Improving safety and quality of care for older hospitalised patients

A mixed methods approach focusing on delirium and e-learning

Lotte van de Steeg

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Contents

1

General introduction

The growing number of older people within most Western countries means that this subpopulation receives increasing attention from politicians, policymakers and researchers. Studies regarding patient safety have shown that older hospitalised patients are at greater risk for adverse events, such as delirium. These increased risks mean hospitals have to take action in order to prevent an aging population leading to an increase in adverse events in hospitals, and an increase in the healthcare consequences and costs associated with these events. In the Netherlands, efforts have been made to improve care for older hospitalised patients in the Frail Elderly Project (FEP), one of the projects of the national Patient Safety Programme. As part of FEP, hospitals worked on improving care for older patients regarding falls, malnutrition, functional decline, and delirium.
This thesis looks at how patient safety and quality of care for older hospitalised patients at risk for delirium can be improved, specifically focusing on the effects of e-learning on the implementation of FEP.

Older patients and patient safety
The Netherlands, as well as other Western countries, currently sees a change in hospital population towards older patients (CBS 2012). This development is leading to calls for changes in the provision of care, in order to continue to meet the needs of patients (RCP 2012, Cornwell et al. 2012). Older patients run an increased risk of experiencing adverse events (AEs) and preventable AEs during hospitalisation, compared to younger patients (Merten et al. 2013, Long et al. 2013, Thornlow 2009, Soop et al. 2009, Kable et al. 2008, Brennan et al. 1991). A Dutch study found that 2.9% of hospitalised older patients experience a preventable AE, compared with 1.8% of hospitalised younger patients (Merten et al. 2013). An AE is an unintended injury which results in temporary or permanent disability, death or prolongation of hospital stay. Furthermore it must be caused by the management of healthcare rather than the patient's disease (Zegers et al. 2007, Thomas et al. 2000). AEs are judged as being preventable if they occurred due to a failure to follow accepted practice.

In the literature, several potential predictors of preventable AEs in older patients have been identified. If predictors of preventable AEs are known, healthcare providers in hospitals can use them to identify high-risk older patients and take preventive measures where possible. Some authors have suggested that the reason AEs and preventable AEs occur more often during the hospitalisation of older patients is not due primarily to their age, but to the diminished physiological reserves of this patient group (Thornlow 2009, Rothschild et al. 2000, Gray et al. 2009). They suggest that diminished

reserves make it more likely that medical mistakes will lead to actual injury. Another possible explanation that is mentioned in the literature is the increased length of stay of older patients, due to clinical complexity (Thornlow 2009, Thornlow et al. 2009). A longer length of stay, according to the authors, means increased exposure to the opportunities for errors to occur. One study attempting to clarify whether age or other factors were the best predictors of preventable AEs found that age was not an independent predictor (Thomas & Brennan 2000). According to the authors, this suggests that age-related discrimination did not play a role in the increased risks of preventable AEs, and that this increased risk in older patients was possibly due to the increased complexity of their care.

Delirium

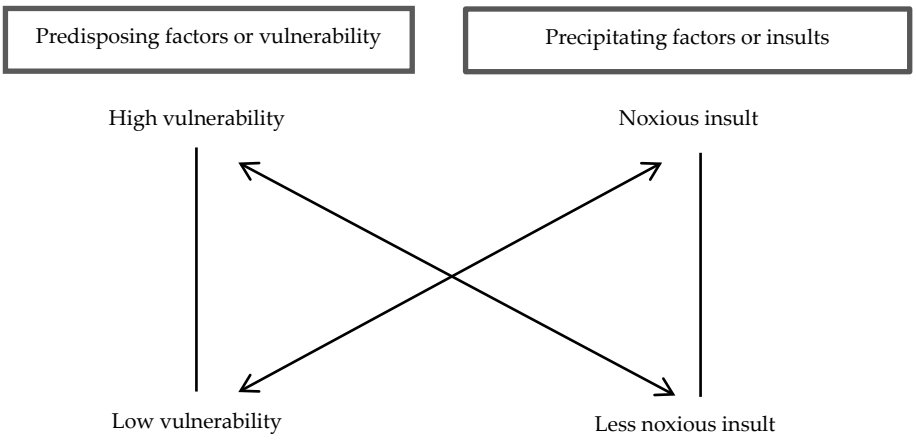
There are many different types of adverse events occurring in hospitals, ranging from medication errors to geriatric syndromes such as falls and delirium. As mentioned in the definition of adverse events given earlier, whether a complication can be considered an adverse event depends on whether it has negative effects on the patient and on whether the event was caused by the provision of care rather than by the disease of the patient. This means that not all hospitalised patients experiencing a delirium experience an adverse event. However, delirium is often caused by deficits in hospital care and can therefore often be considered an adverse event (Inouye et al. 1999).

Delirium is a common condition in older hospitalised people, occurring in up to 30% of this patient population, even higher rates are reported in intensive care, palliative care and surgical settings (Martins and Fernandes 2012, Mittal et al. 2011, Inouye et al. 2014, Morandi & Jackson 2011). It is a neuropsychiatric syndrome characterised by a disturbance of consciousness and attention, as well as a change in cognition or a disturbance of perception (Korevaar et al 2005, Mittal et al. 2011).

The risk of developing delirium depends on a combination of the vulnerability of the patient – predisposing factors – and events taking place during hospitalisation - precipitating factors – (see Figure 1.1, Inouye 1996, Inouye 2014). This multifactorial model of the causes of delirium means that in a vulnerable patient, for instance with existing cognitive impairment, a relatively benign event or insult, such as a dose of a sedative, can lead to delirium. In a healthy patient, with low vulnerability, delirium might only develop after several noxious insults, such as a combination of anaesthesia, major surgery, several doses of psychoactive drugs or sleep deprivation. Common identified predisposing factors are cognitive impairment, functional impairment and advanced age, which can interact with

precipitating factors such as infection, polypharmacy and surgery (Ahmed et al. 2014, de Castro et al. 2014, Inouye et al. 2014, Newman et al. 2015, Zaal et al. 2015).

Figure 1.1 Multifactorial model of delirium (Inouye et al. 2014)



Several studies have shown that around a third of delirium cases can be prevented by improving the quality of delirium care in hospital, often by using multicomponent approaches targeting risk factors for delirium (Cole et al. 1999, Inouye et al. 1999, Marcantonio et al, 2010, Vidan et al. 2009). This can for instance mean improving the physical condition of patients by ensuring they are not malnourished or dehydrated, reducing polypharmacy and preventing or treating infections.

Delirium is noted for its acute onset and fluctuating state (Schuurmans et al. 2001), which are key features that separate delirium from dementia. However, given the fluctuating state of delirium and the similarities in symptoms with dementia, depression, and psychosis, delirium is sometimes hard to diagnose (Schuurmans et al. 2001, Inouye 2006, Inouye et al. 2014), which creates a problem for providing adequate delirium care. Studies have indicated that between 32% and 67% of delirium cases are missed during hospital stay (Inouye 1994). Under-detection and subsequent inadequate care present a problem, because delirium is associated with adverse outcomes, such as increased length of hospital stay, functional decline and higher mortality, as well as a higher workload for nurses and significantly higher healthcare costs (Anderson 2005, Dasgupta et al. 2014, Eeles et al. 2010, Leslie et al. 2008, Siddiqi et al. 2006, Witlox et al. 2010)). Experiencing a delirium often causes great distress to both the patient, their family, and the

healthcare professionals involved (O'Malley et al. 2008, Belanger & Ducharme 2011, Partridge et al, 2013).

National Patient Safety Programme

In the Netherlands, the national Patient Safety Programme ran between 2008 and 2012, aimed at improving patient safety and reducing adverse events in hospitals (VMS Veiligheidsprogramma 2013). The Programme combined two approaches to improving patient safety in Dutch hospitals:

- Implementation of a safety management system;
- Improving care on eleven medical themes[1].

The themes of the Dutch National Patient Safety Programme were:

- Acute coronary syndrome
- Acute deterioration
- Children
- Frail elderly
- High-risk medication
- Kidney failure
- Medication verification
- Post-operative wound infection
- Pain
- Sepsis
- Wrong surgery

The Frail Elderly Project (FEP) was one of the medical themes of the Safety Programme. The FEP seeks to improve care for patients aged 70 and over, by improving care regarding falls, malnutrition, functional decline, and delirium (VMS Veiligheidsprogramma 2009). The project, which includes care guidelines for these four subjects, is based on existing evidence regarding care for older patients, as well as expert opinion. The FEP delirium guideline primarily aims to improve recognition of older patients at risk for developing delirium and recognition of delirious older patients (Van de Steeg et al. 2012, Van de Steeg et al. 2014, VMS Veiligheidsprogramma 2009). Early recognition of at-risk patients gives healthcare professionals the opportunity to take action to identify and minimise risk factors, potentially preventing the occurrence of delirium. In order to identify at-risk patients, use of a short screening instrument –

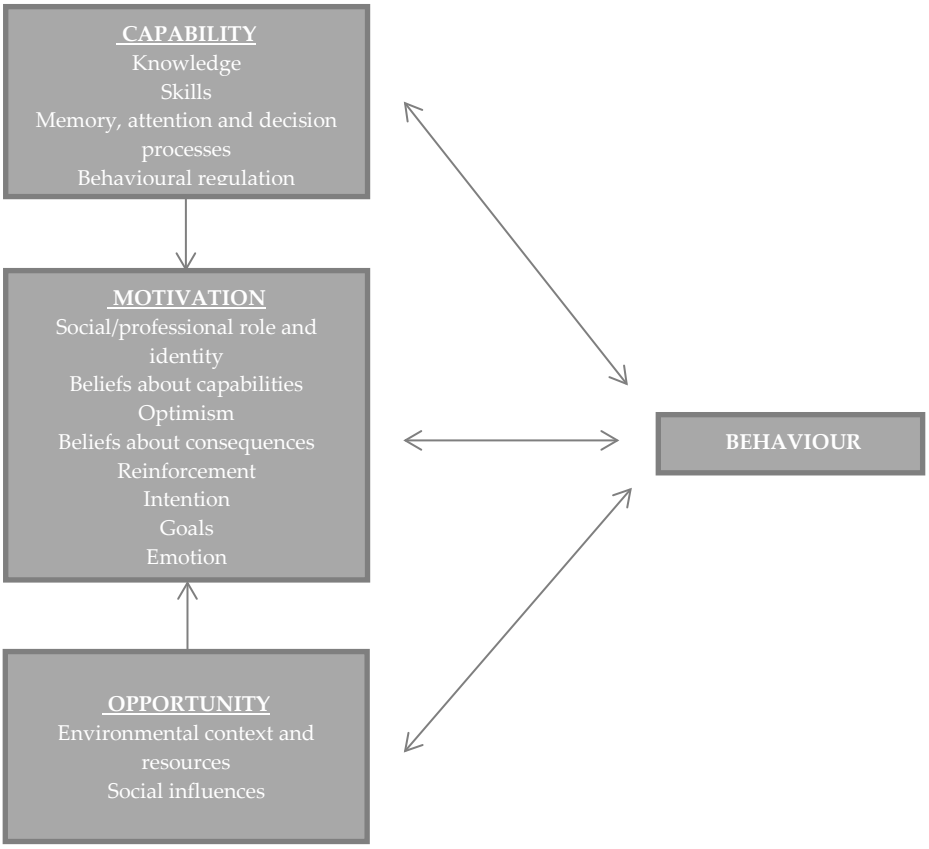
[1] Initially ten themes were included in the programme, but an eleventh – Children – was added later.

consisting of three questions – is advised in the guideline, with some hospitals choosing an alternative instrument, such as the Groningen Frailty Indicator (Steverink et al. 2001) and the Identification of Seniors At Risk or ISAR (McCusker et al.1999).
The FEP delirium guideline also encourages the use of the Delirium Observation Screening scale (DOSS) (Van Gemert & Schuurmans 2007), which nurses can use to identify possibly delirious patients, and provided information on nursing and medical interventions targeting common reversible causes of delirium.
The implementation of FEP was a task for the hospitals themselves; no onsite support or training is provided by the Patient Safety Programme. Nevertheless, national conferences were organised between 2008 and 2012 and a guide was published. In addition, a national network of hospitals, aimed at knowledge exchange, was started as part of the Safety Programme.

Implementing the FEP delirium guideline
As mentioned above, the Patient Safety Programme did not provide implementation support in the participating hospitals themselves; implementation of the projects lay solely with the hospitals. Although FEP included advice on implementation, there were indicators during the project period that implementation was not going smoothly (IGZ 2010). The Dutch Health Care Inspectorate found that in 2010 only 56% of hospital wards screened 80% or more of the older patients for the risk of developing delirium. Of the patients at risk, only 50% were monitored for the presence of delirium using an assessment instrument, such as the DOSS (IGZ 2010). This indicates that, although an evidence-based guideline was available for delirium care, nurses did not follow it consistently. Similar results have been found for healthcare professionals in the United States (Ely et al. 2004, Pun et al 2005).
Other studies have also shown the difficulty of successfully implementing guidelines, regardless of which specific healthcare problem, patient population or professional group the guideline is aimed at (Al-Damouk et al. 2004, Cabana et al. 1999, Davison et al. 2012, Koh et al. 2008). Guidelines are put forward as a means of getting research evidence into practice and are aimed at ensuring that the provision of care is of sufficient quality, suggesting that poor implementation means that the best health outcomes are not achieved. A large array of theories exist, attempting to clarify behaviour change and the factors that influence the behaviour change processes that play a role in the implementation of guidelines. In 2005 a group of researchers developed a theoretical framework on behaviour change, based on available psychological theories (Theoretical Domains

Framework, Michie et al. 2005). The refined framework consist of 14 theoretical domains that play a role in the process of behaviour change, which can be used to explain implementation problems or inform implementation efforts (Michie et al. 2005, Cane et al. 2012). The domains range from knowledge and skills to intentions, environmental context and emotion, which in turn can be condensed into three core components: capability, opportunity and motivation. These three components are represented in the COM-B model (see Figure 1.2). This model shows that human behaviour results from the interaction between an individual's physical and psychological capabilities, including knowledge and skills, their opportunities, consisting of social influences and environmental context, and their motivation, shaped by their beliefs about capabilities, their professional role, etc. (Michie et al. 2011).

Figure 1.2 COM-B model for understanding behaviour, combined with the domains from the Theoretical Domains Framework (Cane et al 2012, Michie et al. 2011)



The Theoretical Domains Framework and the COM-B model illustrate that changing people's behaviour is a complex process, involving many different aspects of the individuals, organisations and interventions involved.

Possible implementation barriers

As mentioned earlier, the implementation of the FEP guideline on delirium care had not been successfully completed by 2010. Based on the Theoretical Domains Framework and international studies on delirium care, several domains can be identified that might play a role in the difficulties Dutch hospitals were experiencing in improving delirium care. One such domain was knowledge. Previous research has shown that nurses often fail to recognise delirium in older hospitalised patients (Flagg et al. 2010, Rice et al. 2011), limiting their ability to provide adequate delirium care. Several authors have suggested that this poor recognition is caused by a lack of knowledge on delirium, especially on the importance of early recognition and treatment of delirium (Teodorczuk et al. 2012, Flagg et al. 2010). Other recent studies showed that an educational intervention on delirium significantly improved nurses' knowledge of delirium (Gesin et al. 2012, Meako et al. 2011).

Poor implementation of the FEP delirium guideline in the Netherlands might be related to a similar problem as identified in the literature: a lack of knowledge on the importance of early recognition of delirium and on the possibilities of treatment, which might in turn mean a lack of motivation concerning the implementation of FEP. This would suggest that an educational tool will be valuable for further improvement of delirium care. Because knowledge about delirium is relevant for virtually all nurses working within the hospital, an educational approach that can improve knowledge and skills for large groups of people is needed. E-learning is one method available for efficiently educating a large number of people.

E-learning

A review by Cook et al. (2008) has shown that the use of e-learning or `internet-based education' is associated with a positive effect on knowledge, skills, and behaviour of healthcare professionals, as well as on patient outcomes. More ambiguous results have been found for computer-assisted learning aimed at nurses, suggesting more research is needed in this field (Bloomfield et al. 2008). Computer-assisted learning refers to all methods of using computerised technology to facilitate education, including e-learning. Whether e-learning can provide a valuable tool for improving delirium care specifically has yet to be determined, though researchers have suggested e-

learning as an important option for improving delirium education (Irving et al. 2009).
In the context of quality and safety in hospitals, it is important to guarantee a sufficient level of knowledge in healthcare professionals. As an alternative to traditional education, which is relatively labour-intensive, time-consuming and therefore expensive, e-learning can be useful when improving knowledge in a large group of nurses (Lahti et al. 2014). Advantages of e-learning include flexibility in time management, pace of learning and quality assurance. However, barriers such as a limited level of computer literacy in users are also associated with the use of e-learning (McVeigh 2009, Roe et al. 2010). All in all, while there are indicators that e-learning will be a valuable addition to efforts aimed at improving delirium care in hospitals, based on the literature we cannot be certain if and to what extent it will solve the problems Dutch hospitals have experienced with the implementation of the FEP delirium guideline.

Aim and research questions

This thesis focuses on patient safety and quality of care for older hospitalised patients at risk for delirium, and specifically on the effects of e-learning on the implementation of FEP. The general research question of this thesis is:

How can safety and quality of care for older hospitalised patients at risk of delirium be improved?

The general research question is divided into five specific research questions:

1. *Which barriers exist to adherence to the FEP delirium guideline by nurses?*

This research question focuses, in particular, on nurses' behaviour regarding delirium care for older patients and the factors that influence that behaviour. We aimed to identify and classify barriers to guideline adherence by nurses by exploring the perceptions of nurses and other professionals regarding the implementation of the FEP guideline on delirium care. (Chapter 2)

2. *Does the use of e-learning improve nurses' delirium knowledge?*

While the first research question aims to identify barriers to the adherence to the FEP guideline, questions two and three look at a possible means of neutralising some of these barriers: adding an educational intervention to FEP. Our aim was to assess the effect of an e-learning course, based on nationally recommended guidelines for delirium including the FEP guideline, on nurses' delirium knowledge. In addition, we looked at the association between participant demographics and baseline delirium knowledge, as well as between demographics and the effect of the course on this knowledge. (Chapters 3 and 4)

3. *Does the use of e-learning improve the provision of delirium care by nurses according to the FEP delirium guideline?*

We focused on the effects a complementary e-learning course has on the implementation of the FEP guideline on delirium care. The hypothesis underlying this question is that use of e-learning will increase nurses' knowledge regarding delirium and their willingness to change their behaviour regarding at-risk patients. We further hypothesised that these effects will in turn lead to changes in the care provided: screening of older patients for risks, observing at-risk patients for delirium, and taking preventive or curative measures. (Chapters 3 and 5)

4. *What can delirium rates based on patient records tell us about the occurrence of delirium in the Netherlands?*

After using patient records to answer several previous research questions, this final question looks more in detail at the usefulness of patient records as a source of information on delirium occurrence. Patient records are an essential part of the care process, facilitating communication of information on patients and patients' care between professionals and between hospital wards. Increasingly, patient records are also being used as a source of data, to assess quality of care or to conduct research. Both uses of patient records –

as part of the care process and as data source – rely on the accuracy of the documentation within these records. To examine whether patient records can provide useful information on delirium occurrence rates, this study aimed to determine delirium rates among hospitalised surgical and non-surgical inpatients in Dutch hospitals, as documented in patient records from 2011/2012. In addition, we looked at the extent to which recorded delirium rates vary between hospitals and hospital wards, after correcting for patient- and admission characteristics. (Chapter 6)

5. *Can preventable adverse events in older patients be predicted using a predictive model?*

After focusing on delirium specifically, the thesis now looks at adverse events in general: is it possible to develop a model with which older patients at risk for all types of preventable adverse events can be identified? Such a model would use clinically important risk factors that are readily available on admission. Our intention is to design a model that can be used by healthcare providers in hospitals, so they can identify older high-risk patients for preventive measures or closer clinical attention. (Chapter 7)

The general discussion (Chapter 8) provides an overall conclusion of results that were found in the preceding chapters, and an interpretation of them. Chapter 8 also discusses methodological considerations and gives implications for future research and recommendations for policy and practice.

