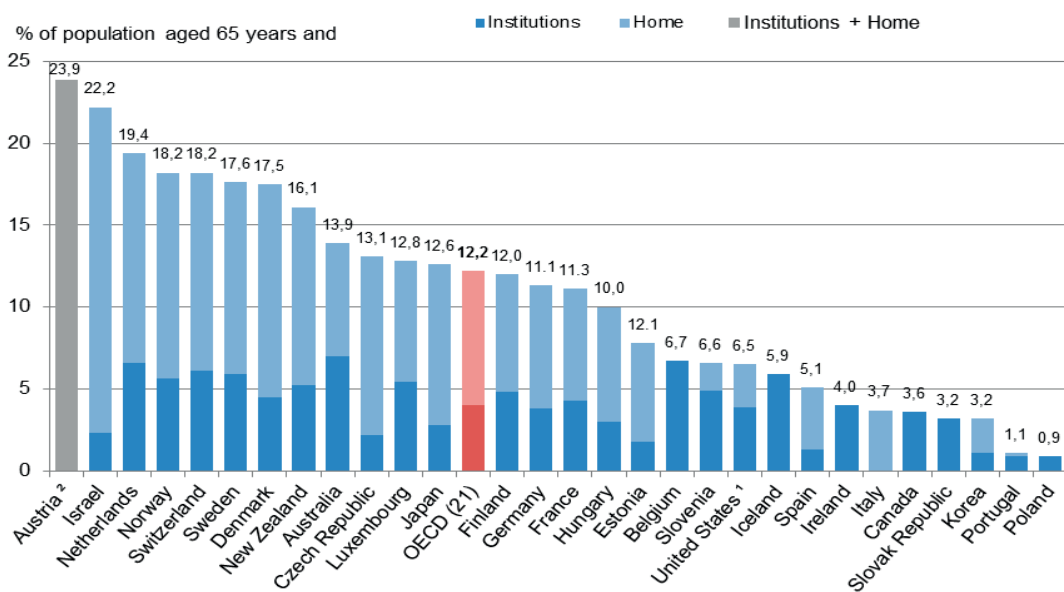
1.1 Demographic changes and trends in long-term care

Gains in life expectancy are seen in most countries and a growing proportion live to become very old. In 1950, less than 1% of the global population was aged 80 years or older. Among the OECD countries (Organisation for Economic Cooperation and Development), the share of 80-year olds rose to 4% in 2010, and by 2050 this number is estimated at 10% (1). While the increased life expectancy is celebrated on the one hand, the development represents challenges on the other. One inevitable projection is the increasing number of older people that will be in need of health- and long-term care (LTC) services. The fact that the proportion of younger people is decreasing sheds light on another interlinked challenge, namely the implication this poses on the future workforce in health and long-term care (1-3).

It is evident that ageing of the population is a common denominator across countries, but that LTC services are vastly differently organized and prioritised (1, 3, 4). For instance, there are large differences in the extent of formal versus informal services; the composition of the work force; the ratio of institutional versus home care ratio and the expenditure on LTC. One example of this is that the proportion of the population (65 years or older) who receives formal LTC services varies from 1% in Poland and Portugal to 24% in Austria (Figure 1). Another example is the number of formal workers as a share of the population 65 years and above, which varies from 1% in Italy to 13% in Sweden (3) (Chapter 8, table 8.6.1). The number of beds in institutions per 1000 population 65 years and above varies from 17 beds in Italy to 82 beds in Sweden. Hungary and Norway are at each end of the scale of LTC spending: Where Hungary spends 4% of their health expenditure on LTC, Norway spends 27% (3) (chapter 8).

The organisation of long-term care (LTC) for societies' oldest has changed character over the last decades. The current trend is to reduce institutional care, among the countries who already have a well-developed nursing home sector, and expand the services offered at lower levels of care, such as in people's own homes and in serviced apartments (1, 3). This reduction is motivated both by people's preference to receive services at home, as well as the increased focus on sustainability and cost of care (1, 3).

Figure 1: Population aged 65 years and over receiving long-term care, 2009 (or nearest year), OECD countries



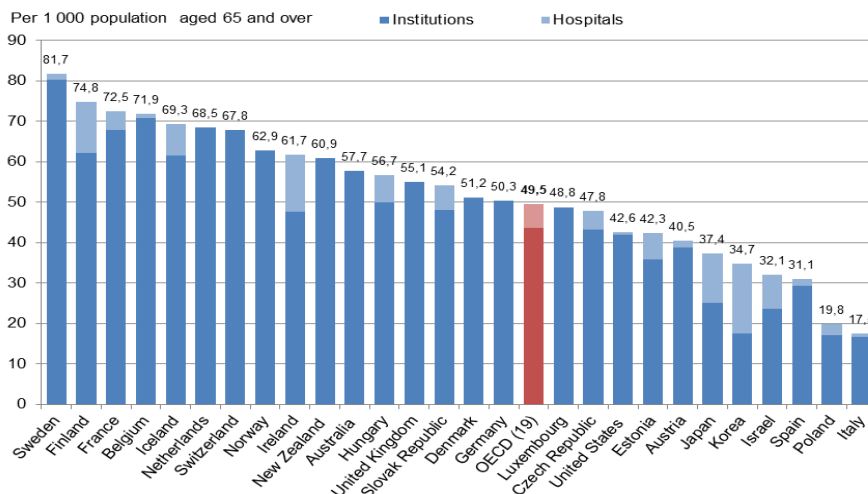
Source: OECD Health Data 2011 <http://dx.doi.org/10.1787/888932526502>