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2

Improving delirium care for hospitalised older patients. A qualitative study identifying barriers to guideline adherence

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Abstract

Rationale, aims and objectives
Guidelines are intended as a means of getting research evidence into practice and ensuring provided care is of sufficient quality. However, the effect of guidelines is hindered by limited guideline adherence. The aim of this study is to identify and classify barriers to adherence by nurses to a guideline on delirium care.

Methods
Open-ended interviews were conducted with a purposive sample of 63 research participants. The sample included 28 nurses, 18 doctors and 17 policy advisors working in 19 hospitals in the Netherlands. The interviews were conducted between June and September 2011. The data were analysed using thematic analysis.

Results
Barriers to guideline adherence that were identified could be grouped into four themes: motivation and goals, knowledge and skills, professional role and identity, and context and resources. While the interviews with nurses, doctors and policy advisors produced similar views of the current situation, doctors and policy advisors placed a higher importance on education as a means of stimulating adherence.

Conclusions
This study illustrates that individual, social and organisational factors play a role in nurse's adherence to a delirium guideline. The potential benefits of following a guideline, both for patients and for nursing staff, need to be highlighted in order to motivate nurses. When formulating new guidelines, nurses' perceptions of their professional role and patient care need to be taken into account to ensure that policy makers and managers are realistic about guideline adherence and engage with nurses from a position of mutual respect and trust.

Introduction

Studies have shown the difficulty of persuading health care professionals to adhere to guidelines regarding the provision of care [1–3]. These guidelines are put forward as a means of getting research evidence into practice and are generally aimed at ensuring that the provision of care is of sufficient quality [4,5]. Why is it that health care professionals show reluctance in following guideline recommendations? Most studies have focused on barriers to doctor's adherence to guidelines rather than on barriers to nurses' and other health care professionals' adherence [6]. Yet considerable consequences can be expected to flow from nurses' adherence or failure to adhere to guidelines. Nurses attend most frequently to patients, given their role and location in immediate care duties by the bedside. Despite increased knowledge about factors influencing guideline adherence and implementation, few clear answers have been given to the question of how to successfully introduce clinical guidelines into practice [3,7].

The opportunity for the current examination of guideline adherence was provided by a national patient safety programme in the Netherlands, which resulted in a guideline on care for older hospitalised patients being delivered in 2009 [8]. This was aimed at care for patients aged 70 and over, and included recommendations regarding delirium care. The guideline was based upon existing evidence regarding care for older patients, as well as expert opinion. The guideline recommends that delirium care includes nursing activities, such as screening patients for the risk of developing delirium, assessing patients for delirium, initiating preventative measures and supporting treatment (Box 2.1). The Dutch Health Care Inspectorate found that in 2010 only 56% of hospital wards screened 80% or more of the older patients for the risk of developing delirium [9]. Of the patients at risk, only 50% were monitored for the presence of delirium using an assessment instrument, such as the Delirium Observation Screening Scale (DOSS) [10]. This indicates that, although an evidence-informed guideline was available for delirium care, nurses do not follow it consistently. Similar results have been found for health care professionals in the United States [11,12].

Box 2.1 Summary of Dutch guideline on delirium care (VMS, 2009).

Risk screening for all patients aged 70 and over.

Three questions for the patient and/or family or caregivers, asked by nursing staff:

- Do you experience memory problems?
- Have you needed help with self care in the last 24 hours?
- Have you experienced periods of confusion during earlier hospital stay or illness?

One or more questions answered with 'yes' indicates a risk of developing delirium.

Possible nursing interventions

- Observation with the Delirium Observation Screening Scale
- Prevent dehydration, infections, electrolyte disturbances, etc.
- Adequate treatment of pain
- Preserve nutritional level
- Inform patients' family
- Improve sensory perception
- Restrict restraining patients mechanically

Possible medical interventions

- Review medication
- Prevent dehydration, infections, electrolyte disturbances, etc.
- Adequate treatment of pain
- Consider stopping the use of invasive interventions
- Restrict restraining patients mechanically
- Provide a circadian rhythm
- Consult geriatrics

Recommendations regarding implementation

- Create a sense of urgency
- Gather a project team together
- Develop a plan of action, containing vision and strategy
- Communicate that vision and strategy to others
- Remove obstacles to following the guideline
- Create short term, visible, successes
- Continue pursuing change after the first results have been had
- Make the new situation part of the organisational culture
- Incorporate the risk screening in medical history forms
- Incorporate the recommendations from the guideline in the hospital delirium protocol

Research indicates that the focus on barriers to guideline adherence ought to be more broadly based, showing that barriers can be found at several levels [6,13–15]. A combined focus on older people and nurses provides an opportunity to test this broadly based focus on guideline adherence. Older people comprise a large proportion of the patient population worldwide, and this proportion is only expected to increase [16]. This implies that looking specifically at guidelines aimed at older patients and the possible barriers that play a role in adherence to these guidelines is of importance for quality of health care now and will become even more so in the future. Furthermore, older people are more likely than younger people to suffer multiple conditions simultaneously, creating greater risks from treatment that is poorly coordinated [17], as well as from possible conflicting guidelines.

This paper focuses, in particular, on nurses' behaviour regarding delirium care for older patients and the factors that influence that behaviour, as a window onto their adherence to guidelines. If guidelines are valued by policy makers, we need to know the range of barriers to guideline adherence and be able to conceptualise them. The aim of this study was to identify and classify barriers to guideline adherence by nurses, by exploring the perceptions of nurses and other professionals regarding the implementation of a guideline on delirium care.

Methods

Study design and setting

This qualitative study was conducted between June and September 2011 and consisted of 63 open-ended interviews. We chose this approach because interviews can offer insight into experiences and attitudes, as well as intentions that inform people's behaviours [18]. This qualitative study was part of a larger research project focusing on the effect of e-learning on delirium care for older patients: a stepped wedge trial on the effect of e-learning on delirium care [19].

Data were gathered in 19 Dutch hospitals, which included 2 university hospitals, 6 tertiary teaching hospitals and 11 general hospitals, varying in size (from 138 to 1230 beds) and geographical location. The hospitals that responded to the invitation within the inclusion period were included in the study, provided they had already started working according to the government-sanctioned guideline of care for older patients [8]. This criterion was chosen to ensure that the hospitals would be able to supply relevant data. Nearly all hospitals in the Netherlands were initially invited (81) to

participate in the study, excluding specialised hospitals such as eye clinics and cancer hospitals, and 10 hospitals already participating in a different study concerning care for older patients. Thirty hospitals responded positively to the invitation, six of which responded outside the inclusion period. Five hospitals declined to participate after receiving more information about the study – one after already being enrolled in the study – mostly due to time constraints.

Participants

Interview participants were selected by asking the contact person for the study in each hospital, generally a policy advisor or team leader, to provide the research team with the names of persons willing to participate. The aim was to interview at least one doctor, one nurse and one policy advisor per hospital, all with experience regarding care for older patients, either directly or indirectly. Policy advisors were employed by the hospital and involved with developing, implementing and monitoring hospital policy. While some had a clinical background, this was not necessarily the case. Our goal was to speak with individuals who could provide information and perspectives on processes and practices in the hospital for delivering care to older patients.

Some contact persons suggested that in order to gain a more rounded view of care for older patients in their hospital, an interview with a fourth person was necessary. If this was the case, such an additional participant was also approached. We chose a wide selection of professionals, from a large number of hospitals, in order to gain insight into the different experiences with, and diversity of opinions on, care for older patients and the guideline on delirium care. Clinicians were recruited both from general medical and surgical wards and from specialty geriatric units. On average, 3.5 persons per hospital were interviewed, with three being the minimum and five the maximum number of participants for a single hospital. See Table 2.1 for the sample of interviewed health care professionals.

Table 2.1 Health care professionals interviewed about delirium care for older patients

Health care professionals	Number
Doctors (surgeon, internist, psychiatrist)	7
Geriatricians	11
Nurses (from surgical and internal medicine wards)	14
Nurse team leaders	4
Geriatric nurses	10
Policy advisors	17
Total	63

Data collection

The open-ended, semi-structured interviews were conducted by two researchers (RI and LS) using a topic guide based upon a review of implementation literature [15]. For policy advisors, the focus was on their experiences with introducing the guideline on care for older patients into their hospital. Nurses, policy advisors and doctors were questioned to gauge their perspectives on the behaviour and attitude of nurses regarding care for older patients and the delirium guideline, as well as their own experiences.

All participants were initially approached by the hospital's contact person for the study, with whom the researchers maintained contact during the research period. The contact person and subsequently the researcher conducting the interview explained the study aims and methods. The participants were assured that their individual comments would remain confidential. Research ethics committee approval was obtained for the study protocol of the larger research project, which included this qualitative study.

Interviews were conducted until data saturation was reached, meaning that no new ideas or themes emerged during the interviews [20]. Overall, the interviews lasted between 30 and 75 minutes. They were audio-taped and later transcribed by the researchers. Three participants were interviewed by phone, for which transcription was undertaken by hand. Reliability of transcription was enhanced by returning the transcripts to the participants for verification and comment [21]. The interviews took place at a location convenient for the participant, generally a meeting room or office in their hospital. The interviews were conducted and analysed in Dutch.

Data analysis and rigour

The interview transcripts were coded by the two researchers who conducted the interviews, using MAXQDA 2007 (VERBI). A coding structure was developed by these researchers prior to coding, to facilitate the thematic qualitative analysis. This structure was based upon the theoretical background that was used when assembling the topic guide and other implementation literature [15,22].

The coding structure was expanded and modified after both researchers independently coded the same interview transcript and discussed the differences in assignment of codes and interpretation of codes [23]. Following the coding of all transcripts, the researchers each independently coded five transcripts that had already been coded by the other researcher. For these 10 transcripts, the double set of codes were discussed until consensus was reached [24]. This led to a further modification of the coding structure. Subsequently, all coded transcripts were reviewed and checked against the final coding structure. Codes were then categorised and themes were identified.

Results

In the following section, the findings from the interviews will be presented, grouped into four themes that emerged from the findings. These themes provided insight into the behaviour of nurses concerning the Dutch guideline on delirium care: motivation and goals, knowledge and skills, professional role and identity, and context and resources.

Motivation and goals

The interviews indicated that overall, nurses lack motivation to use the risk screening instrument, despite the recommendation in the guideline. This is mainly influenced by the apparent lack of clarity of the benefits and goals of screening. As a result, nurses view screening as simply completion of another registration form, encroaching on the time available for patient care.

> *My experience is that nurses are quick to say: 'Oh, not more [registration]' because it always comes at the expense of patient care. And of course it is a lot they have to do, filling in all these forms.*
>
> Geriatric nurse hospital 9

Nursing team leaders in particular suggested that convincing nurses of the benefits of screening would be easier if evidence of these benefits was

available. Studies showing the effect of the risk screening on patient outcomes are believed not to be widely avail- able. The results of screening are not directly visible for nurses either. Most hospitals do not have data available regarding their performance on delirium care, making it impossible to show whether the screening of patients leads to better overall patient outcomes.

> *The readiness to change is there as soon as the nurses see the benefits themselves. A delirious patient takes up a lot of time. (. . .) You will notice few results of the implementation in the short term, only long term will more results become evident. This complicates the implementation.*
>
> Geriatric nurse hospital 12

Doctors had a similar view, recognising that nurses are often initially sceptical towards risk screening, mainly because of the expectation that screening will increase their workload. Like nursing team leaders, doctors felt that nurses needed to be properly informed of the benefits of risk screening in order to motivate them. More importantly, nurses need to experience these benefits first-hand.

> *Besides the lack of time, I think that a lack of awareness and knowledge of health problems in older persons and the importance of screening contributes to the screening not taking place as planned. Nurses rarely see direct effects of the screening taking place or not, making it difficult to connect screening to the end goal.*
>
> Geriatrician hospital 8

Besides the advantages of screening being unclear, nurses did not always experience a need for changing delirium care and introducing screening: they felt that care for delirious patients was already optimal. The risk screening as a whole was seen as an obligation, imposed on the nursing staff from the 'top down'. Nurses would screen patients not because they thought it useful but because they had to.

> *DOSS, for instance, is a lot of work to fill in correctly and not every nurse sees the value of that instrument. They'll say: 'I can see for myself whether a patient is confused'. While at the same time after a fall incident it will become clear that the patient had a very high DOSS score, which had not resulted in any actions.*
>
> Nurse team leader internal medicine hospital 1

Knowledge and skills

The level of knowledge nurses reported concerning the guideline and the larger patient safety programme that it stems from differed greatly. Team leaders and nurses specialised in care for older patients showed greater knowledge about the guideline and its background than most nurses from other medical and surgical units. Risk screening was the aspect of the guideline that most nurses were familiar with.

In general, nurses conveyed that they had sufficient knowledge and skills to use the screening instrument to identify at risk patients, or the DOSS in order to observe possibly delirious patients. This perception is supported by the fact that these instruments were developed for use by nurses without specific training. Whether nurses considered themselves capable of taking subsequent preventive or treatment measures is less clear: some indicated high levels of confidence, whereas others had doubts about their own and others' level of knowledge.

> *I believe I have sufficient knowledge regarding delirium: theoretical knowledge from my formal education and knowledge from personal experience (. . .). My colleagues are well informed about delirium. They are quick to recognise a delirious patient based on their behaviour and the (irregular) answers they give when questioned.*
>
> Orthopaedic nurse hospital 6

During the interviews, it became clear that delirious patients put pressure on nursing staff. They require extra attention from nurses and can also make nurses feel as if they are practicing unsafely. Participants believed that nurses who had experienced the difficulty of coping with these patients on the ward were open to advice on how to handle delirious patients.

> *Nurses are open to training on delirium care, because care for delirious patients can be very difficult and nurses appreciate learning how to deal with these patients better. They [delirious patients] are very difficult [patients], so if you experience a lot of impotence it is no good just being told to act professionally. You have to help people [nurses] of course.*
>
> Geriatric nurse hospital 15

Doctors mainly emphasised the importance of additional education for nurses on delirium screening and treatment.

> *Working with the DOSS is sometimes difficult for nurses. Extra education on this subject is needed. Nurses are inclined to directly judge from their*

observations, while the DOSS requires the observations to be scored without judgment or interpretation.

Psychiatrist hospital 8

One doctor suggested that a lack of knowledge about delirium care might increase the use of pharmacological interventions or patient restraints because nurses are insufficiently aware of the non- pharmacological interventions at their disposal.

Context and resources

The social pressure to screen all older patients appears to be limited: it is generally accepted among nurses that other activities take precedent over screening. This finding is confirmed by the search of nurse team leaders for ways in which screening can be enforced.

It is clear that it still is difficult for nurses to complete the whole medical history, including risk screening, for every older patient. This is probably part of the culture. On the wards we do several things to try to change this, such as starting up a competition. Every week we check which percentage of older patients had a complete medical history. The team with the lowest percentage has to buy the others cake. The competition element helps increase the completion of the medical history of patients.

Nurse team leader internal medicine hospital 1

An important factor influencing nurses' behaviour regarding the guideline was the perceived time nurses have to invest in screening and other activities, such as observing patients using the DOSS. Nurses report having a shortage of time in which to perform their day-to-day tasks, leading to the professed inability to perform time-consuming or perceived non-essential activities such as screening or observing patients using the DOSS. This perception of nurses was not conducive to a positive attitude towards changing delirium care.

Concerning the screening, nurses are quick to say: 'We are already very busy and we already have to fill in so many lists. However, this is nothing new: nurses have complained about lack of time before this project and they will probably be complaining in the future. (. . .) It really is difficult; there are so many measurements that need to be taken for one patient. And you don't have one patient, you have 38 on a ward. It just is a lot.

Nurse team leader surgery hospital 8

The fact that policy advisors generally work for the entire hospital rather than a specific ward or specialty might help them develop a broader view of delirium care. Policy advisors indicated during the interviews that a striking feature of delirium care, for them, was the difference between wards. While some wards were highly receptive to the introduction of risk screening, other wards were less open to this change. The presence of enthusiastic leaders and the experience with delirium care on the ward were factors that the policy advisors identified as influential.

> *The ease with which a protocol is translated into a different way of working differs strongly per ward. On wards such as neurology, many of whose patients are delirious, a new proto- col is easily picked up by nurses because they recognise its importance.*
>
> Policy advisor hospital 10

> *If a team leader 'gets' the subject, the subject gets attention on the ward. (. . .) I see it here, with a team leader who was part of the project team; she is also very actively involved with the subject on her own ward. (. . .) The team leader is the pivot on which everything hinges: the wards that are furthest along have a team leader who makes an effort.*
>
> Policy advisor hospital 1

As well as the doctors, the policy advisors were convinced of the importance of education for nursing staff, especially to increase awareness. However, they indicated that to change nurses' behaviour, education alone was not sufficient. They believed that the effects of formal education wear off over time or are negated by the effects of their working environment, after which old habits reappear.

> *Nurses understand the choice for the new way of working, but when on their wards they do fall back on old methods and patterns. Within the hospital we are still looking for a way to really make the new way of working sink in with the nurses and make them enthusiastic about it.*
>
> Policy advisor hospital 1

The presence of other projects in the hospitals or other changes taking place play a role in the attitude and behaviour of nurses regarding delirium care and changes made to this type of care. Policy advisors suggested that the introduction of an electronic patient record (EPR) influenced the introduction of risk screening, both positively and negatively. Using the introduction of the EPR as a way of including screening instruments in the

regular medical examination also meant using it as a way of stimulating screening. An additional advantage of working with an EPR, expressed by policy advisors, is the data on performances and patient outcomes that can be generated. They expect this will make it possible to show nurses the benefits of changing the care they provide, with the intention of positively influencing the motivation of nurses regarding screening in particular.

> *The hospital is working on an EPR. I hope that this system will lighten the load for nurses, for instance by showing certain measurements and follow-up actions automatically so nurses don't have to keep track of these actions themselves. By making certain fields for registration compulsory in the electronic record, nurses can be supported as well. Because of time pressure, measurements or registrations are sometimes skipped, with the intention of doing them later, which is often subsequently forgotten.*
>
> Policy advisor hospital 4

On the other hand, some argued that the introduction of the EPR required so much attention and time of the nursing staff that delirium care and screening suffered for it. This is supported by the view expressed by some participants that nurses have been and are being confronted with such a great number of changes that they are unable to keep up and fail to fully incorporate these changes in their routine practice.

Professional role and identity

Nurses view screening as not being part of the essential care for older persons. This is exemplified by the fact that nurses report that screening is one of the first activities they omit when time is limited.

> *The project regarding care for older patients was well received; it filled a need. But [computer work] is also the first thing you drop: patient care always comes before computer work. Your report needs to be finished for the next shift and the things you abandon first are scores, check lists or registration lists.*
>
> Internal medicine nurse hospital 18

Not only did these nurses not consider delirium risk screening to be an intrinsic part of their job, some nurses also disagreed with the content of the guideline. The screening instrument is seen as limiting their autonomy, while they have little faith in the useful- ness of the instrument itself.

> *I prefer using my clinical observation instead of a score. I'm sure the three questions on delirium are theoretically sound, but in practice they are useless.*

The question regarding self- care for instance: there are so many people that need help with self-care activities, but even if that is the only question answered positively, you have to use the DOSS three times a day! That is not motivating.

Internal medicine nurse hospital 16

Nurses believe that the screening instrument and DOSS strengthen their position when communicating with doctors. It provides them with a way to clearly indicate the risks or symptoms identified. The increased credibility it gives nurses is believed to stimulate use of the guideline.

A negative influence on delirium care is the general view from participants that most nurses on general wards consider care for older patients to be uninteresting or 'not exciting'. Several doctors concurred with this notion. This type of care is viewed by nurses as 'basic care', as opposed to more attractive highly specialised care such as oncology or intensive care nursing.

There are nurses that are interested in older patients or care for older patients and then there are people who simply say out loud, how horrible they find it.

Geriatric nurse consultant hospital 15

There are surgical wards where the nursing staff believe these types of patients do not belong on their ward. The majority of the staff do not think care for older persons is interesting, and believe these patients do not belong in hospital.

Internist hospital 12

Nurses like having been given more resources. Added to this they don't have to argue with doctors anymore. If a patient meets a certain criterion, then medication has to be started. The protocol has become more clear, which leads to less argument.

Internal medicine nurse hospital 13

Discussion

This qualitative interview study explored the gap between formal guidelines and their adherence in practice, drawing on the case of delirium care in Dutch hospitals. In addition to previous knowledge of barriers to guideline adherence, this study illustrates that individual, social and organisational factors play a role in nurse's adherence to a delirium guideline. Barriers were identified regarding motivation and goals, knowledge and skills, professional role and identity, and context and resources. The findings show

that some barriers were relatively clear-cut, such as a lack of understanding of the potential benefits of working according to the guideline, where others were more complex, touching upon differing views of the professional roles of nurses. Predominantly, the study showed the interplay between behaviour and context that habituates behaviour, the latter of which needs to be taken into account if guideline adherence is to be a realistic prospect in day-to-day work.

Our findings show that nurses often equated screening with registration, not recognising the actual goal of identifying at-risk patients and being able to provide preventative care. The supposed lack of evidence supporting the screening instrument in some quarters is perceived to exacerbate the weak motivation of nurses regarding screening. Given nurses' relative autonomy and professional accountability, the fact that they would question the need to follow this guideline might not come as a surprise. That this critical attitude of nurses is viewed as a problem by the hospital or their colleagues confirms the findings of Bail et al. [25], who found that hospitals expect their nursing staff to be obedient to hospital policy and requirements, while the nursing profession expects nurses to be autonomous professionals with their own clinical judgment.

Furthermore, nurses feel that the guideline has to be followed as is, not leaving room for specific situations in which the patients' needs justify deviating from the guideline. This perceived inflexibility of a guideline in dealing with the complex reality of clinical care has been recognised in other studies [25–27]. While policy advisors expect the introduction of an EPR to improve the adherence to the guideline, this could also increase nurses' dissatisfaction with the guideline by further limiting the autonomy of nurses. In the United States, the use of a reliable and valid instrument for delirium assessment in intensive care units was hindered by a lack of time and confidence in using the instrument [12]. We also found that time played an important role in the Dutch context: nurses who already experienced a shortage of time felt that applying the guideline required them to invest even more time in each patient. Even more important seems to be the view of nurses of risk screening, and to a lesser extent using the DOSS, as being non-essential parts of patient care. Nurses view these as aspects of care that can be pushed aside when time is limited. In addition, we found that there is a sense among nursing staff that caring for older patients is not their core business. Similarly, Teodorczuk and colleagues found a lack of ownership of confused older patients in hospital staff, as well as negative attitudes towards this patient group [28]. How health care professionals define their work and which core activities make up their profession influences how those professionals respond to certain guidelines and patient groups.

Most nurses believed that they and their colleagues possessed sufficient knowledge at least to identify at-risk and delirious patients using these instruments. Working according to the guideline even increased nurses' confidence when communicating with doctors. Like Manias and Street [26], we found that nurses used parts of the guideline – the screening instrument and DOSS – to assert power and legitimise their actions. This fits in with findings from other studies, indicating either that nurses feel that doctors pay more attention to structured delirium assessments, or that doctors lack respect for nurses' clinical observations [29,30].

Delirious patients are often viewed by nursing staff as potential risks to the safety of other patients as well as staff, causing the care for these patients to be challenging and often stressful [31–33]. That nurses in this study differed in how confident they were in caring for delirious patients and often welcomed advice, fits in with this view. Doctors and policy advisors identified education of nurses on delirium as an important way of increasing adherence to the guideline in this study. Education on delirium care could increase nurses' confidence when caring for delirious patients, as well as inform nurses about the goals and benefits of working according to the guideline.

Limitations

This study has some limitations. The interview participants were selected by the hospital contact person, which lead to the researcher not being aware of any potential participants refusing. It is possible that a selection bias was introduced by using this way of selecting and approaching participants. As a qualitative study undertaken in one country only, the findings might not be generalisable to other settings. However, despite differences between countries regarding health systems, we found many similarities between the experiences and attitudes of Dutch nursing staff and of nurses in the UK, the United States and Australia [12,25–30]. This seems to suggest that our findings can be transferred to other countries, at least in the Western world. Overall, the study showed the case of nursing care of delirium patients to be a case study of how health care professionals' intentions towards guidelines are formed. This information can be useful for further study into the factors influencing guideline adherence.

Conclusion

This study shows how varied and sometimes complex the barriers can be, which hinders guideline adherence. Barriers were found concerning the

motivations of nurses, their knowledge and skills, nurses' perception of their professional roles and identities, and finally the context into which the guideline was introduced, as well as the resources available to nursing staff.

When introducing a new way of working, either through a guideline or different method, the potential benefits of changing professional behaviour need to be highlighted, for example, through education and immediate feedback of results.

Policy makers need to take nurses' perceptions of their professional roles and of patient care into account when formulating new guidelines to ensure expectations of guideline adherence are realistic and nurses' autonomy is respected. Otherwise, resistance to the guideline is to be expected, as well as a lack of motivation. Collectively, redressing the barriers to guidelines adherence involves a partnership between the contexts of policy, practice cultures and education to maximise the quality of care for older patients.

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3

The effect of a complementary e-learning course on implementation of a quality improvement project regarding care for elderly patients: a stepped wedge trial. Study protocol

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Abstract

Background

Delirium occurs frequently in elderly hospitalised patients and is associated with higher mortality, increased length of hospital stay, functional decline, and admission to long-term care. Healthcare professionals frequently do not recognise delirium, indicating that education can play an important role in improving delirium care for hospitalised elderly. Previous studies have indicated that e-learning can provide an effective way of educating healthcare professionals and improving quality of care, though results are inconsistent.

Methods and design

This stepped wedge cluster randomised trial will assess the effects of a complementary delirium e-learning course on the implementation of quality improvement initiative, which aims to enhance the recognition and management of delirium in elderly patients. The trial will be conducted in 18 Dutch hospitals and last 11 months. Measurements will be taken in all participating wards using monthly record reviews, in order to monitor delivered care. These measurements will include the percentage of elderly patients who were screened for the risk of developing delirium, use of the Delirium Observation Screening scale, use of nursing or medical interventions, and the percentage of elderly patients who were diagnosed with delirium. Data regarding the e-learning course will be gathered as well. These data will include user characteristics, information regarding use of the course, delirium knowledge before and after using the course, and the attitude and intentions of nurses concerning delirium care.

The study will be conducted in internal medicine and surgical wards of eighteen hospitals that are at the beginning stages of implementing the Frail Elderly Project in the Netherlands.

Discussion

Better recognition of elderly patients at risk for delirium and subsequent care is expected from the introduction of an e-learning course for nurses that is complementary to an existing quality improvement project.
This trial has the potential to demonstrate that e-learning can be a vital part of the implementation process, especially for quality improvement projects aimed at complex health issues such as delirium. The study will contribute to a growing body of knowledge concerning e-learning and the effects it can have on knowledge as well as delivered care.

Background

Given the growing number of elderly within most western countries, the increasing attention that has been paid to this subpopulation is not surprising. Combined with the relatively high use of care associated with elderly patients, this development makes the elderly an increasingly important subpopulation for healthcare organisations. Studies regarding patient safety have shown that elderly hospitalised patients are at greater risk for preventable adverse events than younger patients [1,2], indicating that this growing group of patients will bring specific requirements and risks to hospitals.

In the Netherlands, the publication of a report regarding adverse events in Dutch hospitals [2,3] led to the start of a national patient safety programme in 2008 [4]. The programme consists of several themes or projects, one of which is the Frail Elderly Project (FEP). This project is an evidence-based improvement project aimed at improving care for hospitalised elderly (aged 70 and over). Four health problems are addressed, namely, delirium, falls, malnutrition, and physical impairment. In the project, participating hospitals are advised to screen all elderly patients directly after admission for frailty, defined as the risk of developing or the presence of these four health problems (Additional file 1) [5-8]. Hospitals are provided with advice regarding the prevention and treatment of these problems as well. The overall aim of FEP is to reduce preventable functional decline in elderly patients caused by hospital stay by improving the quality of care. The national programme provides participating hospitals with advice concerning the project through conferences, the programme website, and a guide. The programme does not provide implementation support in the participating hospitals themselves; implementation of the projects lies solely with the hospitals. In our study, we focus on FEP, with specific attention to delirium.

Delirium occurs frequently in hospitalised patients, especially in the elderly: about 25% of hospitalised patients aged 65 and over experience a delirium during their hospital stay [9]. Depending on the population that has been studied and the methods that have been used, the delirium rate can increase to 62% (surgical patients) or even 87% (intensive care) [10]. Delirium, sometimes referred to as acute confusional state, is a temporary neuropsychiatric disorder with physiological causes. A delirious patient will experience disturbance of consciousness and a change in cognition or disturbance of perception [10]. The disorder is noted for its acute onset and fluctuating state [9], which are key features that separate delirium from dementia. However, given the fluctuating state of delirium and the

similarities in symptoms with dementia, depression, and psychosis, delirium is sometimes hard to diagnose [9,11], which creates a problem for providing adequate delirium care. Studies have indicated that between 32% and 67% of delirium cases were missed during hospital stay [12]. Under-detection and subsequent inadequate care pre- sent a problem because delirium in elderly patients is associated with increased length of hospital stay, functional decline, admission to long-term care, and higher mortality [13,14].

Nevertheless, several studies have shown that a significant percentage of delirium cases are preventable, and different strategies have reduced by approximately one-third the incidence of delirious patients [15-18]. FEP aims to decrease the incidence of delirium in hospitalised elderly patients and minimise the adverse effects associated with delirium, such as functional decline. As mentioned earlier, the implementation of FEP is a task of the hospitals themselves; no onsite support or training is provided by the national programme. Because several studies have shown that both physicians and nurses have a lack of knowledge concerning delirium and its recognition [9,19,20], an educational tool would appear to be a valuable supplement to the delirium part of FEP. That an educational intervention can significantly improve delirium recognition and care has been shown by a previous study, which resulted in a strong decline in delirium point prevalence – 9.8% in the intervention group versus 19.5% in the control group [21].

Because knowledge about delirium is relevant for virtually all nurses working within the hospital, an educational approach that can improve knowledge and skills for large groups of people is needed. E-learning is one method available for efficiently educating a large number of people. A review by Cook et al. [22] has shown that the use of e-learning or 'internet-based education' compared with no intervention is associated with a positive effect on knowledge, skills, and behaviour of healthcare professionals, as well as on patient outcomes. Less clear-cut results have been found for computer-assisted learning aimed at nurses, suggesting more research is needed in this field [23]. Computer-assisted learning refers to all methods of using computerised technology to facilitate education, including e-learning. Whether e- learning can provide a valuable tool for improving delirium care specifically has yet to be determined, though researchers have suggested e-learning as an important option for improving delirium education [24].

The aim of the study is to assess the effects a complementary e-learning course has on the implementation of the delirium part of FEP, and thus to see whether the use of e-learning improves the provision of delirium care by nurses. The hypothesis underlying this study is that use of e-learning will

increase nurses' knowledge regarding delirium and their willingness to change their behaviour regarding at-risk patients. It is hypothesised that these effects will in turn lead to changes in the care provided: screening of elderly patients for risks, observing at-risk patients for delirium, and taking preventative or curative measures. This protocol describes the methodology used in this study and provides details of the stepped wedge cluster randomised controlled trial design [25].

Methods

Intervention

For this study, an e-learning course about delirium will be used that is aimed at nursing staff. This course [26] was developed by a commercial publisher (Noordhoff Publishers), in collaboration with a Dutch hospital. The publisher has been approached by the researchers concerning the use of the e-learning course in this study. Prior to selecting the e-learning for this study, the course was reviewed, while still in development, by the researchers and by the Netherlands Centre of Excellence in Nursing. The content of the e-learning course is consistent with Dutch guidelines regarding delirium care [27,28] and FEP. FEP has been implemented by Dutch hospitals independently of this study. The selected e-learning course offers hospitals participating in the study the possibility of supporting their implementation with a course that educates nurses in delirium care (one aspect of the project).

The aims of the e-learning course are on the one hand to create or increase awareness about delirium and the associated risks, and on the other hand to increase knowledge about delirium care. The content of the course consists of information regarding delirium, the risks involved for patients, the recognition of at-risk patients and delirious patients, and the prevention or treatment of delirium. By using fictional patient cases, information is provided in a context familiar to nurses. Throughout the course, users are presented with questions concerning previously given information, providing them with insight into the progress they have made.

During the study, the e-learning course will be offered to nurses in the participating wards online for a period of three months. The estimated time needed per nurse to complete the course, including a knowledge test before and after, is four hours. Nurses can stop the course at any time and continue at a later time. When completing the course and the subsequent knowledge test successfully, nurses will be provided with a certificate stating the completed course and the credits awarded. In cooperation with

implementation managers of the publisher, 'kick-off' meetings will be organised in each hospital in order to introduce the e-learning course to the users. The aim of these meetings will be to familiarise users with the way the e-learning works and to encourage them to use and complete the course within the three-month period. After one month and again after two months, users who have not completed the course will receive an e-mail reminder concerning the course to further encourage its use [29]. In addition to these personal reminders, each ward will be provided with a monthly overview of use and completion of the e-learning course.

Setting

Data will be gathered in 18 Dutch hospitals, all of which are at the beginning stages of the implementation of FEP at the start of the study (self reported status). These 18 hospitals include two university hospitals, five teaching hospitals, and eleven general hospitals, varying in size (smallest 138 beds, largest 880 beds) and geographical location. One internal medicine ward and one surgical ward of each hospital will participate in the study.

Nearly all hospitals in the Netherlands were initially invited to participate in the study, excluding specialised hospitals such as eye clinics and cancer hospitals, and hospitals already participating in a separate study related to FEP. The hospitals that responded most quickly to the invitation were included in the study.

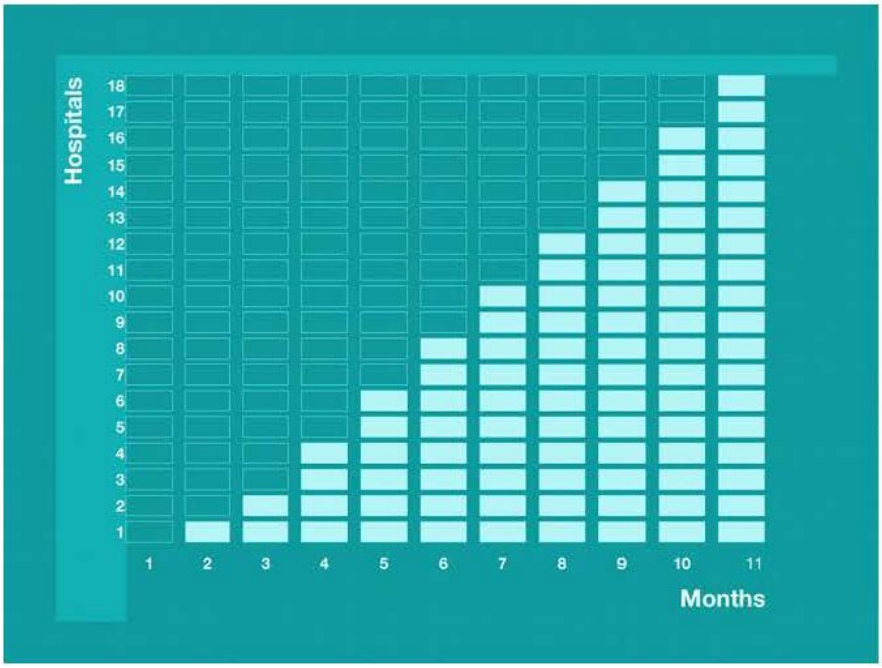

Figure 3.1 Diagrammatic illustration of the stepped wedge design. Each cell represents a moment of data gathering. The dark grey cells represent data gathering in hospitals without e-learning (control period). The light grey cells represent data gathering in hospitals with e-learning (intervention period)

Study design

The study will be conducted using a stepped wedge cluster randomised trial design. The defining feature of this design is that the intervention will be introduced to all clusters – or in this instance, hospitals – in a sequential order [25,30,31]. At the start of the study in May 2011, no hospital will have access to the intervention, while at the end in March 2012 all hospitals will have been given access. This offers an advantage over parallel trials, in which certain hospitals would not receive the intervention. The e-learning course is expected to do more good than harm, making it unethical to withhold the intervention from participating hospitals [25,31].

After every monthly data collection moment, one or two new hospitals will receive access to the intervention, as illustrated in Figure 3.1. The start date at which each hospital is given access to the e-learning course will be randomly assigned, using simple or unrestricted randomisation. Hospitals will each be informed of the start date of the intervention prior to the start of the trial. After a period of 11 months, all 18 hospitals will have received the

intervention, and the stepped wedge design will have resulted in gathered data from all hospitals for both the control and the intervention group. This offers an important methodological advantage: each hospital acts as its own control, thereby reducing contamination bias [31].

Data collection

Monthly patient record reviews of patients 70 years or older will be the main source of data. During 11 months, research nurses will review approximately 10 records per ward per month (20 per hospital), using both nursing and medical records. If a ward provides the research nurse with more than 10 records fitting the inclusion criteria, the nurse will take a random sample from the available records. All record reviews will take place within the same week of the month, using records of patients still in hospital or discharged during the previous week. From these records, data concerning provided delirium care will be gathered, which will offer the following information about the implementation of the delirium aspect of FEP:

1. Detection of risk for delirium, as well as screening for falls, malnutrition, and physical impairment. FEP has provided hospitals with screening instruments to assess these risks (Additional file 3.1). Alternative instruments that are used by hospitals are the Groningen Frailty Indicator [32] and the Identification of Seniors At Risk or ISAR [33].
2. Detection of delirium by nurses using the Delirium Observation Screening scale [34,35] (DOSS, Table 3.1).
3. Diagnosis of delirium by physicians.
4. Prevention of delirium by nursing or medical interventions targeting common reversible causes of delirium.
5. Treatment of delirium by starting nursing or medical interventions targeting common reversible causes of delirium or by prescribing medication.