1.2 Nursing homes as a corner stone of long-term care

In many countries nursing home institutions are considered a corner stone in the provision of LTC for older people, but this varies among the OECD countries (Figure 2). As the cost of LTC is set to double or triple between now and 2050, mainly as a consequence of the changes in demography, claims are that major reforms are needed

(4). The provision of LTC in institutions is more costly than at lower levels, which is one major drive for the reduction of institutional beds. In turn, the relatively fewer recipients of LTC in nursing homes are sicker, frailer, and medically more complex to care for. By nature, therefore, the care for nursing home residents operates on a close link to acute care. Acute episodes may call for services not available in the nursing homes, including diagnostic procedures, specific interventions or a shift towards end-of-life care. This interface of LTC in nursing homes and acute care has been in constant spotlight from both political and research point of views, where claims are that many transfers are avoidable (1, 5-9).

Figure 2: Long-term care beds in institutions and hospitals, per 1 000 population aged 65 and over (2009 or nearest year).



Source: OECD Health Data 2011 <http://dx.doi.org/10.1787/888932526654>

1.2.1 The nursing home population and susceptibility to acute illness

High age, multiple chronic diseases, frailty and disability are common characteristics of the geriatric nursing home population. All these characteristics are concurrent patient health risk factors of attaining acute exacerbations of underlying chronic

diseases, or other acute incidences like falls or infections (10-12). This implies that acute incidences are common in the nursing home setting and concomitantly the judgment of whether to hospitalise the resident. The situation may call for services not available in the nursing homes, including diagnostic procedures, specific interventions, or a shift towards end-of-life care. Several studies have looked into the decision-making processes involved when nursing home residents are hospitalised and found this process both complex and multidimensional (13-16).

From an international perspective, indeed, studies from a range of different countries with well-developed nursing home sectors have demonstrated that acute hospital admissions occur commonly, but still with great variation in annual rates reported. Three different population-based studies from different regions of Canada reported annual rates between 0.16-0.30 per nursing home bed (17-19). In UK, Godden and Pollock found an annual hospitalisation rate of 0.26 among nursing and residential home beds in a defined health district (20). From the United States (US), where the larger portion of these studies have taken place, rates vary greatly between 0.09-0.59, according to a review of US-based studies by Grabowski and colleagues (21). From Sweden, the annual hospitalisation rate among a drawn sample of newly assigned nursing home residents reportedly was between 0.50 and 0.60, over a three year study period (22). More recently, two more studies from Norway and one from Sweden found annual hospitalisation rates between 0.35–0.60 (23-25).

1.2.2 The detriments of hospitalisation

The physiological mechanisms involved when the frail and old is hospitalised, are well described, where the bodily processes of ageing is placed in the context of acute illness, frailty and the hospital setting (10, 12, 26, 27). Besides, a number of studies have pointed to the detrimental impacts that hospitalisations may have on elderly people, including iatrogenic illnesses, as well as functional and cognitive decline (10, 26-32). Nursing home residents have been found to have more iatrogenic complications than patients admitted from their homes (32). For elderly people with a low functional status at presentation to hospital, iatrogenic illness is an extremely

common experience (31). Several studies have additionally documented what appears to be a consistent finding of cognitive decline post-hospitalisation among older persons (29, 30), as well as a loss of independence in function (12, 26-28). In a cohort of nursing home residents that visited the emergency department, a significant risk of infection was found (33).

Over the last decade, there has been a range of studies focusing on the appropriateness of the usage of acute hospital services among nursing home residents. Claims are that there is an inappropriately high rate of hospital admissions from the subpopulation of nursing home residents, and that many of the reasons for admission either are preventable, or could be treated in the nursing home setting (6-9).

1.3 Quality of care

Although the future challenges of long-term care to societies' oldest are closely linked to the demographic changes and the workforce puzzle most countries are facing (3, 34), a recent joint report from the OECD and the EU commission, urges health authorities to focus on a current struggle first, namely to provide high-quality care to older people (35). Although several measures are taken across countries to absorb the increasing focus on quality in health care, few nations have put in place systematic monitoring of the quality in long-term care (35). In fact, it is claimed that LTC lags behind health care on this issue (36, 37). Different nuances exist in definitions of *quality* in health care across nations, but most of them are in consistency to the Quality of care statement from WHO (38). The Norwegian adaption to quality in health care is presented in the Norwegian National Strategy for Quality Improvement in Health (39). The following requirements are identified as constitutional properties of high quality health services: They are effective and safe; they involve users; they are well-coordinated; they utilize resources appropriately; they are available and equally distributed (p 19).