In addition to data regarding the implementation of FEP, data regarding the demographic and clinical characteristics of the patients will be gathered.

The record reviews will be carried out by specially trained nurses who have previous experience with reviewing records. An online registration tool will pro- vide these nurses with the means to collect data in the various hospitals. The research nurses will be blinded for the trial condition of the hospitals and are not employed by the hospital where they are conducting the record reviews. Because the e-learning will be used by nurses of the

wards participating in the study, the hospitals and wards cannot be blinded to the trial condition.

Besides data from the patient record reviews, data regarding the use of the e-learning course will be gathered. These data include characteristics of the nurses that are given access to the course, such as age, gender, and educational level. Whether the nurses use the course and if so, how often and for how long, will be registered with the web-based course itself. All users will be obligated to complete a delirium knowledge test before and after using the e-learning. These tests consist of randomly selected questions from large question databases. After successfully completing the e-learning and knowledge tests, users will be asked to complete a short evaluation of the course. This evaluation contains five questions regarding the use of the course and the attitude and intention of the user concerning improving delirium care.

Table 3.1 Delirium Observation Screening scale [34,35]

	The patient:	**Never**	**Sometimes or always**
1	Dozes during conversation or activities	0 points	1 point
2	Is easily distracted by stimuli from the environment	0 points	1 point
3	Maintains attention to conversation or action	1 point	0 points
4	Does not finish questions or answers	0 points	1 point
5	Gives answers which do not fit the question	0 points	1 point
6	Reacts slowly to instructions	0 points	1 point
7	Thinks to be somewhere else	0 points	1 point
8	Knows which part of the day it is	1 point	0 points
9	Remembers recent events	1 point	0 points
10	Is picking, disorderly, restless	0 points	1 point
11	Pulls IV tubes, feeding tubes, catheters etc.	0 points	1 point
12	Gets easily or suddenly emotional (frightened, angry, irritated)	0 points	1 point
13	Sees persons/things as somebody/something else	0 points	1 point

For each of three daily shifts the total score is calculated; the total score per shift is a minimum of 0 and a maximum of 13; the total score for a day is a minimum 0 and a maximum of 39. The DOSS final score is calculated by dividing the total score for the day by 3; the DOSS score is between 0 and 13 The cut-off point is 3; a DOSS final score of 3 or more indicates a delirium

Research population

Records of patients admitted to the participating wards will be included in the study if the patient is 70 years or older and if the length of stay at the time of the record review is at least 24 hours. Only records of patients still in hospital at the time of the record review and patients discharged in the previous week will be included. A total of approximately 3,960 patient records will be reviewed in the course of the study.

Sampling

The power calculation for the part of the study focused on the effect of e-learning for nurses on provided care (i.e., screening for delirium risk) resulted in a power of 0.8, based on the following assumptions: 18 hospitals (36 wards); an improvement of delirium risk screening of 20% (from having 40% of the elderly patients screened to 60%) after the e-learning introduction; an alpha of 0.05; a total of 360 patient records for reviewing per month; an intracluster correlation coefficient (ICC) of 0.1.

For the aspect of the study focused on the effect of e-learning on knowledge, we expect a power of 0.99 assuming the study is conducted in 36 wards (18 hospitals), with an e-learning effect size of 1.00 [22], an alpha of 0.05, at least 30 nurses per ward, and an intraclass correlation of 0.20. When adjusting the effect size to 0.5, a power of at least 0.8 is still achieved.

Outcomes and data analysis

As part of FEP, hospitals are advised to screen all elderly patients directly after admission for the risk of developing or the presence of delirium, falls, malnutrition, or physical impairment. The e-learning course educates nurses on screening for delirium. The percentage of elderly patients that are indeed screened for the risk of delirium is the primary outcome of this study. Secondary outcome measures include: the percentage of elderly patients with an increased risk of delirium that are observed with the DOSS; the percentage of elderly patients with (an increased risk of) delirium that receive care aimed to prevent or treat delirium; and the percentage of elderly patients that are diagnosed with delirium. Covariates that will be used in the analysis are: age, gender, living situation, comorbidity [36], and admission diagnosis of the patients.

The data analysis will firstly consist of a comparison between hospitals that have received the intervention and hospitals that have not yet received the intervention, according to the stepped wedge schedule. This will be done using multilevel linear regression and multilevel logistic regression analyses.

In these analyses, we will adjust for temporal trends and for clustering within hospitals using generalised estimating equations.

Different organisational or system factors that might influence adherence to the intervention or might lead to differences between hospitals in delivered care will be analysed. These factors include hospital type (academic, teaching, general), size, location (urban or rural), and type of records used (paper versus electronic).

Ethical approval

The Medical Ethics Review Committee of the VU University Medical Centre has approved the study protocol. Patients and representatives on the participating wards will be given the opportunity to object to the use of their (or their relative's) patient record.

Discussion

The number of studies using a stepped wedge design in order to evaluate the effectiveness of an intervention in routine practice is steadily increasing [25]. The reasons for using the design in this study varied: first, it offered an opportunity to introduce the intervention to all participants, which has both ethical and methodological advantages [25,31]. Second, the fact that the intervention will be made available to all participating hospitals will probably have made participating in the study more attractive to hospitals. Third, by using a stepped wedge design the researchers also aim to avoid a problem experienced in other research regarding changes in healthcare: the fact that the context of the study is constantly changing and that any changes made by an intervention can not be separated from changes due to this dynamic context. The stepped wedge design offers an opportunity to take into account the effect of time on the outcome measures and thus to make a distinction between change that would have occurred without the intervention and change attributable to the intervention [25,37].

This study has several potential limitations. The main limitation of the study is that data on provided care and the behaviour of care providers are gathered from patient records. The risk inherent to this method is that changes found are interpreted as actual changes in care and behaviour, while they might only indicate changes in registration. The e-learning course on delirium that nurses will use in this study does not focus on registration however, but educates nurses in improving the care they provide. Because the screening of patients for increased risks can only benefit patients when all relevant care professionals are aware of the outcomes, screening without

proper registration would still imply poor quality of care. In this case, an improvement in registration would also suggest an improvement in care. Still, differences in quality of patient records between hospitals or wards might influence the outcome of this study. Records of poor quality could provide research nurses with insufficient information regarding provided care, which could result in the appearance of poor quality of care.

The presence of the research nurse for the monthly record reviews might influence the professionals working on the wards. In order to minimise bias, hospitals will not be provided with information regarding their performance on FEP during the research period. Another limitation is that the selection of participating hospitals was based on speed of response to the initial invitation. However, the final group of hospitals provide a fairly complete and balanced overview of hospitals within the Netherlands, varying in type of hospital, size, and geographical location. A final limitation is that hospitals were asked to participate in the study if they considered themselves to be at the beginning stages of implementation of FEP. Which level of implementation had actually been achieved by the hospitals has not been measured or objectively determined before the start of the study. This indicates that the actual situation in each participating hospital regarding the implementation of the project might vary.

Improving quality of care by implementing evidence- based practice is a difficult process. One way to support this process is by providing healthcare professionals with education regarding the desired change. Education can be a vital part of the implementation process, especially for complex health issues such as delirium. E-learning provides healthcare organisations with a potentially effective and simple way of educating large groups of professionals. This study will contribute to a growing body of knowledge concerning e-learning and the effects it can have on knowledge as well as delivered care.

Additional File 3.1

Screening instruments Frail Elderly Project

Delirium, questions for the patient:

- Do you experience memory problems?
- Have you needed help with self care in the last 24 hours?
- Have you experienced periods of confusion during earlier hospital stay or illness?

One or more questions answered with `yes' indicate a risk of delirium.

Falls, one question for the patient:

- Have you fallen in the past six months?

If this question is answered with `yes' a risk of falling is indicated.

Malnutrition, using the Short Nutritional Assessment Questionnaire to question the patient:

1. Did you lose weight unintentionally?
   □ More than 6 kg in the last 6 months — 3 points
   □ More than 3 kg in the last months — 2 points
   □ No — 0 points
2. Did you experience a decreased appetite over the last month?
   □ Yes — 1 point
   □ No — 0 points
3. Did you use supplemental drinks or tube feeding over the last month?
   □ Yes — 1 point
   □ No — 0 points

Two points indicate risk of malnutrition and three points indicate malnutrition.

Or using the Malnutrition Universal Screening Tool:

- Calculate the Body Mass Index of the patient.
  BMI Score:
  >20 = 0 points
  18.5 to 20 = 1 point
  <18.5 = 2 points
- Note the percentage of unplanned weight loss in the last 3 to 6 months.
  <5 % = 0 points
  5% to 10 % = 1 point
  >10 % = 2 points
- Establish acute disease effect. If the patient is acutely ill and there has been or is likely to be no nutritional intake for >5 days = 2 points

One point indicates risk of malnutrition, and two points indicate malnutrition.

Physical impairment, using the Katz-ADL6 to question the patient:

- Do you need assistance in bathing?
- Do you need assistance getting dressed?
- Do you need help using the toilet?
- Do you use incontinence material?
- Do you need help moving in and out of bed or chair?
- Do you need assistance with eating?

Each question answered with `yes' indicates dependence and earns one point. A score of two or more indicates risk of functional decline. A score of 6 indicates complete dependence, a score of 4 indicates mild dependence, and a score <2 indicates complete independence.

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4

The effect of an e-learning course on nursing staff's knowledge of delirium: a before-and-after study

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Abstract

Background
Delirium is a common condition in hospitalised patients, associated with adverse outcomes such as longer hospital stay, functional decline and higher mortality, as well as higher rates of nursing home placement. Nurses often fail to recognise delirium in hospitalised patients, which might be due to a lack of knowledge of delirium diagnosis and treatment. The objective of the study was to test the effectiveness of an e-learning course on nurses' delirium knowledge, describe nursing staff's baseline knowledge about delirium, and describe demographic factors associated with baseline delirium knowledge and the effectiveness of the e-learning course.

Methods
A before-and-after study design, using an e-learning course on delirium. The course was introduced to all nursing staff of internal medicine and surgical wards of 17 Dutch hospitals.

Results
1,196 invitations for the e-learning course were sent to nursing staff, which included nurses, nursing students and healthcare assistants. Test scores on the final knowledge test (mean 87.4, 95% CI 86.7 to 88.2) were significantly higher than those on baseline (mean 79.3, 95% CI 78.5 to 80.1). At baseline, nursing staff had the most difficulty with questions related to the definition of delirium: what are its symptoms, course, consequences and which patients are at risk. The mean score for this category was 74.3 (95% CI 73.1 to 75.5).

Conclusions
The e-learning course significantly improved nursing staff's knowledge of delirium in all subgroups of participants and for all question categories. Contrary to other studies, the baseline knowledge assessment showed that, overall, nursing staff was relatively knowledgeable regarding delirium.

Background

Delirium is a common condition in hospitalised people, with the highest incidence rates reported in intensive-care, palliative care and postoperative care settings [1-4]. It is a neuropsychiatric syndrome characterised by a disturbance of consciousness and attention, as well as a change in cognition or a disturbance of perception [5,6]. Delirium is associated with adverse outcomes, such as longer hospital stay, functional decline and increased mortality, as well as higher rates of nursing home placement [3,7-9]. Previous research has shown that nurses often fail to recognise delirium in hospitalised patients [10,11] limiting their ability to provide adequate delirium care. Several authors have suggested that this poor recognition is caused by a lack of knowledge of delirium, especially of the importance of early recognition and the treatment of delirium [10,12-14]. Increasing nursing knowledge of delirium through educational programmes could improve nurses' identification of delirious patients and the quality of delirium care they provide.

Previous studies have examined nurses' level of knowledge regarding delirium. Hare et al. [15], for example, assessed nurses' level of knowledge using a questionnaire including questions on delirium and its associated risk factors. They concluded that nurses had inadequate levels of knowledge, particularly in relation to risk factors. Other recent studies examined the effect of an educational intervention on nurses' knowledge of delirium [16-19]. These showed that an educational intervention on delirium significantly improved nurses' knowledge. Furthermore, Meako et al. [17] found that the number of years of experience of nurses significantly influenced the effect of an educational intervention on test scores, while the level of education did not. However, these studies were limited by the use of a small number of hospitals (≤3), a small sample size, and in all but one study a low number of items in the delirium knowledge tests. Therefore, further insight into differences in knowledge level and the extent to which subgroups of nurses benefit from educational interventions is needed. This will provide hospitals with the information needed to tailor their educational policy for specific subgroups.

In the context of quality and safety in hospitals, it is important to guarantee a sufficient level of knowledge in health professionals. As an alternative to traditional education, which is relatively labour-intensive and time-consuming, e-learning can be useful when improving knowledge in a

large group of nurses [20]. Advantages of e-learning include flexibility in time management, pace of learning, and quality assurance. However, barriers such as a limited level of computer literacy in users are also associated with the use of e-learning [21,22].

In this study we investigated the effect of an e-learning course, based on nationally recommended guidelines for delirium [23,24], on nurses' delirium knowledge. Furthermore, we examined the baseline delirium knowledge in a large sample of nurses working in hospitals throughout the Netherlands. In addition, we described the association between participant demographics and baseline delirium knowledge, as well as between demographics and the effect of the course on this knowledge.

Methods

Study design and population

An e-learning course on delirium was introduced to the hospitals participating in a trial measuring the effect of e-learning on the implementation of a quality improvement project with special attention for delirium care, which has been described extensively elsewhere [25,26]. One hospital included initially refrained from participation due to practical circumstances in the hospital. The remaining 17 hospitals included two university hospitals, four tertiary teaching hospitals and 11 general hospitals. Each hospital participated in the study with two wards; typically these would be an internal medicine ward and a surgical ward. All nursing staff working on these wards were invited to participate in the study, including healthcare assistants and nursing students participating in a clinical placement at the hospital.

The moment each hospital received access to the intervention was randomised: the first hospital started in June 2011, the last hospitals started in March 2012. Each month, one or two hospitals gained access to the intervention, resulting ultimately in all hospitals having had access to the intervention. Contact persons from the hospitals provided the researchers with names, email addresses and demographic characteristics of all nursing staff working on the participating wards. Delirium knowledge was tested before and after participants completed the e-learning course.

Intervention

The e-learning course was developed by a commercial publisher [27] in collaboration with a Dutch hospital. The course was reviewed, while still in development, by the researchers and by the Netherlands Centre of Excellence in Nursing. The content of the e-learning course was consistent with Dutch guidelines regarding delirium care [23,24]. It consisted of a baseline knowledge test, the course itself, and a final knowledge test.

The aims of the e-learning course were to create or increase awareness about delirium and the associated risks, and to increase knowledge about delirium care. It incorporated case studies and short tests for self-assessment to facilitate the learning experience. The course contained information on subjects such as clinical features, risk factors, diagnostics, prevention and treatment (Table 4.1). The estimated time needed to complete the course, including both knowledge tests, was four hours.

In turn, each hospital gained a 3-month period access to the e-learning course. Access codes and instructions were sent to the nursing staff of participating wards by email, on the first day of access. In addition, a meeting was organised in each hospital to introduce the course, to explain the goals of the research project, and to answer any questions. After each month, participants who had not yet completed the course received a reminder by email from the researchers. Furthermore, contact persons from the hospitals received a monthly overview of the degree of participation in their wards. Nursing staff were able to access the e-learning course from any computer with internet access, which gave them the opportunity to choose whether to follow the course at home or at work.

Table 4.1 Content of the delirium e-learning course

Chapter	Content
I Introduction	i. Introduction to the e-learning course, the patients from the case studies and the subject
II What is delirium?	i. Introduction to the goals and content of the chapter ii. Definition of delirium, its clinical features and course iii. Risk patients, predisposing and precipitating risk factors, and prevention iv. Consequences of delirium
III Risk screening	i. Introduction to the goals and content of the chapter ii. Predisposing and precipitating risk factors and risk screening iii. Recording and discussing delirium risk of a patient
IV Preventive interventions	i. Introduction to the goals and content of the chapter ii. Short overview of preventive medical interventions iii. Preventive nursing interventions
V Early recognition and diagnostics	i. Introduction to the goals and content of the chapter ii. The importance of early recognition of delirious patients iii. Delirium Observation Screening scale iv. Confusion Assessment Method – ICU v. Delirium and dementia, delirium tremens and delirium caused by medication
VI Treatment and care	i. Introduction to the goals and content of the chapter ii. Focus of treatment and disciplines involved iii. Medical treatment iv. Nursing interventions regarding treatment and care v. Aftercare vi. Delirium in the terminal or palliative phase
VII More information	i. References to guidelines, reports and other sources of information on delirium

Knowledge tests

Prior to starting the course, nurses had to take a baseline knowledge test consisting of a random sample of 24 questions - multiple choice, true/false and matching questions - out of a database with 82 different questions about delirium and delirium care. The questions in the database used in the study were developed by Leerstation Zorg [28], which is a national foundation that develops tests and test questions for organisations in healthcare. This development is always carried out by a group of experts, including a specialist in educational measurement, two to ten experts on the subject matter - such as physicians and nurses - and a text editor. While the specialist in educational measurement is responsible for ensuring construct validity of the tests and the questions, the experts on the subject matter are responsible for ensuring content validity. To further guarantee sufficient validity and reliability, all test questions are put through a validation process before being used regularly. This validation process is carried out by a panel of 20 to 50 people selected from the intended user group, who answer the questions and comment on the content or phrasing of the questions. These answers and comments are analysed and used by the expert group to adjust questions if necessary.

The use of experts and a test panel ensure that the questions correspond with the level of knowledge in the intended user group. The cut-off score of each test - the lowest possible score that must be earned to pass the test – is calculated, taking into account the possibility that a question can be answered correctly by chance. Finally, the validity of each question is tested after the first 50 times a question is used and again after the first 200 times.

The questions in the delirium knowledge test were divided into five categories, with a predetermined number of questions from each category being combined to form one test: definition (five questions), risk screening and prevention (seven questions), early recognition (four questions), Delirium Observation Screening scale [29] (DOSS) (two questions) and treatment (six questions). After completing the e-learning course, participants were asked to take a final knowledge test, which again consisted of 24 randomly selected questions. The participants could choose when to take the final test: it was possible to take the test immediately after completing the e-learning course, or to take the test at a later date. However,

unlike the e-learning course, the test had to be completed in one sitting. When successfully completing this final test by answering 80% or more of the questions correctly, participants were provided with a certificate which could be used for applying for quality registry accreditation points. The e-learning and final test were only accessible after starting the baseline knowledge test.

Statistical analysis

All statistical analyses were performed using STATA 12.1 and MLwiN 2.25. Demographics of participants and non-participants were compared using the student's t-test or Chi squared test. Multivariable multilevel linear regression analysis - including hospital level, ward level, nurse level, test level - was used to compare mean baseline test scores and change scores within subgroups. These analyses were adjusted for repeated measures. Analyses of the baseline and final test score per question category were also conducted using multivariable multilevel linear regression analysis, adjusted for repeated measures. When analysing the change scores, all completed tests were included: when a nurse did not have a complete baseline test and a complete final test, the one test that was available was included in the analysis. In order to gain insight into the effect size, Cohen's d was calculated, by dividing the change score (the mean of the final score minus the mean of the baseline score) by the standard deviation of the baseline score.

Ethics

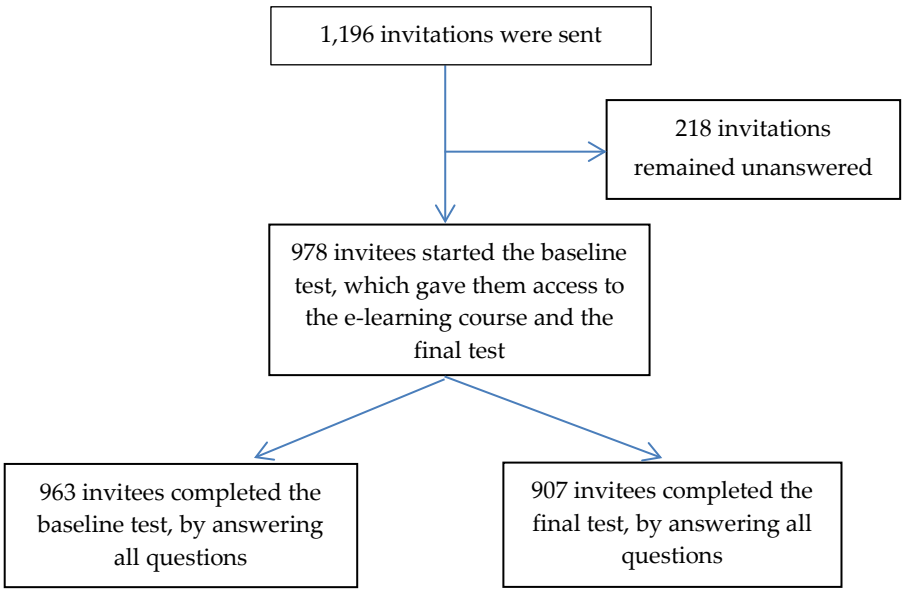
The study had been granted ethical approval by the ethical review board of VU University Medical Center in Amsterdam, the Netherlands, which covered the study in all participating hospitals.

Results

All nursing staff working on the participating hospital wards received an invitation to participate in the e- learning course, resulting in 1,196 invitations being sent. The mean age of invited nursing staff was 35.7 years, 7.4% were male. The largest group comprised nurses (95.7%), which included ward managers, regular nurses, and specialised nurses. Almost a quarter of the included nursing staff had a bachelor's or master's degree in nursing and 62.4% worked in a general hospital.

978 invitees started the baseline test, resulting in a participation rate of 86.4% (95% CI 81.1 to 90.5), adjusted for clustering on the ward and hospital level. Characteristics of participants as well as non-participants are shown in Table 4.2. Participants were on average slightly older than non-participants (36.1 vs. 33.8 years). The number of people younger than 30 years was higher in the non-participant group (48.4%) compared to the participant group (35.5%) ($p<0.01$). Furthermore, participants were less often nursing students (0.9 % vs. 5.0%) ($p<0.01$), and worked more often on an internal medicine ward (51.0% vs. 41.7, <0.01). Incomplete tests - where not all 24 test questions were answered - were excluded from further analysis (see Figure 4.1).

Figure 4.1 Flow chart to illustrate the response rate of nursing staff



Participants' mean score for the baseline test was 79.3 (95% CI 78.5 to 80.1, SD 10.5, n=650) on a scale of 0 to 100, adjusted for age, sex, function, level of education, experience, type of ward and type of hospital. Those aged 50 years or older scored significantly lower than those under the age of 30 (77.0 vs. 79.7, $p<0.01$) (Table 4.3) and those aged between 30 and 50 (79.7, $p<0.01$). Further- more, nursing staff with a bachelor's or master's degree scored significantly higher than those with a vocational education (81.2 vs. 78.7, $p<0.01$). No significant differences were found for sex, function, work experience, type of ward or type of hospital. After following the e-learning course, 907 of the 978 participants - 95.4% (95% CI 92.3 to 97.3) - continued to complete the final test. Their mean final test score was 87.4 (95% CI 86.7 to 88.2, n=618), adjusted for age, sex, function, level of education, experience, type of ward and type of hospital. On average, final test scores were 8.1 points higher than baseline test scores (95% CI 7.4 to 8.8, $p<0.01$), resulting in an effect size of 0.8. The change scores by demographic category are shown in Table 4.4. No significant differences in change score were found between subgroups.

When comparing different categories of questions, we found that participants scored best at baseline on questions from the category Delirium Observation Screening scale (DOSS) (83.8, $p<0.05$) (Table 4.5). Lowest scores at baseline were found for the question category Definition (74.3,$p<0.05$). However, change scores were highest for this category (11.3, $p<0.01$). For all question categories, we found a significantly higher score on the final test compared to the baseline test.

Table 4.2 Characteristics of the research population

	Participants (%) (n=978)	Non-participants (%) (np.218)	P value
Age (202 missing values)			
<30 years	297 (35.5)	76 (48.4)	<0.01
30-50 years	395 (47.2)	58 (36.9)	
>50 years	145 (17.3)	23 (14.7)	
Sex (69 missing values)			
Male	63 (6.8)	20 (10.2)	0.09
Female	868 (93.2)	176 (89.8)	
Function (1 missing value)			
Nurse	945 (96.7)	199 (91.3)	<0.01
Nursing student	9 (0.9)	11 (5.0)	
Healthcare assistant	23 (2.3)	8 (3.7)	
Level of education (216 missing values)			
Vocational	634 (75.8)	107 (74.3)	0.69
Bachelor or master	202 (24.2)	37 (25.7)	
Experience (233 missing values)			
0-1 years	33 (4.1)	13 (8.4)	0.09
1-5 years	362 (44.8)	69 (44.8)	
5-10 years	171 (21.1)	34 (22.1)	
>10 years	243 (30.0)	38 (24.7)	
Type of ward (0 missing values)			
Internal medicine ward	499 (51.0)	91 (41.7)	<0.01
Surgical ward	414 (42.3)	119 (54.6)	
Other	65 (6.7)	8 (3.7)	
Type of hospital (0 missing values)			
University	114 (11.7)	18 (8.3)	0.10
Tertiary teaching	249 (25.5)	69 (31.7)	
General	615 (63.9)	131 (60.1)	

Table 4.3 Baseline test score by demographic category, using multivariable multilevel linear regression analysis*

	Mean score	95% CI	P value
Age (year)			
<30	79.7	78.5 to 80.9	r.c.
30-50	79.8	78.8 to 80.8	0.84
>50	77.0	75.4 to 78.7	<0.01
Sex			
Male	79.4	77.1 to 81.7	r.c.
Female	79.3	78.5 to 80.1	0.92
Function			
Nurse	79.4	78.5 to 80.2	r.c.
Nursing student	78.3	72.1 to 84.5	0.74
Healthcare assistant	77.5	73.7 to 81.3	0.34
Level of education			
Vocational	78.7	77.9 to 79.6	r.c.
Bachelor or master	81.2	79.9 to 82.6	<0.01
Experience (year)			
0-1	77.4	74.5 to 80.2	r.c.
1-5	79.5	78.4 to 80.6	0.15
5-10	78.6	77.2 to 80.0	0.45
>10	79.9	78.7 to 81.2	0.10
Type of ward			
Internal medicine ward	79.4	78.4 to 80.4	r.c.
Surgical ward	79.3	78.2 to 80.3	0.86
Other	73.4	64.7 to 82.1	0.18
Type of hospital			
University	79.5	77.3 to 81.6	r.c.
Tertiary teaching	79.7	77.9 to 81.6	0.86
General	79.1	78.1 to 80.1	0.79

* Incomplete tests were excluded from analysis.

Bold: test score differs significantly from the test score of the reference category.

Table 4.4 Change score by demographic category, using multivariable multilevel linear regression analysis*

	Mean score	95% CI	P value
Age (year)			
<30	8.2	7.1 to 9.4	r.c.
30-50	7.7	6.7 to 8.7	0.49
>50	9.3	7.5 to 11.0	0.33
Sex			
Male	6.9	4.3 to 9.5	r.c.
Female	8.2	7.5 to 8.9	0.33
Function			
Nurse	8.0	7.3 to 8.8	r.c.
Nursing student	12.7	5.5 to 19.8	0.20
Healthcare assistant	9.6	5.0 to 14.2	0.51
Level of education			
Vocational	8.4	7.6 to 9.2	r.c.
Bachelor or master	7.1	5.6 to 8.6	0.12
Experience (year)			
0-1	9.7	6.5 to 12.9	r.c.
1-5	7.7	6.6 to 8.8	0.25
5-10	8.5	7.0 to 10.0	0.51
>10	8.2	7.0 to 9.5	0.42
Type of ward			
Internal medicine ward	8.0	7.1 to 9.0	r.c.
Surgical ward	8.1	7.1 to 9.2	0.92
Other	17.7	7.6 to 27.7	0.06
Type of hospital			
University	9.2	7.3 to 11.2	r.c.
Tertiary teaching	7.2	5.7 to 8.6	0.09
General	8.3	7.4 to 9.1	0.36

* Incomplete tests were excluded from analysis.

Table 4.5 Test scores and change score per question category, using multivariable multilevel linear regression analysis*

Category	Score baseline test (95% CI)	Score final test (95% CI)	Change score (95% CI)
Definition	74.3 (73.1 to 75.5)	85.6 (84.5 to 86.6)	11.3 (9.7 to 12.8)
Risk screening and prevention	81.4 (80.3 to 82.5)	89.5 (88.6 to 90.5)	8.1 (7.1 to 9.2)
Early recognition	78.0 (76.7 to 79.3)	83.2 (81.9 to 84.5)	5.2 (3.4 to 7.0)
DOS scale	83.8 (82.1 to 85.6)	89.6 (88.2 to 91.1)	5.8 (4.2 to 7.5)
Treatment	76.5 (75.1 to 77.9)	84.1 (82.8 to 85.3)	7.5 (5.9 to 9.2)

* Incomplete tests were excluded from analysis.

Discussion

In this study we investigated the effect of e-learning on specific aspects of delirium knowledge in nursing staff in hospitals in the Netherlands. We found that the e-learning course had a significant positive effect on nurses' know- ledge on delirium, in all subgroups of nursing staff and for all question categories, with a mean change score of 8.1 and a large effect size (0.8). At baseline, nursing staff had the most difficulty with questions related to the definition of delirium: what are its symptoms, course, consequences, and which patients are at risk.

Of the 1,196 members of nursing staff that were invited to participate, 978 started the baseline knowledge test. This high level of participation might confirm the findings of Karaman [30], who found that nurses were open to online learning and found it to be appropriate for their working conditions and needs. However, we expect that in this study the email reminders and encouragement provided by team leaders following the monthly overview of participation per ward increased participation rates. Nursing staff's baseline knowledge was fairly high, with a mean test score of 79.2, where other studies found a mean score of 53-61 [15-17]. This could indicate that more attention has been paid to delirium in nursing education in the Netherlands than in other countries. However, it might not be possible to directly compare the test scores from these different studies, because they all used different instruments to test the level of delirium knowledge. Future research should focus on utilising the same assessment instrument on delirium knowledge in different studies and in different countries. This

would not only make it possible to compare studies and educational interventions, but would also provide insight into the differences in levels of delirium knowledge between countries with different health care systems and educational systems.

Some significant differences were found in the current study between baseline test scores of different demographic groups. Nursing staff aged over 50 had a lower average baseline score than their younger colleagues. Furthermore, nursing staff with a bachelor's or master's degree had a significantly higher baseline score than staff with a vocational education. However, these differences in scores were relatively small. The differences between older and younger members of nursing staff might indicate that the education on delirium that nursing students receive has improved in the Netherlands over the years. Because the course was originally developed for nursing staff with a bachelor's degree, we might have expected nurses with a bachelor's or master's to benefit more from the e-learning course than those with a vocational education. This, however, was not the case. Our study shows that, regardless of characteristics of the individual nurse, on average nurses benefitted significantly from the e-learning course. While Meako et al. [17] also found that an educational intervention on delirium was effective for all participating nurses, no matter their educational level or years of experience, they did find that those nurses with little work experience benefitted more from the e-learning. Our findings did not show a similar impact of work experience on the effect of e-learning on knowledge.

At baseline, nursing staff had the most difficulty with questions related to the definition of delirium. However, this was also the question category that saw the highest knowledge increase. This indicates that e-learning was effective in decreasing a knowledge gap that existed among the participating nursing staff. Besides the questions on definition, nursing staff also scored relatively low on the questions regarding treatment of delirium. These findings are similar to those of Agar et al., in Australia, who found that nurses had limited knowledge of the features of delirium, as well as delirium management [31].

The strengths of this study are its large sample size, the relatively large number of questions per test and the use of an e-learning course developed by a group of experts on didactics as well as content. However, our study also has some limitations. First, because the final knowledge test was taken online, the possibility exists that participants used written notes or other sources of information in order to answer the test questions. There were no

means available to the researchers to ensure nursing staff only used their own knowledge when taking the test. However, the method used in this study - with an online knowledge test and a certificate when successfully completing the test - is similar to how e-learning is used by Dutch hospitals in daily practice. Second, the current study only examined delirium knowledge of nursing staff shortly after completing the e-learning course. This means that no insight into knowledge retention was gained in this study, which would be important information for hospitals planning their education of nursing staff. Third, because the trial of which this study was a part followed a stepped wedge design, the e-learning course was eventually introduced in all participating hospital wards [25]. This means the effect on knowledge was tested using a before-and-after study design, without a control group. Fourth, while the e- learning course used in this study was based on the Dutch guidelines on delirium care available at the time, in 2013 a revision of the delirium guideline from 2004 was published [32]. This could indicate that the e-learning course is no longer up-to-date for the Dutch situation. However, the main changes made to the guideline regarding nursing care in hospitals concern an increased emphasis on non-pharmacological interventions, screening of patients for delirium risk factors and using the Delirium Observation Screening scale. These are all topics that were already included in the e-learning course, suggesting the course is still suitable for use.

Conclusions

E-learning appears to have a positive effect on nursing staff's knowledge of delirium, for all subgroups studied. Moreover, the high participation rate in our study appears to show that staff members are willing to improve their knowledge through e-learning. This, together with a high prevalence of delirium in hospitalised older patients, associated with adverse outcomes, advocates for a more widespread introduction of e-learning on delirium to nursing staff working in hospitals. When nursing staff have a better understanding of delirium and delirium care, they will be better able to recognise the importance of early detection of delirium and take measures to identify delirious patients or patients at risk for delirium. Increased knowledge on delirium care will also enable nursing staff to potentially prevent the occurrence of delirium and its negative consequences.

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5

Can an e-learning course improve nursing care for older people at risk of delirium: a stepped wedge cluster randomised trial

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Abstract

Background
Delirium occurs frequently in older hospitalised patients and is associated with several adverse outcomes. Ignorance among healthcare professionals and a failure to recognise patients suffering from delirium have been identified as the possible causes of poor care. The objective of the study was to determine whether e-learning can be an effective means of improving implementation of a quality improvement project in delirium care. This project aims primarily at improving the early recognition of older patients who are at risk of delirium.

Methods
In a stepped wedge cluster randomised trial an e-learning course on delirium was introduced, aimed at nursing staff. The trial was conducted on general medical and surgical wards from 18 Dutch hospitals. The primary outcome measure was the delirium risk screening conducted by nursing staff, measured through monthly patient record reviews. Patient records from patients aged 70 and over admitted onto wards participating in the study were used for data collection. Data was also collected on the level of delirium knowledge of these wards' nursing staff.

Results
Records from 1,862 older patients were included during the control phase and from 1,411 patients during the intervention phase. The e-learning course on delirium had a significant positive effect on the risk screening of older patients by nursing staff (OR 1.8, p-value <0.01), as well as on other aspects of delirium care. The number of patients diagnosed with delirium was reduced from 11.2% in the control phase to 8.7% in the intervention phase (p=0.04). The e-learning course also showed a significant positive effect on nurses' knowledge of delirium.

Conclusions
Nurses who undertook a delirium e-learning course showed a greater adherence to the quality improvement project in delirium care. This improved the recognition of patients at risk and demonstrated that e-learning can be a valuable instrument for hospitals when implementing improvements in delirium care.

Background

Delirium is a common complication among older hospitalised patients. Approximately 25% of patients aged 65 and over experience delirium during a hospital stay [1]. The incidence is significantly higher among specific patient groups, such as surgery patients [2]. Delirium in older patients is associated with a longer stay in hospital, functional decline, admission to long-term care, and higher mortality [3-6]. However, studies show that healthcare professionals often fail to recognise delirium during a hospital stay [7,8]. This might be explained by a lack of knowledge of delirium among physicians and nurses [1,9-11].

The Frail Elderly Project (FEP) is part of a national Patient Safety Programme launched in the Netherlands in 2008 [12]. FEP seeks to improve care for patients aged 70 and over, and includes a delirium care guideline for older hospitalised patients. The project and its guidelines are based on existing evidence regarding care for older patients, as well as expert opinion. The FEP delirium guideline primarily aims to improve early recognition of older patients at risk of delirium through risk screening
(Table 5.1). This gives healthcare professionals the opportunity to take action to identify and minimise risk factors.

Table 5.1 Screening instrument for delirium from the Frail Elderly Project

Risk screening for all patients aged 70 and over.	
Three questions for the patient and/or family or caregivers, asked by nursing staff:	
1.	Do you experience memory problems?
2.	Have you needed help with self care in the last 24 hours?
3.	Have you experienced periods of confusion during earlier hospital stay or illness?
One or more questions answered with 'yes' indicates a risk of developing delirium.	
Possible nursing interventions for at-risk patients	
1.	Observation with the Delirium Observation Screening scale
2.	Prevent dehydration, infections, electrolyte disturbances et cetera
3.	Adequate treatment of pain
4.	Preserve nutritional level
5.	Inform patients' family
6.	Improve sensory perception

Previous research has demonstrated the difficulty of putting guidelines into practice [13-15]. Although FEP provided hospitals with advice on the

implementation of the guidelines, there were indicators that implementation was not going smoothly [16]. A lack of knowledge and a failure to recognise patients with delirium have been identified as possible causes of poor care [7,10]. An educational tool such as e-learning could be a valuable tool for improving delirium care. E-learning is increasingly used in health care as a means of educating large groups of professionals [17,18]. A review by Cook et al. [19] has shown that the use of e-learning or 'internet-based education' is associated with a positive effect on the knowledge, skills, and behaviour of healthcare professionals, as well as on patient outcomes. Computer-assisted learning aimed specifically at nurses has produced less clear-cut results [18].

The aim of this study was to determine whether e-learning can be an effective means of improving the implementation of a quality improvement project. The primary objective was to investigate whether offering nursing staff an e-learning course in delirium care in- creased the adherence to the FEP guideline. A further objective of the study was to investigate the impact of the course on nurses' knowledge of delirium.

Methods

The rationale and design of this study has been described previously in detail [20].

Intervention

The intervention we studied was an e-learning course on delirium geared towards hospital nursing staff. This course was developed by a commercial publisher (Noordhoff Publishers), in collaboration with a Dutch hospital [21]. The researchers selected this e-learning course for the study and requested and received permission from the publisher for its use. The content of the e-learning course was consistent with the Dutch guidelines regarding delirium care - including the FEP delirium guideline [12,22]. The course contained information on subjects such as clinical features of delirium, risk factors, diagnostics, prevention and treatment (Table 5.2). It also incorporated case studies and short tests for self-assessment, to facilitate the learning experience.