1.3.1 Evidence-based practice

Evidence-based practice is recognized as the necessary underpinning of any work with quality of care (4, 38, 39). Evidence-based practice (EBP) can be defined as “...clinical decisions based on systematically obtained research evidence, clinical expertise and patient needs and preferences in a given context” (40). As the recognition of evidence-based decision making has gained foothold in health care, the need for summarized research has grown strong. Systematic reviews came as a result of the acknowledgement that decision makers were faced ‘...with unmanageable amounts of information, including evidence from healthcare research’ (41). The response to this acknowledgement has been a movement, initiated and led by the Cochrane collaboration, to summarize research and present it in formats that are accessible for the different decision makers in health care (42, 43). To systematically review the results of primary studies is viewed as an important bridge between research evidence and decision makers. “ A systematic review attempts to collate all empirical evidence that fits pre-specified eligibility criteria in order to answer a specific research question” (41) (Chapter 1.2.2).

1.3.2 Unwarranted variation and the link to quality of care

Unwarranted variation can be defined as “...variation in clinical practice that cannot be explained by illness severity or patient preferences” (44) (p 961). Studies of practice variation are population-based investigations of health care utilisation within geographic boundaries of health care markets (45) (chapter 1). The method is applied to discover variation that cannot be explained by underlying differences in illness or preferences in the population at study. As such, mapping of variation addresses questions about access to and quality of care. If a large variation in utilisation rates of health care exists, such as hospitalisation rates, then there is a need to focus on explanatory factors and the appropriateness of the service use (44).

From the perspective of nursing homes, several investigations have shown that the large variation in hospitalisation rates among nursing home residents only partly is

explained by clinical factors and that non-clinical factors actually play a significant role (21, 46, 47).

Much work is done on the field of practice variation to improve the understanding of the mechanisms that lay behind and how it may best be reduced (44, 45, 48, 49).

Although there is an interplay of factors that impact on practice variation, the professional uncertainty principle is often a significant explanatory factor (49). The professional uncertainty principle refers to situations where clinicians lack a clear and evidence-based treatment option as support to the decision. This uncertainty will result in a variety of practises, based on the opinions of various clinicians.

1.4 The case for the Norwegian nursing home sector

Norway is facing similar demographic challenges as the OECD average, and must prepare for an increasing demand in LTC for elderly. On the contrary, Norway deviates from the OECD average in several noteworthy aspects: First of all, Norway is a country with extensive formal arrangements for LTC in place already. Secondly, it is one of the countries with the largest share of formal LTC recipients over 65 years (1) (chapter 7, figure 7.1). Proportional to the number of people aged 65 or older, Norway holds a very high density of formal care workers in LTC (chapter 1, figure 1.7). This is further reflected in the spending per capita on LTC, where Norway stands out (chapter 1, figure 1.10).

In Norway, quality in LTC is high on the current political agenda, evident in white papers (5, 39, 50); the establishment of Research and Development Centres (51-53); and the National Strategy for Quality Improvement in the Health and Social services (39).

The coordination reform is normative for the organization of services in the primary care sector, with early intervention, improved coordination of services, more health care services closer to where people live and more responsibility in the municipalities

(5). Despite this, Norway is still among the countries lacking a system for monitoring of LTC in general and quality in particular (4). Little data is readily available about the nursing home population, and none of the current quality indicators are in line with the dimensions of what constitutes quality in LTC (37).

As yet, therefore, there is a need for health and care services research upon areas where data is non-existing, to inform decision making on different policy levels. The nursing home population is a frail population, at risk of attaining acute illness and need of acute care services across the levels of care. Despite the fact that acute deteriorations is more or less a daily issue in the nursing home setting, studies of hospitalisations from nursing homes in a Norwegian setting has been lacking and warranted for (54).

The Norwegian nursing home setting holds several qualities that make this setting suitable for doing research upon. First of all, there is more uniformity to this sector in Norway than in many other countries with a well-developed nursing home setting. This is largely due to limited privatisation. One other important factor is the municipal administration of admittance that ensures equity in the assignment of beds.

2. AIMS AND OBJECTIVES

The overall aims of this study were to i) describe acute hospital admissions from nursing homes in Norway; ii) investigate and explain the variation in admission rates in a geographically well-defined area and iii) systematically review the effects of interventions to reduce hospitalisations from nursing homes.

The specific objectives were:

- To determine the incidence of acute hospital admission among nursing home residents versus community dwellers, and describe the hospital stays of the nursing home population according to diagnosis at discharge, length of stay and mortality (Paper I).
- To quantify overall and diagnosis-specific variation in acute hospital admission rates among nursing homes, and estimate the association between the hospitalisation rate and the following characteristics of the nursing homes: size, the number of short-term versus long-term beds, ownership status and suburban area (Paper II).
- To summarise the effectiveness of interventions to reduce acute hospitalisations from nursing homes (Paper III).

3. MATERIALS AND METHODS

3.1 Setting

The study setting for papers I and II was the municipality of Bergen, Norway, with a population of 247 746 per January 1st 2008 (Statistics Norway, table 06913). At the time of data collection, the municipality listed 38 institutions as nursing homes, with a total of 2 384 beds (range: 10-174 beds). These beds were a mix of short-term and long-term beds, where the short-term beds made up approximately 18% of the overall capacity. Among the nursing homes, the mix of short-term and long-term beds varied from 0-100% of the capacity. There are two hospitals in the health trust in this geographical region, who mainly serve the population according to their registered addresses. Admissions to both hospitals from the 38 nursing homes in eight different suburbs were included.