At the time of this trial, the FEP delirium guideline was being implemented by Dutch hospitals independently of this study. We selected an e-learning course which offered the hospitals participating the opportunity of supporting their own implementation process with a course that educates nurses in delirium care.

Table 5.2 Content of the delirium e-learning course

Chapter	Content
I. Introduction	i. Introduction on the e-learning course, the patients from the case studies and the subject
II. What is delirium?	i. Introduction on the goals and content of the chapter ii. Definition of delirium, its clinical features and course iii. Risk patients, predisposing and precipitating risk factors, and prevention iv. Consequences of delirium
III. Risk screening	i. Introduction on the goals and content of the chapter ii. Predisposing and precipitating risk factors and risk screening iii. Recording and discussing delirium risk of a patient
IV. Preventive interventions	i. Introduction on the goals and content of the chapter ii. Short overview of preventive medical interventions iii. Preventive nursing interventions
V. Early recognition and diagnostics	i. Introduction on the goals and content of the chapter ii. The importance of early recognition of delirious patients iii. Delirium Observation Screening scale iv. Confusion Assessment Method – ICU v. Delirium and dementia, delirium tremens and delirium caused by medication
VI. Treatment and care	i. Introduction on the goals and content of the chapter ii. Focus of treatment and disciplines involved iii. Medical treatment iv. Nursing interventions regarding treatment and care v. Aftercare vi. Delirium in the terminal or palliative phase
VII. More information	i. References to guidelines, rapports and other sources of information on delirium

The e-learning course had two goals: to create or increase awareness about delirium and the associated risks; and to increase knowledge about delirium care. The nurses on the wards which participated received on- line access to the course for a period of three months. The estimated time needed to complete the course and the test of knowledge that preceded and followed the course, was four hours.

The e-learning course was introduced to the nursing staff during meetings in each hospital in order to optimise the nurses' participation. In order to stimulate participation further, e-mail reminders were sent to

nurses who had not completed the course within one month and again to nurses who had not completed the course within two months [23]. In addition, each ward was provided with a monthly overview of the use and completion of the e-learning course. All the nurses who completed the knowledge test successfully by following the course and answering 80% of the questions correctly received a certificate. If nurses scored less than 80% on the test following the course, they had one opportunity to re-take the test.

The study setting and its participants

Nineteen of the 81 hospitals that were invited initially were enrolled in the trial. The hospitals that responded to the invitation within the inclusion period were included, provided they had already started implementing the FEP. One hospital declined to participate after initially being enrolled in the study. The remaining 18 hospitals participating included two university hospitals, five teaching hospitals, and eleven general hospitals, varying in size and geographical location.

Data were gathered from two wards in each hospital, typically a general medical and a surgical ward. The e-learning trial required data from two groups of participants from each hospital: patients aged 70 and over admitted to one of the participating wards; and the nursing staff employed on these wards. Nursing staff could not blinded as to whether they received the intervention. Patients and data collection staff (research nurses) were blinded to the trial condition. However, it is possible that they were informed of the trial condition through verbal comments from nursing staff.

The study design and its randomisation

The study was a stepped wedge cluster randomised trial design [24,25], lasting 11 months. The hospitals that participated crossed over from the control to intervention phase, as illustrated in Figure 5.1. At the start of the study in May 2011, no hospital had access to the intervention, while at the end in March 2012 all but one hospital had been given access. The order in which the hospitals received the intervention was randomised by assigning computer-generated random numbers to each hospital and subsequently sorting hospitals from the lowest number to the highest. At the start of the study period, all hospitals were informed of the date on which the participating wards would receive access to the e-learning course.

The stepped wedge design resulted in data being gathered from all the hospitals involved, both for the control and the intervention phase. This reduced contamination bias [26].

The initial power calculation for the part of the study focused on the effect of e-learning for nurses on provided care (i.e., screening for delirium

risk) resulted in a power of 0.8, based on the following assumptions: 18 participating hospitals (36 wards); an improvement of delirium risk screening of 20% after introduction of the intervention; an alpha of 0.05; a total of 360 patient records for reviewing per month; an intracluster correlation coefficient (ICC) of 0.1.

Outcomes and data collection

The primary outcome used to determine the effectiveness of e-learning was the percentage of older patients screened for delirium risk. We also looked at the number of nursing interventions received by patients identified as at-risk, as well as the use of the Delirium Observation Screening scale (DOSS) [27] in this patient group (Table 5.1). This data was gathered through monthly reviews of patient records, from May 2011 to the end of March 2012. Records were included if the length of stay of the older patient, at the time of data collection, was at least 24 hours. The aim was for research nurses to review ten records per ward per month during the study period. These research nurses did not work for the hospital where they conducted record re- views. Risk screening for delirium was defined as: having used the screening instrument provided by the FEP (Table 5.1) or an alternative instrument, such as the Groninger Frailty Indicator [28] and the Identification of Seniors At Risk or ISAR [29]. Data on the demographic characteristics of the patients were also gathered.

Secondary outcomes included the percentage of nurses participating in the e-learning course and changes in nurses' knowledge of delirium after completing the course. These data were gathered using the web-based course itself. Data collection through the e-learning course ended after the final hospitals completed their three month period of access, at the end of June 2012. The characteristics of the nurses working on the wards, such as their age and level of education were collected through the ward managers.

The research nurses conducting the record reviews were blinded for the trial condition of the hospitals. Because the e-learning tool was used by nurses working on the wards participating in the study, the hospitals and wards could not be blinded to the trial condition.

Statistical analyses

All statistical analyses were performed using STATA 12 and MLwiN 2.25. We compared delirium care in the intervention phase with that of the control phase. We calculated absolute differences and odds ratios using multilevel logistic regression analysis, adjusting for clustering on the ward and hospital level. The outcome were adjusted for hospital type (general or non-general); ward type (general medicine or surgical); patients' age and

sex. Multilevel logistic and linear regression analysis was used to calculate the percentage of nurses participating in the e-learning course, the percentage of participants successfully completing the course, and the changes in the knowledge of delirium, adjusting for hospital type; ward type; and nurses' age.

If a nurse failed to pass the second test on the first attempt, and made use of the opportunity to re-take the test, results from the second attempt were used in the analysis.

Ethics

The study had been granted ethical approval by the Vrije Universiteit (VU) University Medical Center in Amsterdam, the Netherlands. According to Dutch legislation, active in- formed consent was not required.

Results

Provided delirium care

During the study period, records from 3,320 patients were reviewed, from all 18 hospitals and 36 wards. Of these, 37 records were excluded from the study because the patient was not admitted, primarily, to one of the general medical or surgical wards participating in the study. A further ten records were excluded because they showed the patient was already suffering from delirium upon arrival at the hospital. Of the 3,273 records included, 1,862 were reviewed during the control phase and 1,411 during the intervention phase (Table 5.3).

Table 5.3 Patient characteristics and outcome measures, N=3,273

Patient characteristics	Control phase	Intervention phase	p
Included patient records	1,862	1,411	
Patients' age, mean (SD)	81.0 (6.3)	81.2 (6.5)	0.48
Male patients %	44.4	43.8	0.73
Admitted to a surgical ward %	49.9	47.6	0.20
Admitted to a general hospital %	61.7	59.7	0.27
Delirium risk screening %	50.8	65.4	<0.01
Use of DOSS %	6.5	10.6	<0.01
Number of nursing interventions	2.1	2.9	<0.01
Recorded delirium diagnoses %	11.2	8.7	0.04

The adjusted delirium risk screening rate was 50.8% (CI 29.9 to 72.4) in the control phase and 65.4% in the intervention phase (CI 60.4 to 70.2) (Table 5.3). There was a statistically significant effect of the e-learning course for nurses on the risk screening for delirium among older patients, with an OR of 1.8 (CI 1.5 to 2.3, p value <0.01). The intra-class correlation coefficients (ICC) in Table 5.4 show that 50% or more of the variance in delirium risk screening is due to differences between hospitals.

We also found a significant effect on the number of at-risk patients that were observed using the DOSS, which went up from 6.5% (CI 3.9 to 10.6) in the control phase to 10.6% (CI 8.3 to 13.5) in the intervention phase.

The number of nursing interventions that were received by at-risk patients, not including the DOSS, slightly increased from 2.1 (CI 1.5 to 2.8) in the control phase to 2.9 (CI 2.6 to 3.2) in the intervention phase. While the number of patients for which a diagnosis of delirium was recorded in the patient record saw a decrease, with an OR of 0.8 (CI 0.6 to 1.0, p=0.04) (Table 5.4). There were no season fluctuations in diagnosis of delirium (data not shown).

Table 5.4 Effect of e-learning on the provided delirium care in odds ratios, N=3,273

Aspect of care	OR	CI	ICC hospital	ICC ward
Risk screening	1.8	1.5 to 2.3	52.4	1.9
Use of DOSS	1.7	1.3 to 2.2	24.2	2.1
Recorded delirium diagnosis	0.8	0.6 to 1.0	7.6	0.0

Participation in e-learning and knowledge of delirium

Of the 18 hospitals participating, one declined the intervention when the trial was already underway, because of organisational circumstances. In total 1,123 invitations for the e-learning course were sent to nurses from 32 wards (17 hospitals); 533 to nurses working in surgical wards and 590 to nurses working in general medical wards (Table 5.5). The patients from two of the wards participating could be included in the study. However, the nurses could not because we were unable to determine whether they worked on a general medical or surgical ward.

Table 5.5 Nurse characteristics, N=1,123

Nurse characteristics	Non-participants	Participants	*P*
Included nurses	210	913	
Nurses' age, mean (SD)*	33.6 (11.9)	35.7 (11.3)	0.04
Male nurses %**	9.6	6.7	0.17
Working in a surgical ward %	56.7	45.4	<0.01
Working in a general hospital %	58.6	60.5	0.61
Level of education: vocational %***	74.1	75.2	0.78
Level of education: university %***	25.9	24.8	0.78

* Missing values: 179
** Missing values: 69
*** Missing values: 193

Altogether, 90.8% (CI 84.7 to 94.6) of nurses started the course by taking a test of their knowledge of delirium. After attending the course for three months, 92.7% (CI 88.9 to 95.3) of the nurses who had started the course passed the second knowledge test, which signified the successful completion of the e-learning course (Table 5.6). On average the scores on the second test were 8.9% (CI 8.3 to 9.5, p<0.01) higher than the scores for the initial test. The corrected average score for the first knowledge test was 79.6% (CI 78.9 to 80.4), compared to 88.6% (CI 88.0 to 89.2) for the second test (Table 5.6).

Table 5.6 Results of the delirium e-learning course for nurses

	N	%	CI	ICC hospital	ICC ward
Participation	944	90.8	84.7 to 94.6	8.8	18.7
Successful completion	792	92.7	88.9 to 95.3	10.7	2.0
Mean score initial test	904	79.6	78.9 to 80.4	1.9	0.0
Mean score second test	904	88.6	88.0 to 89.2	1.9	0.0
Mean difference	904	8.9	8.3 to 9.5	1.9	0.0

Discussion

This stepped wedge trial showed that an e-learning course on delirium did have a significant effect on the nursing staff's delirium care for older patients, as evidenced by the risk screening. The adjusted screening rate was

50.8% in the control phase, compared with 65.4% in the intervention phase. The e-learning course also showed a significant positive effect on nurses' knowledge of delirium. An e-learning course on delirium appears to be a valuable addition to the efforts of hospitals to improve delirium care. However, the goal of FEP, to ensure all older patients were screened for the risk of delirium and all at-risk patients were observed using the DOSS, was still not achieved.

Our study found a significant increase in the knowledge of delirium after nurses completed the e-learning course. Many experts have emphasised the lack of knowledge regarding delirium in healthcare professionals as a cause of poor delirium care [1,9-11,30]. One study has indicated that nurses do not understand the need for preventive measures because the negative outcomes associated with delirium are not understood well enough [10]. Some experts have suggested that the same is true for clinical and strategic leaders in healthcare, leading to a low priority being awarded to improving the recognition of delirium [30]. Besides the e-learning, and the improvement in knowledge accompanying it, other factors - at the organisational level - might have influenced the delirium care in the hospitals participating. An evaluation of the Dutch Patient Safety Programme found several factors that influenced, positively, the implementation of the patient safety projects. These included, among other things, the presence of an enthusiastic project leader, having the project fit in well with existing guidelines and procedures, and the presence of an electronic patient record [31]. These factors could, and did, differ between the hospitals participating in our trial, and could, potentially, have influenced their adherence to the FEP delirium guideline and the effect of e-learning. This might explain the high ICCs we found.

We did not include a time variable in the model to account for a time effect as suggested by Hussey et al. [25]. The time variable is an important point in stepped wedge designs. One should include the time variable in the model if it can be assumed that delirium is subject to change over time. Balan et al. found a possible seasonal influence on diagnosis of delirium in a geriatric hospital [32]. However, we did not find a seasonal influence on the diagnosis of delirium. This may be due to the relatively low amount of events we found. In addition, several calendar-related effects, such as changes in staff and changes in clinical management, are hospital dependent and reflected in the clustering on hospital level. Therefore we decided not to include the time variable in the model. By including several measurement points over time, the timeframe is included in the model itself.

The event studied – delirium - may be associated with competing events, such as discharge. As the association between delirium and length of

hospital stay can go two ways (a longer hospital stay can increase the risk of delirium, while a delirium will likely increase the length of stay) authors felt that an analysis focussing on these competing events was beyond the scope of this article.

The main strengths of this trial include its large sample size, both of patients and nurses [18], high participation rates for the e-learning course and the inclusion of both surgical and general medical wards. The stepped wedge design enabled a practical evaluation of the effects of an e-learning course, while offering the methodological advantage of using the participating wards as their own control.

The limitations of the study include a potential delay in the intervention effect, resulting from the relatively late uptake of the e-learning course by nurses. All wards were given access to the e-learning course for the period of three months, but most nurses participated in the course only at the end of this period. This would mean that although the wards had entered, officially, the intervention phase of the trial, minimal effects of the intervention could be expected in the first and second month. This could mean that the effect of e-learning on delirium care was actually larger than was calculated. Another limitation is that the first date of delirium diagnosis was not recorded. Therefore it was not possible to study if the intervention reduces the delirium hazard rate.

In addition, the nurses were dependent for data collection on information written in the patient record, which might not always have been complete [33,34]. Nonetheless, screening without proper registration would have the same results for the patient as not screening at all, because the screening of patients for increased risks or the presence of delirium can only benefit patients when all the relevant care professionals are aware of the outcome. Also, there was no indication that the documentation in patient records differed between the control and intervention phase.

FEP was part of a national Patient Safety Programme which ended in December 2012, when all hospitals were expected to have implemented, successfully, all aspects of this programme. This external deadline could have had a positive influence on the implementation of FEP, which could have had an impact on our findings. However, an evaluation of the Patient Safety Programme has shown that despite this deadline, several of its projects did not show an increase in implementation during 2012 [31]. In addition, any role the external pressure played in hospitals was present both during the control and the intervention phase.

Conclusion

This study demonstrated that an e-learning course on delirium aimed at nurses from general medical and surgical wards of Dutch hospitals improved the delirium care provided by nurses, and decreased the number of older patients diagnosed with delirium. It showed that by following an e-learning course nurses could build upon their existing knowledge of delirium care. Our findings support the view that educational approaches focussed on increasing awareness of delirium and increasing knowledge on delirium management, are a valuable tool for healthcare organisations in promoting better delirium care for their older patients.

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6

Delirium rates based on documentation in patient records: What can they tell us? A retrospective patient record review

This article is submitted as:
Lotte Van de Steeg, Maaike Langelaan, Cordula Wagner. Delirium rates based on documentation in patient records: What can they tell us? A retrospective patient record review.

Abstract

Background
Delirium occurs frequently in older hospitalised patients and is associated with poor health outcomes. It often goes unrecognised by health care professionals, and there are indications that even when recognised, the diagnosis is not always documented correctly in patient records. To examine whether patient records can provide useful information on delirium occurrence rates, this study aimed to gain insight into delirium rates in Dutch hospitals as documented in patient records.

Methods
Data was collected during the course of a national study on adverse events among hospitalised patients in the Netherlands, consisting of retrospective patient record reviews using 4,048 patient records from 2011/2012, from patients aged one and over. The main outcome measure was delirium diagnosis documented in patient records, among surgical and non-surgical inpatients.

Results
After adjusting for patient, admission, and hospital characteristics, we found a corrected delirium occurrence rate of 3.5 % in surgical patients and 5.5 % in non-surgical patients. Recorded delirium rates did not vary across hospitals (ICC 0.0) and varied little across wards (ICC 5.3 surgical, 9.3 non-surgical). For patients aged 70 and over, we found a delirium occurrence rate of 6.3% in surgical patients and 5.5% in non-surgical patients.

Conclusions
The delirium occurrence rates found in this study were significantly lower than expected based on the literature. This study made clear that only using delirium diagnoses as recorded in patient records can provide information on delirium rates, but whether this information is reliable remains uncertain given the fact that other studies have found that delirium diagnosis was poorly documented in patient records. If routine patient records are to be considered as a means of gaining insight into delirium occurrence or quality of delirium care, either additional information from patient records is needed - using specific symptoms recorded in patient records - or additional research into the reliability of the data source.

Background

Delirium - an acute decline in cognitive functioning, awareness and attention - occurs often in older hospitalized patients. Incidence rates are particularly high in intensive care, postoperative care and palliative care settings, while prevalence rates are especially high in intensive care, general medical, and geriatric wards [1-3].

Delirium is associated with poor outcomes, such as longer hospital stay, higher mortality, higher rates of nursing home placement, functional, and cognitive decline [2, 4-6], and with significantly higher health care costs [7]. Experiencing a delirium often causes great distress to both the patient, their family, and the health care professionals involved [8-10]. Multiple risk factors for delirium have been identified, such as dementia, older age, comorbidity, illness severity, medication use, sensory impairment, malnutrition, and length of hospital stay [3, 11, 12]. The risk factors are often separated into factors associated with the vulnerability of the patient - predisposing factors - and factors associated with events taking place during hospitalisation - precipitating factors – [3, 13]. Common identified predisposing factors are cognitive impairment, functional impairment, and advanced age [3, 14, 15], which can interact with precipitating factors such as infection, psychoactive drugs, and surgery [[3, 15]. Several studies have shown that around a third of delirium cases can be prevented by improving the quality of delirium care in hospital, often by using multicomponent approaches targeting risk factors for delirium [16-19].

Despite the large body of knowledge that exists, delirium frequently goes unrecognised by health care professionals [20, 21], and even when it is recognised, the diagnosis is not always documented correctly in health records [22, 23]. Providing adequate care for patients with delirium requires not only timely recognition of delirium, but also proper documentation of these findings in order to support health care professionals in the care process. Patient records are an essential part of the care process, facilitating communication of information on patients and patients' care between professionals and between hospital wards [24, 25]. Increasingly, patient records are also being used as a source of data, for instance to assess quality of care or to conduct research. Both uses of patient records - as part of the care process and as data source- rely on the accuracy of the documentation within these records. Although there are signs that documentation of delirium in patient records leaves something to be desired [22, 23], to our knowledge no large-scale attempt has been made to determine whether patient records can provide useful information on delirium occurrence rates.