3.2 Designs and samples

Papers I and II in this study have population-based observational designs and mainly utilise data from the same sample. This sample is a cohort of nursing home residents who were hospitalised from any nursing home institution in the municipality of Bergen during the period 01.01.2007 – 31.12.2008. The sample comprised 2 451 cases of acute hospital admissions in this period, stemming from the 38 nursing homes and from residents age 67 years and above.

Paper III has the design of a systematic review. A systematic review aims ‘to collate all empirical evidence that fits pre-specified eligibility criteria in order to answer a specific research question’ (41) (Section 1.2.2). The key characteristics of a systematic review are: ‘A clearly stated set of objectives with pre-defined eligibility criteria for studies; an explicit, reproducible methodology; a systematic search that attempts to identify all studies that would meet the eligibility criteria; an assessment of the validity of the findings of the included studies; and a systematic presentation, and synthesis of the characteristics and findings of the included studies’ (Cochrane

handbook, section 1.2.2). The sample for this paper consists of evaluations (studies) of interventions to reduce hospitalisations from nursing homes, systematically collected from relevant databases and other resources, according to the criteria above and in line with the protocol developed in advance of undertaking the systematic review (55).

3.3 Data sources

In paper I we studied acute hospital admission rates among elderly people (age ≥ 67) in the Municipality of Bergen, Norway, a geographically well-defined area, from 1st January 2007 to 31st December 2008. The overall number of cases of acute hospital admissions was identified through the Acute Medical Information System (AMIS) by the Bergen Hospital Trust under the Western Norway Regional Health Authority. The cases hospitalised from nursing homes were identified through ambulance records in AMIS, which were linked electronically to patient journals and investigated further with respect to characteristics of hospital stays and mortality. Further, data from Statistics Norway was obtained, with information on the number of nursing home residents in the nursing homes in the study period.

In paper II, we used data from the same cohort. Additionally we used data on known characteristics of the 38 nursing homes, provided by the municipality, including size, the number of short-term versus long-term beds, ownership and suburban area.

The source of data in paper III comprises selected studies from a systematic literature search in relevant databases and other relevant sources, set up and performed in collaboration with a research librarian at the Norwegian Knowledge Centre for the Health Services. The search strategy is available in the protocol (55) and as a supplementary file to paper III. Results from the different searches in the different databases were then merged, using reference management software. Two reviewers then independently screened titles and abstracts and retrieved full text copies of

potentially relevant reports. Retrieved reports were examined for eligibility according to the inclusion and exclusion criteria (55).

3.4 Analysis of data

In paper I, incidence rates of hospitalisation were calculated based on the number of hospitalisations divided by person-time at risk during the two years study period.

Person-time is an estimate of the actual time-at risk in the study period. The estimated person-time at risk for the nursing home residents was based on the number of persons who had occupied nursing home beds in the study setting in the study period. These data were provided from Statistics Norway and were stratified on age (0-66, 67-79, 80-89, 90+), gender and type of stay (short-term versus long-term).

We used the information that 18% of the nursing home capacity was short-term beds. As such, we were able to estimate the mean duration of short- and long-term stays in the study period, which is the equivalent of *time at risk* of being hospitalised per resident. This was done by dividing the number of people occupying long- and short term beds in the study period, by the number of short and long term beds, respectively. This gives us the mean duration of short-term and long-term stays, or *time at risk*. Because the data from Statistics Norway was stratified on age, gender and type of stays, we were able to calculate specific time at risk for each stratum, and also exclude the residents <67 years. The patient-time at risk for each age and gender category was thus calculated as:

(# of persons in short-term beds multiplied by estimated time at risk for short-term stays) + (# of persons in long-term beds multiplied by estimated time at risk for long-term stays)

Confidence intervals were based on a Poisson distribution of the number of hospitalizations.

Person-time at risk for the community dwelling population in the municipality (age 67 and above), was calculated as the sum of individuals in the general population, minus

the person-time from the nursing home residents. Then equivalent hospitalisation rates were calculated for the community-dwellers and we were able to calculate rate ratios between the two.

In paper I we also included descriptive statistics of the characteristics of the hospital stays including the distribution of diagnoses and mortality rate (in-hospital and 30-days mortality); and inter-quartile range (IQR) and median for length of hospital stay. IQR was used to account for the extremes in the material.

In paper II, the level of analysis is shifted from resident level to the nursing home level. The information we obtained from Statistics Norway only held information on the persons occupying nursing home beds during the study period, but no information concerning the 38 nursing homes. The hospitalisation rate for each nursing home in this paper was therefore determined by dividing the number of hospitalisations by the number of beds for each nursing home.

Pearson correlation was used to assess the consistency of the annual hospital admission rate among the 38 nursing homes across two years; the squared correlation coefficient indicates how much of the admission rates in the second year could be explained by the rate in the previous year.

Chi-square was used to test the overall variation in acute hospital admission rates between the nursing homes. The test was made on a table using bed-days as the unit and grouped according to the nursing homes and categorised according to hospitalization or not. We also studied diagnosis-specific variation between the nursing homes for the six most prevalent diagnoses at discharge, aggregated at main chapter level (ICD-10). This was done using the Systematic Component of Variation (SCV). SCV permits comparisons of the variability of rates between nursing homes adjusting for varying levels of prevalence of the various diagnoses (56).

A multiple regression model was used to study the association between the mean annual hospitalisation rates as the dependent variable and the following explanatory variables: Size of the nursing home (number of beds), percentage short-term beds and ownership status. To test for a difference in rates between the 8 suburbs, we used analysis of variance (ANOVA).

Statistical analyses in papers I and II were conducted using SPSS versions 17.0-18.0 (SPSS Inc., Chicago, IL, USA).

In paper III analyses were mainly descriptive as the interventions in the included studies were too heterogeneous to combine. We extracted data according to the eligibility criteria. If an outcome was measured several times, then we used the last. RevMan 5 was used to do additional calculations, for example relative risk calculations, if this was considered a better reporting of the effect estimate. Where possible, we reported combined effect estimates from meta-analyses from included systematic reviews. In the summary of findings tables, the following data were presented: Outcome, calculations of absolute effect, the relative effect if possible, the number of participants and studies, quality of the documentation and a comment, where relevant.

4. ETHICAL AND LEGAL ISSUES

Ethical and legal issues to make use of existing data sources were cleared with the Regional Ethical Committee-Western Norway and the Data Protection Official for Research. Only unidentifiable data were collected and for this reason the study was exempted patient consent.

The project number at the Norwegian Social Science Data Services (NSD) is 21485.

5. SUMMARY OF RESULTS

In this chapter, a condensed summary of the results from the three papers I, II and III is presented. Each paper is presented separately, with an initial repetition of the specific objectives. The comprehensive presentation of the results is available in papers I, II and III.

5.1 Paper I

Graverholt B, Riise T, Jamtvedt G, Ranhoff AH, Krüger K and Nortvedt MW. **Acute hospital admissions among nursing home residents: a population-based observational study.** *BMC Health Services Research* 2011, **11**:126.

In this study, we aimed to 1) determine the incidence of acute hospital admission among nursing home residents versus community dwellers, and 2) describe the hospital stays of the nursing home population according to diagnosis at discharge, length of stay and mortality.

The mean admission rate was 0.62 admissions per person-year (95% CI: 0.60-0.65) in the nursing home population and 0.26 (95% CI: 0.25-0.26) in the community dwelling population.

In descending order, the commonest ICD-10 diagnoses at discharge for the nursing home population were diseases in the respiratory system (20%), diagnoses related to injury, poisoning and certain other consequences of external causes (18%) and diagnoses of the circulatory system (17%).

The overall median length of stay for the NH was 3 days (mean 5.1, SD \pm 6.1, range 1-73, IQR 4).

There was a 16% in-hospital mortality rate in the NHP. The overall mortality rate 30 days after discharge was 29%.

5.2 Paper II

Graverholt B, Riise T, Jamtvedt G, Husebo BS and Nortvedt MW. **Acute hospital admissions from nursing homes: predictors of unwarranted variation?** *Scand J Public Health* 2013, 41:359.

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 versus long-term beds, ownership status and suburban area.

The overall un-weighted mean annual rate of hospital admission across the 38 nursing homes was 0.58 per bed (SD \pm 0.30). There was a marked and highly significant variation between the nursing homes (Chi-square test, $p < 0.0001$, $X^2 = 746.4$; 37df) ranging from 0.16 to 1.49 per bed. A significant variation was also found for all subgroups of diagnoses ($p < 0.0001$). The admission rates were rather consistent for each nursing home across the two years, with a correlation coefficient of 0.78, $p < 0.0001$.

We found significant correlations between variation in hospitalisation 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 hospitalisation rates between 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 hospitalisation rate, with smaller nursing homes and nursing homes with a high percentage of short-term beds showing higher rates. The regression coefficient 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 hospitalisation 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 hospitalisation 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.

5.3 Paper III

Graverholt B, Forsetlund L and Jamtvedt G. **Reducing hospital admissions from nursing homes: a systematic review.** *BMC Health Services Research*, Vol.14:36.

The objective of paper was to summarise the effect of interventions to reduce acute hospitalisations from nursing homes.

Based on predefined eligibility criteria, four systematic reviews and five primary studies were included in this review. In total there were eleven unique interventions reported, who were gathered in three categories:

Interventions to structure and standardise clinical practice:

Four out of seven interventions in this category yielded fewer hospital admissions for the intervention groups: Two of these evaluated the implementation of advance care planning in nursing homes, one palliative care and one a clinical care pathway to care for lower respiratory infections in nursing homes. The quality of the evidence, however, was assessed as being low or very low.

Geriatric specialist services:

Geriatric specialist teams compared with usual care was evaluated in two trials. The interventions demonstrated fewer hospital admissions in the intervention groups in both studies, however, the evidence was judged as very low.

Influenza vaccination

Promoting influenza vaccination of health personnel in nursing homes was evaluated in a systematic review. Vaccination demonstrated unclear results for hospital admissions. The quality of the evidence was judged as low.

Influenza vaccination of nursing home residents was evaluated in a systematic review. Vaccination showed fewer hospital admissions, but noteworthy, the findings for laboratory confirmed influenza was unclear. The quality of the evidence was judged as very low.