The aim of this study was to gain insight into delirium rates in Dutch hospitals, as documented in patient records. We sought to determine the occurrence of delirium among hospitalised surgical and non-surgical inpatients, and to establish to what extent the recorded delirium rates vary between hospitals and hospital wards, after correcting for patient and admission characteristics.

Methods

Design and setting

We used data collected during the course of a national study on adverse events among hospitalised patients in the Netherlands, consisting of retrospective patient record reviews using patient records from 2011/2012 [26].

The patient records came from a random sample of 20 Dutch hospitals, sampled out of a total of 93. The sample was stratified for hospital type: university, tertiary teaching and general hospitals. We excluded hospitals with fewer than 200 beds or without an intensive care unit or emergency department from the sample (n=4). In each hospital, 200 patient records were randomly selected for review. Records from patients admitted to the psychiatry or obstetrics departments were excluded, as well as records from children aged under 12 months.

In order to gain sufficient data on deceased patients and patients admitted to a university hospital - a relatively small patient group, but with increased risk for adverse events - oversampling of records from these patients took place. A stratified sample was taken, with half of all records taken consisting of randomly selected patient records of patients discharged after a stay of longer than 24 hours, and half of patients who died in hospital. In reality, only 2.2% of patients die in hospital in the Netherlands. In calculating the results, the 50% deceased patients were weighted back to 2.2%, to ensure that the presented results were a representation of the total hospital population of discharged and deceased patients. The same procedure was followed for the distribution of type of hospital.

Record review and outcome measures

Nurses trained in and experienced with record review for research purposes conducted the record review, using all nursing and medical records of the patient admissions sampled. In order to gather information on the occurrence and recognition of delirium in the hospital population, questions were added to the collection tool from the main study. The question used here was: Did the record indicate a diagnosis of delirium or suspicion of

delirium? This is similar to the question used in the validated chart-based instrument for identification of delirium developed by Inouye et al. (2005): 'Is there any evidence from the chart of acute confusional state?' [27].

The record review conducted by nurses also included information on patient characteristics, such as age, sex, admission diagnosis, comorbidity, admission ward, and length of hospital stay.

Statistical analyses

All statistical analyses were performed using STATA 13 and MLwiN 2.3. We calculated rates of recorded delirium for surgical and non-surgical patients using multilevel logistic regression analysis, adjusting for clustering on the ward and hospital level as well as correcting for oversampling of deceased patients and patients admitted to a university hospital (Model 1). In Model 2 we corrected for patient and admission characteristics, based on the literature on delirium risk factors [11, 12]. These included age, Charlson comorbidity score, length of stay, and type of admission (acute or planned). We also corrected for patient sex. Because we used data from an adverse events study for secondary analysis, not all delirium risk factors identified in the literature were available to us.

Intraclass correlations (ICCs) were calculated for each model. The ICC shows how much of the variance in recorded delirium rates can be attributed to differences between hospitals or wards.

Ethics

The study has been granted ethical approval by the Vrije Universiteit (VU) University Medical Centre in Amsterdam, The Netherlands.

Results

Table 6.1 shows the patient, admission, and hospital characteristics for the study sample as a whole and for the surgical and non-surgical subsamples separately. The study sample contained 4,048 hospitalised patients who were admitted to a hospital between April 2011 and March 2012, 1,309 of whom were surgical patients and 2,735 non-surgical patients.

In Model 1, correcting only for oversampling and clustering, the variance in recorded delirium rates at the hospital level was very low, with an ICC of 0.0 for both surgical and non-surgical patients (Tables 6.2 and 6.3). We found a delirium occurrence rate of 3.9% in surgical patients (CI 2.8 to 5.4) and 6.1% in non-surgical patients (CI 4.8 to 7.9), based on the included patient records.

Table 6.1 Characteristics of the total study sample and the surgical and non-surgical subsamples

	Total study sample	**Surgical patients**	**Non-surgical patients**
Patients admitted	4,048	1,309	2,735
Patients admitted to a university hospital (% of total admissions)	799 (19.7)	275 (21.0)	524 (19.2)
Patients who died during admission (% of total admissions)	2,025 (50.0)	336 (25.7)	1,688 (61.7)
Mean age (SD)	67.0 (19.4)	62.2 (19.9)	69.4 (18.7)
Sex (% male)	54.2	52.2	55.5
Mean length of stay (SD)	8.5 (17.2)	7.8 (22.1)	8.8 (14.3)
Type of admission (acute %)	2,831 (69.9)	554 (42.3)	2,276 (83.2)
Mean Charlson score (SD), *n*=3.167	1.7 (2.4)	1.0 (2.0)	2.0 (2.5)

After correcting for oversampling, clustering, and patient and admission characteristics in Model 2, we found a delirium occurrence rate of 3.5% in surgical patients (CI 1.9 to 6.1) and 5.5% in non-surgical patients (CI 3.6 to 8.2), as recorded in patient records. Looking only at patients aged 70 and over, we found a delirium occurrence rate of 6.3% in surgical patients (*n*=285, CI 2.6 to 14.5) and 5.5% in non-surgical patients (*n*=640, CI 3.3 to 9.0).

We again found that the variance in recorded delirium rates at the hospital level was 0.0 for both subsamples, indicating that zero percent of the total variance is accounted for by clustering at the hospital level (Tables 6.2 and 6.3). Model 2 found the clustering of recorded delirium rates in hospital wards to be substantially higher than in hospitals - ICC 5.3 versus ICC 0.0 for surgical patients and ICC 9.3 versus ICC 0.0 for non-surgical patients. This shows that there was more clustering at the ward level - 5.3% and 9.3% of the total variance is accounted for by clustering at the ward level.

We found that patients were more likely to have delirium documented in their patient records if they were surgical patients, older, stayed longer in hospital, were admitted to a university hospital, or died during admission (Table 6.2). For non-surgical patients this was true for male patients, who were older, stayed longer in hospital, or who died during admission (Table 6.3).

Table 6.2 Recorded delirium rates for the two multilevel logistic regression models and the independent associations between recorded delirium rate and patient, admission and hospital characteristics, for surgical patients

	Model 1* (*n*=1306)	**Model 2* (*n*=709)**
Recorded delirium rate	3.9 (CI 2.8 to 5.4)	3.5 (CI 1.9 to 6.1)
ICC hospital level	0.0	0.0
ICC hospital ward level	4.3	5.3
Patient, admission and hospital characteristics	OR (95% CI)	OR (95% CI)
Age	-	**1.07 (1.04 to 1.10)**
Sex (ref male)	-	0.79 (0.44 to 1.42)
Length of stay	-	**1.06 (1.04 to 1.09)**
Charlson comorbidity score	-	0.98 (0.86 to 1.11)
Type of admission (ref planned)	-	1.05 (0.57 to 1.94)
Patient death	**11.71 (7.84 to 17.51)**	**4.29 (2.22 to 8.30)**
Hospital type (ref general)		
University	1.64 (0.95 to 2.85)	**3.08 (1.40 to 6.80)**
Tertiary teaching	0.95 (0.57 to 1.59)	1.42 (0.59 to 3.44)

Bold: significant ORs (P < 0.05).

* Corrected for oversampling of deceased patients and of patients admitted to a university hospital.

Table 6.3 Recorded delirium rates for the two multilevel logistic regression models and the independent associations between recorded delirium rate and patient, admission, and hospital characteristics, for non-surgical patients

	Model 1* (*n*=2,727)	**Model 2*(*n*=1,187)**
Recorded delirium rate	6.1 (CI 4.8 to 7.9)	5.5 (CI 3.6 to 8.2)
ICC hospital level	0.0	0.0
ICC hospital ward level	9.5	9.3
Patient, admission, and hospital characteristics	OR (95% CI)	OR (95% CI)
Age	-	**1.05 (1.03 to 1.07)**
Sex (ref male)	-	**0.59 (0.42 to 0.85)**
Length of stay	-	**1.04 (1.03 to 1.06)**
Charlson comorbidity score	-	1.03 (0.96 to 1.10)
Type of admission (ref planned)	-	1.04 (0.64 to 1.69)
Patient death	**4.72 (3.57 to 6.25)**	**2.71 (1.74 to 4.23)**
Hospital type (ref general)		
University		
Tertiary teaching	0.88 (0.58 to 1.33)	1.37 (0.80 to 2.35)
	1.24 (0.89 to 1.74)	1.55 (0.91 to 2.62)

Bold: significant ORs (P < 0.05).

* Corrected for oversampling of deceased patients and of patients admitted to a university hospital.

Discussion

In this study based on patient records from patients aged one and over, we found a corrected delirium occurrence rate of 3.5% in surgical patients and 5.5% in non-surgical patients, and for patients aged 70 and over, a delirium occurrence rate of 6.3% in surgical patients and 5.5% in non-surgical patients. This is significantly lower than would be expected based on the literature, where percentages starting at 11% for surgical patients and 29% for medical patients are often found [3, 28, 29]. Because there is a lack of standardised methods for determining delirium prevalence and incidence, comparing delirium rates between studies is difficult. Confounding factors include the different methods of diagnosing delirium - i.e. using a diagnostic instrument or not - and the different professionals performing the diagnosis - nurses, physicians, researchers.

We found that, after adjusting for patient, admission, and hospital characteristics, recorded delirium rates did not vary across hospitals (ICC 0.0) and varied little across hospital wards (ICC 5.3 and 9.3). There is no reason to assume that actual delirium rates vary significantly between Dutch hospitals, which would mean that the low hospital ICC found here shows there is no difference in quality of delirium documentation between hospitals. Based on the literature, differences in actual delirium rates are expected across specific hospital wards due to differences in patient population [3, 11, 12]. This is in line with the hospital ward ICC found here, as well as the differences found between surgical and non-surgical patients.

Our findings that older patients with a longer length of stay are more likely to have delirium documented in their records are also in line with the literature [3, 11, 12]. Although this could indicate that there is not a large difference between actual delirium occurrence and delirium occurrence as documented, several risk factors could not be included in this study, because they were not part of the national adverse event study this study was part of. This includes risk factors such as dementia, illness severity, medication use, sensory impairment, and malnutrition.

The delirium occurrence rates found in this study based on patient records were rather low, when compared to rates found in studies using delirium assessments conducted specifically for research purposes by clinicians or researchers [3]. Other studies have found that delirium was poorly documented in patient records, even for patients with a confirmed diagnosis of delirium [22, 23, 30]. This suggests that the actual delirium occurrence rate in the hospitals participating in this study might be significantly higher than the rates identified here. Based on this study alone, it is not possible to determine whether the low delirium occurrence rate can be attributed to actual low delirium occurrence due to good quality of care, or the opposite - poor recognition or poor documentation of delirium. However, taking into account the previously mentioned studies that compared actual delirium diagnosis with information in the patient records, it seems likely that documentation of delirium is an aspect of quality of delirium care that still requires attention in the Netherlands as well.

One study found that failure to use the term 'delirium' as a documented diagnosis was associated with reduced use of evidence-based management [30]. This supports the idea that poor or unclear documentation on delirium can be seen as an indicator for poor quality of care. Efforts to improve delirium care have been mostly focused on improving delirium recognition and treatment, either through education of professionals or through multifaceted programmes [31-34]. However, little to no attention is being

paid to the importance of clear and correct documentation of delirium, while this seems necessary to ensure that all health care professionals are aware of the delirium diagnosis and can act appropriately.

The results from this study can not tell us if efforts to improve delirium care led to high quality of care in the final years of the Dutch patient safety programme, and therefore to low delirium occurrence rates. It would be interesting to see whether the recognition and documentation of delirium in Dutch hospitals is better than found elsewhere or similar [22, 23, 30]. A recently validated chart abstraction method for retrospectively diagnosing delirium in hospitalised patients might offer a means of comparing documented delirium rates - based on recorded delirium diagnoses - with delirium rates based on symptoms recorded in the patient record [35]. However, both methods still rely only on patient records and are therefore dependent of the quality of record keeping. An important benefit of using patient records as a data source, as opposed to using delirium assessment by clinicians or researchers, is that it is less labour-intensive and significantly less invasive for the patient. Whereas patient record reviews mean the patient receives care as usual, conducting delirium assessments for research purposes mean patients will have extra professionals at their bedside, conducting observations and asking questions.

This study had some limitations. By looking only at patient records and documented delirium, we were unable to determine whether the differences in delirium rates found across hospital wards were due to differences in record keeping, differences in delirium recognition, or differences in actual delirium occurrence. Furthermore, not all relevant delirium risk factors could be included as they were either not included in the data collection tool from the larger adverse events study, or because the risk factor was not routinely recorded in patient records at all. In addition, the Charlson comorbidity score included in the analysis was based on data supplied by hospitals, not on data gathered in the course of this study. Consequently, the reliability of this data was unclear.

Conclusions

Delirium occurs frequently in older hospitalised patients and is associated with poor health outcomes. Delirium often goes unrecognised by health care professionals and even when recognised, the diagnosis is not always documented correctly in health records. The delirium occurrence rates found in this study were significantly lower than expected based on the literature.

Whether this is due to low delirium occurrence rates in the Netherlands or poor documentation of delirium in patient records remains unclear. If routine patient records are to be considered as a means of gaining insight into delirium occurrence or quality of delirium care, either additional information from patient records is needed - using symptoms recorded in patient records instead of only a diagnosis - or additional research into the reliability of the data source.

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7

Can preventable adverse events be predicted among hospitalised older patients? The development and validation of a predictive model

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Abstract

Objective
To develop and validate a predictive model for preventable adverse events (AEs) in hospitalised older patients, using clinically important risk factors that are readily available on admission.

Design
Data from two retrospective patient record review studies on AEs were used. Risk factors included patient characteristics as well as admission and organisational characteristics. Multilevel logistical regression analysis was used to develop the model. Backward elimination was applied to identify the most parsimonious model.

Setting
Twenty-one Dutch hospitals were included in the 2004 sample and 20 Dutch hospitals in the 2008 sample.

Participants
A total of 3977 patients aged 70 years or over who were admitted to a Dutch hospital in 2004 and 2119 patients aged 70 years or over admitted in 2008.

Main Outcome Measures
Identified predictors of preventable AEs in older patients.

Results
In 2004 predictors of preventable AEs in patients aged 70 years or over were increased age (OR 1.04, confidence interval (CI) 1.01–1.06); elective admission (OR 1.65, CI 1.14–2.40) and admission to a surgical ward (OR 1.53, CI 1.08–2.16). The area under the receiver operating characteristic curve for the 2004 sample was 0.60 and for 2008, 0.59.

Conclusions
This study showed that several expected risk factors for preventable AEs in older patients, including comorbidity, could not predict these events. It was not possible, using in-patient data available on admission and collected during the course of two patient record review studies, to develop a satisfactory predictive model for preventable AEs in older patients.

Introduction

Older patients run an increased risk of experiencing adverse events (AEs) and preventable AEs during hospitalisation, compared with younger patients [1–5]. A recent Dutch study found that 2.9% of hospitalised older patients experience a preventable AE, compared with 1.8% of hospitalised younger patients [3]. An AE is an unintended injury which results in temporary or permanent disability, death or prolongation of hospital stay. Furthermore, it must be caused by the management of health care rather than the patient's disease [6,7]. AEs are judged as preventable if they occurred due to a failure to follow accepted practice.

A clinical prediction model estimating the risk to older patients of experiencing preventable AEs would make it possible to identify a specific group of older patients who run a higher risk of experiencing preventable AEs than their peers. Instead of viewing all older patients as high risk this would enable clinicians to focus preventive interventions on these specific patients during their stay in hospital.

In the literature several potential predictors of preventable AEs in older patients have been identified. However, the consideration of importance of these risk factors is mostly only theoretical. Little research has been done to determine, empirically, the importance of these potential risk factors. Some authors have theorised that the reason AEs and preventable AEs occur more often during the hospitalisation of older patients is not primarily due to their age, but due to the diminished physiological reserves of this patient group [2,8,9]. They suggest that diminished reserves make it more likely that medical mistakes will lead to actual injury. Another possible explanation that is mentioned in the literature is the increased length of stay of older patients due to the complex diseases older patients suffer from [2,10]. A longer length of stay, according to the authors, means increased exposure to the opportunities for errors to occur. One study attempted to clarify whether age or other factors were the best predictors of preventable AEs. It found that age was not an independent predictor [11].

The objective of this study was to develop a predictive model for preventable AEs in older patients. Such a model would use clinically important risk factors that are readily available on admission. Our intention was to design a model that could be used by health-care providers in hospitals so that they could take the initiative in identifying older high-risk patients for preventive measures or closer clinical attention.

Methods

We used data collected during the course of two studies on AEs among hospitalised patients in the Netherlands. Both studies consisted of retrospective patient record reviews, one using patient records from 2004 and the other from 2008 [3,12,13]. The data from the former study were used to develop the model and the data from the latter to validate it. The overall method of data collection and analysis is presented below.

Design and setting

A retrospective patient record review study was conducted in 21 hospitals, sampled randomly, during 2005/06–the 2004 records—and 20 hospitals in 2009/10—the 2008 records. These were sampled out of a total of 93 Dutch hospitals. Both samples were stratified for hospital type (university, tertiary teaching and general hospitals) and contained a good representation of both urban and rural settings. Eight hospitals were included in the samples from both years. Hospitals with fewer than 200 beds or without an intensive care unit or emergency department were excluded from the samples (n=4).

In both the 2004 and 2008 study, oversampling of deceased patients and patients admitted to a university hospital took place. This was in order to gain sufficient data on these relatively small—but high risk—patient groups. Patient records of patients discharged after a stay of >24 h, and of patients who died in hospital were randomly selected per hospital, each making up 50% of the sample. In reality only 3% of the patients die in hospital in the Netherlands. Our intention was to design a predictive model identifying high-risk older patients, as opposed to a model predicting preventable AE rates. This made it unnecessary to correct or weigh the results for this oversampling.

A total of 400 (2004) or 200 (2008) records was selected in each hospital. Records from patients admitted to the psychiatry or obstetrics wards were excluded, as well as records from children aged <1 year.

Record review and outcome measures

Trained and experienced nurses and physicians conducted the record review in both studies. They used nursing, medical and, if available, outpatient records of the patient admissions sampled. Over half of all included patient records were records for older patients (70 years or over): 3,977 records from 2004 and 2,119 records from 2008.

The outcome measures of these studies were AEs and preventable AEs, determined using a method comparable to those of other studies [1,5,14]. The nurses first reviewed all the records included using screening criteria

designed to discover triggers indicating the possible presence of an AE [1,14]. If one or more triggers were detected, the record would subsequently be reviewed by a physician. The physician would then determine whether an AE had indeed occurred, guided by a standardised procedure. An AE was defined by three criteria:

(i.) an unintended injury;
(ii.) the injury resulted in prolongation of hospital stay, temporary or permanent disability or death;
(iii.) the injury was caused by the management of health care rather than the patient's disease.

The AEs identified were studied further by the physician in order to determine, among other aspects, how preventable the event was [6, 13]. An AE was found to be preventable when the care given fell below the current level of expected performance for practitioners or systems [13]. The preventability was scored on a six-point Likert scale and an AE was counted as preventable if the score was 4–6. This indicated that the reviewer regarded the event as having a >50% chance of being preventable.