6. DISCUSSION

The overall aims of this study were to describe acute hospital admissions from nursing homes in Norway; investigate and explain the variation in admission rates in a geographically well-defined area; and systematically summarise evidence to inform the quality of care in nursing homes.

Paper I documents robust population-based numbers on hospital admissions from nursing homes, revealing remarkably high rates and new knowledge about the characteristics of the hospital stays. Paper II shows a nine-fold variation in hospital admission rates among the 38 nursing homes in one municipality, where you would expect less. In the third paper, the effects of interventions to reduce acute hospital admissions from nursing homes were systematically reviewed. Eleven interventions were identified, broadly categorised in interventions to standardise and structure care, geriatric specialist services and influenza vaccination. Some of the interventions showed promising results, but the quality of the evidence was low or very low.

6.1 Methodological strengths and weaknesses

In the following, the methodological weaknesses and strengths of this study are discussed. First, the concepts of validity, bias and confounding are presented, as the three most important terms in a methodological discussion. Then, the strengths and weaknesses of the three papers are discussed.

6.1.1 *Validity, bias and confounding*

Validity refers to the broad concept of a study's soundness, or the degree to which the study accurately reflects what is under investigation (57). Commonly, validity is divided into internal and external validity. Internal validity may be defined as the degree to which it can be inferred that the independent variable caused the observed effects (58). Others have defined internal validity as the degree to which biases are absent in a study (59) (p 44). External validity concerns the generalizability of the

findings, and the degree to which the inferences of the observed relationships will hold true over variations in persons or settings (58).

The validity of a research study can be placed on a continuum, and its judgement is based on the assessment of how sources of biases are present or absent in a study. Bias refers to any type of systematic error or a deviation from the truth, in the results or inferences (41) (Chapter 8). As such, a discussion about a study's validity is, for a large part, a discussion about the presence or the absence of biases, which in turn are specific for different study designs. In epidemiology different biases are broadly categorised in selection bias, information bias and confounding (58). Selection bias is a systematic error in a study that occurs as a result of how the subjects are selected for a study. Selection bias can be present if the study population is different from the target population. Information bias can occur if information about study subjects is incorrect. If erroneous information is collected at a categorical level and a study subject is placed in a wrong category, then this is referred to as misclassification (58) (p 98). Confounding refers to the confusion of, or mix-up, of effects, where the effect of the exposure is mixed up with the effect of another variable (58) (p101). A confounder is a variable that correlates with the independent variable and have the same effect on the dependent variable. The validity of a systematic review depends on a judgement of the presence or the absence of biases at two different levels: The level of the review process and the level of the included primary studies (41, 60).

6.1.2 Papers I and II

The major strength of papers I and II lies in the inclusion of cases from all nursing homes within a geographically well-defined area, and over two years. In investigations upon practice variation, population-based numbers is an important characteristic of the methodology (45) (p 6). This reduces the chance of selection bias, which is a principal concern in observational studies (58). The timeframe and the extensiveness in the design strengthens the validity of papers I and II in several

aspects: Seasonal changes are overcome by this design, individual differences between nursing homes are picked up on, and there has been a major replacement of long-stay residents during this study period (61). Two assumptions made in this study are that close to all transfers to hospitals occur *from* the nursing homes and *by* ambulance. It has not been possible to identify studies or statistics to verify these assumptions in a Norwegian context. If these assumptions are wrong, then this may have resulted in an underestimate of the hospital admission rates reported in papers I and II, and even a possibility of selection bias if the rates of transfer by other means than ambulance differed between the nursing homes included. From a US-based context, two studies have reported that transfers to emergency department from nursing homes happen in ambulance in 95% of the cases (62, 63). Unpublished statistics from AMIS show that overall, three out of four patients >67 years admitted to hospital arrive by ambulance (*personal communication*).

Several challenges are known when using data from linked health registries in research, which may introduce information bias (64, 65). These are data primarily collected for other purposes, and their appropriateness for use in research must be assessed. Administrative data are known to sometimes have questionable quality through poor coding or punching errors, which is difficult to assess in retrospect (64). In papers I and II, this issue first and foremost relates to the diagnoses reported. The reliability of the ICD-10 system has been tested, and these studies suggest that the further into the diagnosis system, the poorer the inter-rater reliability of the coding. On chapter-level, where the main analyses in papers I and II are done, though, reliability tests showed satisfactory results (66, 67). This means that although misclassification can occur at the specific diagnosis-level, the reliability at chapter levels is satisfactory.

Further, any misclassification of the diagnoses in our study is likely a non-differential misclassification, i.e. that the error rate has the same probability across the study subjects (58). Non-differential misclassification can deflate any differences and can, as such, not cause the observed results.

The major weakness in paper II is the lack of possibility to adjust for possible confounding variables, including patient characteristics and types and severity of underlying illnesses. The individual risk of hospitalisation is clearly related to underlying differences in patient characteristics (45). In lack of this information, our claims are based on the assumption that underlying illness and severity is more or less distributed evenly across the nursing homes under study. This is a plausible assumption given the administration of the system in the study setting. Nevertheless, we cannot exclude the possibility that unknown factors related to the risk of hospitalisation and also influencing size and bed-mix of the nursing home could explain parts of the association found.

There is further a concern at whether the municipality of Bergen is representative of the wider nursing home population. It is likely that hospital admissions depend on context specific issues and the larger system of health in which it is operating, in addition to health related characteristics (21, 47). The external validity may be reduced in settings that differ to the context of Bergen, like in rural areas farther away from hospitals. This applies particularly to the hospitalisation rate, as there may be different thresholds for hospitalisation in rural versus suburban areas, and particularly for discretionary diagnoses (46).

6.1.3 Paper III

The overall validity of a systematic review depends on the validity of the *review process* and the included *studies* (41, 60). At review level, the validity of paper III is attended to by applying explicit, transparent and systematic methods to search for; select; assess and synthesise the studies according to eligibility criteria in a predefined protocol. The pre-specified protocol was developed and published in advance of the review process, clearly stating the review question, the search strategy, eligibility criteria and plans for data extraction, data synthesis and dissemination of results (55). The protocol reduces the chance of post-hoc selection bias, including selective

outcome reporting (68) (p 18). Moreover, the explicit methods used to assess risk of bias in the included studies, to grade the quality of the evidence and to ensure transparency of the review process is made available to the readers in a supplementary file (Supplementary file). Additionally, steps are taken to report the results in conformity to the PRISMA guideline (69).

At *study* level this review has limitations because of the high risk-of-bias and other limitations of the included studies. In fact, the quality of the evidence was graded low or very low for all eleven comparisons which reduce the confidence in the findings and thus the clinical usefulness.

6.2 How are findings from this study relevant to quality of care?

The findings from this study are relevant for quality of care in several aspects. Although this study was not designed to answer the questions linked to the hallmarks of what constitute high quality services, our study has relevance to several of them: Is this practice effective and safe? Does it involve users? Are they well-coordinated? Do they utilise resources appropriately? Are the same services available for all residents and equally distributed? (39, 70). Given that hospital admissions constitute a major strain for the frail and old, the high admission rate is a concern. In light of the facts that Norway has the highest proportion of skilled formal LTC workers and is the country among the highest monetary spenders on LTC, one would perhaps expect lower rates (1, 3, 35). In light of the findings in our systematic review (paper III), clinicians may struggle to know what best to do in situations like this, and what is the safest for the resident.

Essential to quality of care and evidence-based practice is the user involvement and shared decision-making (39, 40, 70). Although shared decision-making may appear difficult in a setting where many of the users have dementia, several studies have shown that implementing this has reduced the number of hospital admissions without adverse effects like lower patient satisfaction (71, 72).

It is well-documented in studies, as well as recognised in white papers, that care coordination across primary and secondary care levels often is fragmented (73). The abruptness of continuity and coordination of care is caused by several identified factors: There is an obvious split responsibility between the two settings; service points are fragmented and isolated, and there is a lack of information technology (IT) infrastructure to support the transitions back and forth (35). As such, these structural aspects need to be in focus in improvements of care for the acutely ill nursing home resident.

It is also questionable whether the practice under study utilises resources appropriately. Not only are the residents transferred from a skilled geriatric environment, to hospitals that lack this, but when they are hospitalised, their beds in nursing homes are left empty. Based on the number of residents hospitalised annually and their lengths of stays, on average, 17 hospital beds are occupied by nursing home residents at all times. At the same time, an equal number of nursing home beds are empty because their occupants are hospitalised (74).

When the variation in hospital admissions has a factor of nine, this gives additional fuel to the concern that this is an issue of quality and equity concern. Are residents receiving the same level of services in the different nursing homes? The consistent variation in rates across the two years of assessment is a particularly interesting finding when discussing unwarranted variation. Across the two years where hospital admissions were counted, residents are probably replaced, and yet, still, the same nursing homes have high and low rates both years. In a setting where all residents apply to a nursing home on common grounds; where the decision and assignment are taken by the municipal administration and where all nursing homes are in the same health market – a variation with a factor of nine is a sign of unwarranted variation. The current health policy direction in Norway may be used as support to this interpretation of findings: Several of the current white papers acknowledge that there is a lack of quality systems to promote quality improvement (70, 75). Unwarranted

variation is explicitly mentioned in these policy papers as a sign of quality and equity issues, and as an opportunity to act upon.

The means of reducing unwarranted variation depends on what causes it, however two important premises need be in place: The presence of high quality decision support for clinicians, and user involvement (45, 48). In lack of decision support, such as evidence-based clinical guidelines, health personnel must rely on other sources of knowledge, a situation where clinicians tend to act upon that 'more is better' (45). Interestingly, by involving users in decisions, studies have shown that patients tend to choose less care instead of more, when their choice is based on shared-decision making (45, 48, 71, 72).

As there is no 'right rate' of hospitalisation from nursing homes, the nine-fold variation that we observed can only serve as a pointer to what appears to be unwarranted variation. Importantly, the discovery of a large variation is a first and often necessary starting point for acting on a quality and equity issue. In fact, a growing number of initiatives are monitoring for variation on certain indicators, like hospitalisation rates (48, 76). Watchful observing over geographic areas on particular indicators will pick up on variation and serve as an initial step to act upon. Studies of unwarranted variation, has increasingly become the focus of attention for professional groups striving to reach best practice, as well as health care policy makers. The identification of an area with an unexplained practice variation is a necessary starting point to address that different practices occur and patients receive different care (44, 45, 48).

The significance of findings from systematic reviews to achieve high quality of care is pivotal. Not only are systematic reviews a corner stone to achieve high quality and evidence-based services by making available summaries of often large amounts of primary research (40, 68). As importantly, as a foundation to inform clinical practice, there is a need for a balanced presentation of *all* research evidence on a particular research question. For the same reasons, clinical guidelines should be based on results from systematic reviews. Finally, systematic reviews are useful in identifying

evidence gaps, and should guide researchers and policy makers in their priorities. Fortunately, the number of systematic reviews is increasing and so is the recognition of them. Still, there are adjacent challenges to achieving an evidence-based practice, as key decision makers across the health care setting fail to use research evidence to inform their decisions (68) (Chapter 2). In the realm of nursing homes, several audits have uncovered examples that underscore the difficulty of implementing evidence-based recommendations in clinical practice (77-79). These are examples of areas of practice where evidence-based recommendations exist, but where they are not in use. This is a highly recognized challenge, which is about implementing what we know into practice, or knowledge translation (43, 76).

This thesis is underpinned by the large number of studies claiming that hospitalisation is detrimental for the frail and old (10, 28-31) and that many hospitalisations from nursing homes are potentially avoidable (6-9). These bodies of literature show that the transfer to hospital, the hospital environment and the abruptness of the continuity of care contributes to what has been described as a cascade of events in a downward spiral for the frail and old, resulting in increased dependency and a reduction of physical and mental functioning. It is important to acknowledge the methodological shortcomings of this literature. For one, there are very few of these studies that have compared nursing home residents that are transferred for acute care, with a control group treated within the nursing homes. In turn, it is not possible to draw conclusions on what the relative effects are. Secondly, many of the studies are retrospective, making use of administrative data, which has disadvantages of its own (64).

6.3 Implications of this study

The findings of this study demands for political action to improve the quality of care and the premises for informed decision making in nursing homes. To achieve this, it is necessary to fund further studies to strengthen the evidence-base for clinicians. But

as important is the necessity of supporting the uptake of existing evidence in nursing homes.

The Norwegian Directory of Health currently develops new quality indicators in LTC. It is advisable that this work extends in line with recommendations from the international work on quality indicators in LTC. For instance, to develop an external regulatory control, in addition to self-regulatory and legislative initiatives. This external authority, could deal with developing evidence-based standards, structural aspects like labour and infrastructure, and maybe accreditation of services. Another initiative that is highly valued is the idea of establishing a health registry in nursing homes, for quality improvement and research purposes.

6.3.1 Unanswered questions

Specific questions that are unanswered and that have emerged through the work with this study are:

- What are effects of interventions to promote evidence-based practice in nursing homes?
- How can an evidence-based practice best be implemented in nursing homes?
- What are effective quality improvement strategies in nursing homes?
- What are the patient and family preferences in case of acute illness, regarding hospitalisation or treatment in nursing home?
- What are attitudes, knowledge and skills levels for treating acute illness in nursing homes?
- What are the barriers among health personnel in nursing homes for treating the acute illness in the nursing home?
- What are patient level and nursing home level characteristics of Norwegian nursing home residents?
- What are outcomes for hospitalised nursing home residents, compared to residents treated in the nursing home?

- What are the underlying differences in small versus large nursing homes that determine hospitalisation practice?

7. CONCLUSIONS

Based on the objectives in the three papers that make up this thesis, major findings include:

7.1 Paper I

- The mean annual admission rate was 0.62 admissions per person-year for the nursing home population (≥ 67 years) and for the equivalent community dwelling population 0.26, in a large municipality in Norway.
- Among the nursing home residents, the commonest main diagnoses at discharge were falls related, respiratory- and circulatory diseases, which made up 55% of the cases. Length-of-stay during hospitalisation was median 3 days (IQR 4). In-hospital mortality rate was 16% and 30-days mortality rate was 29%.

7.2 Paper II

- The mean annual hospital admission rate per nursing home bed varies between 0.16 – 1.49 per nursing home, a variation with a factor of 9.
- There was a high correlation between the hospitalisation rates the first year to the next, specific to the nursing homes.
- Size and percentage short-term beds could explain 32% of the hospitalisation rate, while no association was found between hospitalisation rate and ownership.

7.3 Paper III

- The effects of eleven interventions to reduce hospital admissions were summarised and categorised into i) interventions to structure and standardise clinical practice, ii) geriatric specialist services and iii) influenza vaccination.
- Four out of seven interventions to structure or standardise treatment showed a reduction in hospital admissions (two advance care planning interventions, one intervention on palliative care services and a care pathway for lower respiratory tract infection).

- Both interventions testing geriatric specialist services reported fewer hospitalisations in favour of the intervention (both studies testing add-on human resources in the care in nursing homes with special competence).
- Two systematic reviews respectively tested influenza vaccination in residents and health personnel, where the former consisted of only observational studies. None of the reviews were able to show a reduction in hospitalisation rates.
- Using GRADE, the quality of the evidence for all outcomes was low or very low, making it impossible to draw firm conclusions.

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