For each patient included, data from the patient record was supplemented with diagnosis data from the national hospital administration database (Prismant). This information was coded according to the International Statistical Classification of Diseases, 9th revision (ICD-9).

Risk factor variables

The potential risk factors for AEs were identified, based on the previous literature on AEs and, in particular, AEs in older patients [3, 4, 8]. Data on all the potential risk factors had to be present for all older patients at the time of admission, meaning data had to be collected routinely by hospital staff for all patients aged 70 or over. Only those risk factors were considered that were gathered as part of the two AEs studies, or that could be derived from data gathered during those studies. This meant that potential risk factor variables such as, impairment in activities of daily living [15] and frailty scores [16], were not included in the development of the predictive model.

The risk factors which were considered included patient characteristics as well as admission and organisational characteristics. These were patients' sex; age; the Charlson comorbidity score; their home circumstances, that is whether they lived independently or in a care facility; the type of hospital (general, tertiary teaching or university); whether the hospital admission was a readmission related to the original admission within 12 months after discharge; whether it was an elective or acute admission; an admission to a surgical or non- surgical ward and whether the admission was during a weekend (Saturday or Sunday). The Charlson comorbidity score was

calculated based on the ICD-9 codes, using a Charlson module for STATA [17].

Model development and validation

A multivariable logistical regression analysis was used to develop the model to predict preventable AEs in older patients. This used only data from patients aged 70 and over from 2004. The analyses were carried out using multilevel analyses (MLwin 2.25) in order to account for possible clustering of patients within hospitals and hospital wards. Backward elimination was applied to identify the most parsimonious model. The variables that showed insignificant effects (P>0.05) were removed in order to determine the final model. We assessed the performance of the predictive model by using the area under the receiver operating characteristic curve (ROC AUC), both in the 2004 development sample and in the 2008 validation sample. The AUC can range from 0.5 to 1.0, with 0.5 indicating no accuracy of the model in predicting the studied event and 1.0 indicating a perfect accuracy. Generally, an AUC of 0.5–0.7 is interpreted as a model with low discriminatory power, 0.7–0.9 moderate and >0.9 as a model with a high discriminatory power [18,19]. The AUC can be interpreted as the probability that a randomly chosen patient with a preventable AE is rated as more likely to experience a preventable AE by the predictive model than a randomly chosen patient without a preventable AE [20].

To determine how stable the predictors in the final model were over time, bootstrapping of the predictors in the final model was used (STATA 12.1). Two thousand random bootstrap samples were drawn with replacement from both datasets. The odds ratios of the predictors in the final model were calculated in each bootstrap sample. This enabled us to calculate confidence intervals (CIs) for the predictors, both for 2004 and 2008. We gained insight into the stability of the predictors by comparing the intervals between 2004 and 2008. The more overlapping intervals indicate a more stable predictor.

Results

Table 7.1 shows the patient and admission characteristics for the development and the validation samples. The 2004 sample contained 178 older patients who had experienced a preventable AE (n=3,977). The 2008 sample contained 124 older patients who had experienced a preventable AE (n=2,119). The patient and admission characteristics did not differ greatly between the development and validation samples.

Table 7.1 Comparison of patient and admission characteristics of the study samples 2004 and 2008

Patient and admission characteristics	Development sample, 2004[a] (*n*=3,977)	Validation sample, 2008[a] (*n*=2,119)	*P*
Age, years, mean (SD)	80.0 (6.4)	80.3 (6.5)	0.03
Male sex, %	49.9	50.4	0.72
Charlson comorbidity score, mean (SD)	1.5 (2.1)	1.3 (1.9)	<0.01
Living at home, %	94.2	85.7	<0.01
Acute admission, %	78.8	77.9	0.45
Readmission, %	5.3	3.8	0.01
Weekend admission, %	19.1	18.8	0.83
Surgical admission, %	26.6	26.1	0.69
Admission to university hospital, %	13.0	13.8	0.39
Admission to tertiary teaching hospital, %	30.4	30.2	0.83
Admission to general hospital, %	56.6	56.1	0.70
Length of hospital stay, days, mean (SD/median)	11.6 (12.4/8)	10.8 (11.2/7)	0.02

[a] Patient admission in psychiatry and admission of <24 h for non-deceased patients were excluded.

Predictive model

The nine variables considered for the predictive model are presented in Table 7.2. The final model for preventable AEs included three of these variables: preventable AEs were associated with older age; elective admissions and surgical admissions. The regression parameters for the predictive model appear in Table 7.3.

Table 7.2 Variables considered as predictors in a multilevel multivariable predictive model for preventable AEs in 2004, adjusted for clustering at the hospital level and hospital ward level, n=3,975

Potential risk factors	**Univariable analysis**		**Multivariable analysis**	
	OR (95% CI), 2004	***P***	**OR (95% CI), 2004**	***P***
Age (years)	1.03 (1.00–1.06)	0.039	1.03 (1.01–1.06)	0.006
Sex (ref. male)	1.14 (0.83–1.56)	0.428	1.04 (0.75–1.43)	0.804
Charlson comorbidity score	0.99 (0.92–1.07)	0.883	1.02 (0.96–1.11)	0.463
Elective admission (ref. acute)	0.59 (0.42–0.83)	0.003	0.63 (0.43–0.92)	0.017
Home circumstances (ref. institutionalised)	0.66 (0.37–1.18)	0.162	0.71 (0.40–1.26)	0.241
Readmission (ref. no)	0.91 (0.43–1.89)	0.791	0.99 (0.48–2.04)	0.972
Weekend or week day admission (ref. weekday)	0.75 (0.48–1.16)	0.190	0.80 (0.52–1.22)	0.296
Surgical admission unit (ref. non-surgical)	0.57 (0.42–0.79)	0.001	0.64 (0.45–0.90)	0.012
Hospital type (ref. general)				
University	1.11 (0.57–2.16)	0.761	1.03 (0.53–2.00)	0.920
Tertiary teaching	1.00 (0.58–1.71)	0.996	1.00 (0.59–1.70)	0.994

Table 7.3 Final predictive model for preventable AEs in 2004, adjusted for clustering at the hospital level and hospital ward level

Risk factors	OR (95% CI), 2004	*P*	Bootstrap 95% CI, 2004	Bootstrap 95% CI, 2008
Age (years)	1.0 (1.0–1.1)	0.004	1.0–1.1	1.0–1.0
Elective admission (ref. acute)	1.7 (1.1–2.4)	0.009	1.1–2.5	0.6–1.7
Surgical admission unit (ref. non-surgical)	1.5 (1.1–2.2)	0.017	1.0–2.3	1.7–4.3

Including bootstrap CIs of the odds ratios for the predictors for preventable AEs in 2004 and 2008.

Performance of the predictive model

The predictive model for preventable AEs yielded an ROC AUC of 0.60 (95% CI 0.56–0.65), using the 2004 development sample. Using the validation sample an AUC of 0.59 (95% CI 0.53–0.64) was found. This indicates that the model fitted the data poorly and had low discriminatory power.

We found that for 2004, 18.2% of the variation could be explained by the predictors in the final model. This confirms that the model we developed has limited ability to predict preventable AEs in older patients.

The bootstrap CIs for all three variables included in the final model are presented in Table 7.3, both for 2004 and 2008. They show that the only significant predictor of preventable AEs in both samples was the type of admission. The odds of developing a preventable AE for surgical admissions were even larger in the 2008 sample.

Discussion

With this study we attempted to develop a predictive model for preventable AEs in older patients, using data available on admission that were collected during record review studies. We found that we were only able to develop a predictive model with a poor performance in which preventable AEs were associated with older age; elective admissions and surgical admissions. However, only one factor was identified that contributed independently to the risk of preventable AEs in older patients in both the development and validation samples; when the admission was to a surgical ward, an increased risk of preventable AEs was present both in 2004 and 2008. This information could guide hospitals when choosing how to go about

improving patient safety.

In our study, we did not find that comorbidity was an independent predictor of preventable AEs in older patients, in contrast to our expectations based on the literature [2,8,9]. We did find age to be a predictor of preventable AEs in 2004, as opposed to an earlier study on AEs in older patients [11]. It remains unclear whether this indicates that older patients received less adequate care. It might mean that we have not included a variable that represents the physical state of the patients sufficiently, making age the best available indicator. However, we included not only the Charlson comorbidity score in the initial model, but home circumstances as a proxy for physical state as well. Both were not found to be predictors of preventable AEs.

By using routine in-patient data we were only able to develop a model with poor ROC AUC scores. This does not indicate that the risk of preventable AEs cannot be reliably predicted at all, but that the ability to identify at risk older patients is limited when using only routinely collected data which are available on admission. Other information, that is more difficult or costly to measure, might contain stronger predictors of preventable AEs. For instance, more detailed information on the frailty of older patients [21] or specific laboratory results regarding physical fitness could provide better predictors, if they were available on, or directly after, ad- mission. An alternative approach would be to investigate more specific types of preventable AEs. While we focused on all preventable AEs in older patients, other studies have shown good results with, for instance, a predictive model for the development of pressure ulcers during admission to hospital [22]. However, developing separate predictive models for the numerous different types of preventable AEs would not only require substantial research, but would hardly simplify life for clinicians.

Both the 2004 and 2008 samples showed that the need remains to improve the quality of care for older patients provided by surgical wards. This could be met by providing further education on geriatric medicine for surgeons and surgical nurses. Additional research should focus on preventable AEs during surgical admissions and more specifically on the causes of these events in order to guide future efforts in prevention.

One of the strengths of this study was the use of two large samples of hospitalised older patients from different years. These samples made it possible to develop and validate the predictive model in two separate groups (2004 and 2008 data). This adds to the degree to which the findings apply generally. However, by choosing record reviews as a data source, this study was also subject to several potential limitations. First, we were unable to examine some risk factors identified in previous studies, such as frailty

scores. These risk factors may have improved the performance of our predictive model. However, our goal was to utilise the data readily available for all older patients on admission. This was not the case for several potential risk factors, including frailty scores. However, future studies may use the presented model to examine the incremental value of using frailty scores. Secondly, the registration and quality of patient records may vary, possibly influencing the patient characteristics and AEs found [23]. Finally, although the goal was to develop a predictive model that could be used in future patient populations; our results suggest that the predictors of preventable AEs may vary over time, making it hard to develop a stable model. This might also be due to changes in the quality of care and changes in patient case mix [13]. Residual confounding by patient complexity cannot be completely ruled out. Indications for treatment and surgery are extended to increasingly older and more complex patients with more comorbidity.

Conclusions

This study showed that several expected risk factors for preventable AEs in older patients, including comorbidity, could not predict whether these events would occur.

Using routine in-patient data available on admission and collected during the course of two patient record reviews, we were only able to develop a predictive model with a poor performance, in which preventable AEs were associated with older age, elective admissions and surgical admissions. The risk factors found were not all stable over time, suggesting that developing a predictive model for preventable AEs in older patients might not be possible due to the constant changes taking place in hospitals. The increased risk of preventable AEs in older patients admitted to a surgical ward was present in both the development and the validation sample, indicating that improvement projects as well as future research efforts should continue to focus on surgical care.

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8
General discussion

This thesis looked at how patient safety and quality of care for older hospitalised patients at-risk for delirium can be improved, specifically focusing on the effects of e-learning on the implementation of the national Frail Elderly Project (FEP). In this final chapter the main findings of this research are discussed, as well as some methodological considerations. This chapter also looks at the implications of this research for practice, policy and future research.

Main findings

In the Netherlands, efforts have been made to improve delirium care, as part of the national Frail Elderly Project (FEP). Because there were indications that the implementation of FEP and its delirium guideline was not as successful as hoped (IGZ 2012), we first decided to look into possible barriers to this implementation.

1. **Which barriers exist to adherence to the FEP delirium guideline by nurses?**

We found that individual, social and organisational factors play a role in nurse's adherence to the FEP delirium guideline. Barriers were identified regarding motivation and goals, knowledge and skills, professional role and identity, and context and resources.

Overall, nurses lack the motivation to use the risk-screening instrument aimed at identifying patients at risk for delirium, despite the recommendation in the guideline. This is mainly influenced by the apparent lack of clarity of the benefits and goals of screening. Nurses stated that they did have sufficient knowledge and skills to use the screening instrument to identify patients at risk, or the Delirium Observation Screening Scale (DOSS) in order to observe possibly delirious patients. Whether nurses considered themselves capable of taking subsequent preventive or treatment measures is less clear: some indicated high levels of confidence, while others had doubts about their own and others' level of knowledge. Physicians mainly emphasized the importance of additional education for nurses on delirium screening and treatment.

Nurses report having a shortage of time in which to perform their day-to-day tasks, leading to the professed inability to perform time-consuming or perceived non-essential activities such as screening, or observing patients using the DOSS. Nurses do not consider delirium risk screening to be an intrinsic part of their job, and in addition some nurses disagreed with the

content of the guideline. The screening instrument is sometimes seen as limiting their autonomy, while they have little faith in the usefulness of the instrument itself. A negative influence on delirium care is the general view that nurses on general wards consider care for older patients to be uninteresting or 'not exciting'.

An educational intervention could be a means of helping improve the implementation of the FEP delirium guideline. Such an intervention could potentially help solve some of the barriers to guideline adherence we had identified, such as the nurses' lack of understanding of the benefits and goals of risk screening. We now turned our attention to an educational intervention: an e-learning course on delirium for nursing staff.

2. Does the use of e-learning improve nurses' delirium knowledge?

Our study into the effects of e-learning demonstrated that an e-learning course on delirium had a significant positive effect on nurses' knowledge on delirium, in all subgroups of nursing staff and for all question categories. Test scores on the final knowledge test (mean 87.4, 95% CI 86.7 to 88.2) were significantly higher than those on baseline (mean 79.3, 95% CI 78.5 to 80.1). At baseline, nursing staff had the most difficulty with questions related to the definition of delirium: what are its symptoms, course, consequences, and which patients are at risk. However, the mean score for this category of questions was still relatively high (74.3, 95% CI 73.1 to 75.5). The high participation rate in our study appears to show that staff members are willing and able to improve their knowledge through e-learning.

3. Does the use of e-learning improve the provision of delirium care by nurses according to the FEP delirium guideline?

Our stepped wedge trial showed that an e-learning course on delirium did have a significant effect on the nursing staff's delirium care for older patients, as evidenced by the risk screening. The adjusted screening rate was 50.8% in the control phase, compared with 65.4% in the intervention phase ($p < 0.01$). An e-learning course on delirium appears to be a valuable addition to the efforts of hospitals to improve delirium care. However, the goal of FEP – to ensure all older patients were screened for the risk of delirium and all at-risk patients were observed using the DOSS – was still not achieved.

After using delirium rates based on recorded delirium diagnoses in patient records as a secondary outcome measure of our stepped wedge trial on the effects of e-learning, we were interested to see whether this outcome measure could potentially be used for other research on delirium and quality of care. Which is why in the next article of this thesis, we wanted to determine what delirium rates based on patient records can tell us about the occurrence of delirium in the Netherlands.

4. What can delirium rates based on patient records tell us about the occurrence of delirium in the Netherlands?

After adjusting for oversampling of deceased patients and patients admitted to a university hospital, we found a delirium occurrence rate of 3.5% in surgical patients and 5.5% in non-surgical patients, and for patients aged 70 and over, we found a delirium occurrence rate of 6.3% in surgical patients and 5.5% in non-surgical patients. The delirium occurrence rates found in this study were lower than expected based on the literature. However, we also found that, after adjusting for patient-, admission- and hospital characteristics, recorded delirium rates did not vary between hospitals (ICC 0.0) and varied little between hospital wards (ICC 5.3 and 9.3). This is in line with expectations regarding actual delirium occurrence rates: we would expect no differences between Dutch hospitals, but would expect differences between hospital wards, given the different patient populations on those wards.

This study made clear that using only delirium diagnoses as recorded in patient records can provide information on delirium occurrence, but because this study could not compare recorded delirium rates to actual delirium rates, how reliable this information is remains uncertain. If patient records are to be used as a means of gaining reliable insight into delirium occurrence and quality of delirium care, additional information is needed besides recorded delirium diagnoses, either from patient records – using additional data – or from additional measurements, such as delirium assessment and clinical observation.

After focusing specifically on delirium, this thesis concluded by looking at adverse events in general, as a possible alternative approach to improving patient safety and quality of care for older hospitalised patients.

5. **Can preventable adverse events in older patients be predicted using a predictive model?**

In the final article included in this thesis, we examined whether preventable adverse events (AEs) in older patients can be predicted using a predictive model. Our intention was to design a model that could be used by healthcare providers in hospitals, so they could identify older high-risk patients for preventive measures or closer clinical attention. Several expected risk factors for preventable AEs in older patients, including comorbidity, could not predict whether these events would occur. Using routine in-patient data available on admission and collected during the course of two patient record reviews, we were only able to develop a predictive model with a poor performance, in which preventable AEs were associated with older age; elective admissions; and surgical admissions. The risk factors found were not all stable over time, suggesting that developing a predictive model for preventable AEs in older patients might not be possible due to the constant changes taking place in hospitals. The increased risk of preventable AEs in older patients admitted to a surgical department was present in both the development and the validation sample, indicating it was the only risk factor that remained stable over time.

Reflection

The central question of this thesis was "How can safety and quality of care for older hospitalised patients at risk of delirium be improved?". Looking at the studies that make up this thesis, four answers can be formulated to this question:

1. *Educate healthcare professionals and increase awareness on care for older patients.*

An educational intervention is a means of helping to improve the implementation of the FEP delirium guideline, and probably other guidelines as well. Such an intervention can help solve some of the barriers to guideline adherence we have identified, such as the nurses' lack of understanding of the benefits and goals of risk screening. Our study into the effects of e-learning demonstrated that an e-learning course on delirium aimed at nursing staff not only improved knowledge, but also improved delirium care provided, and decreased the number of older patients diagnosed with delirium. It showed that by following an e-learning course,

staff could build upon their existing knowledge of delirium care. Our study supports the concept that professional education is an effective method of improving delirium care (McCrow et al. 2014, Wand et al. 2014, Devlin et al. 2008).

In Barr et al.'s adaptation of Kirkpatrick's framework for measuring outcomes of educational initiatives, several levels are identified on which education can have an impact before it leads to benefits for the patient (Barr et al. 2005, Kirkpatrick, 1996). This framework shows that education can be expected to change not only learners' knowledge and skills, but attitudes and perceptions as well, before leading to changes in behaviour. Given the barriers to the implementation of FEP we identified regarding the motivation of nurses and the perception of their professional role, the influence of education on the attitudes and perceptions of healthcare professionals might be its most valuable effect when aiming to improve care for older patients at risk of delirium.

Table 8.1 Adaptation of Kirkpatrick's framework for outcomes of educational interventions (Barr et al. 2005)

Level	
1	Learner's reaction
2a	Modification of attitudes and perceptions
2b	Acquisition of knowledge and skills
3	Behaviour change
4a	Changes in organisational practice
4b	Benefits to patients

In the literature on delirium education, attention is increasingly being paid to the importance of focusing education not only on increasing knowledge and skills, but also – or especially – on changing attitudes to and perceptions of older patients and geriatric syndromes (Tullo et al. 2015, Teodorczuk et al. 2012). This reinforces the view that educational interventions are valuable tools for healthcare organisations in promoting better care for their older patients, especially if they are capable of addressing knowledge gaps as well as negative attitudes.

2. *Ensure the context is ready for the improvement project.*

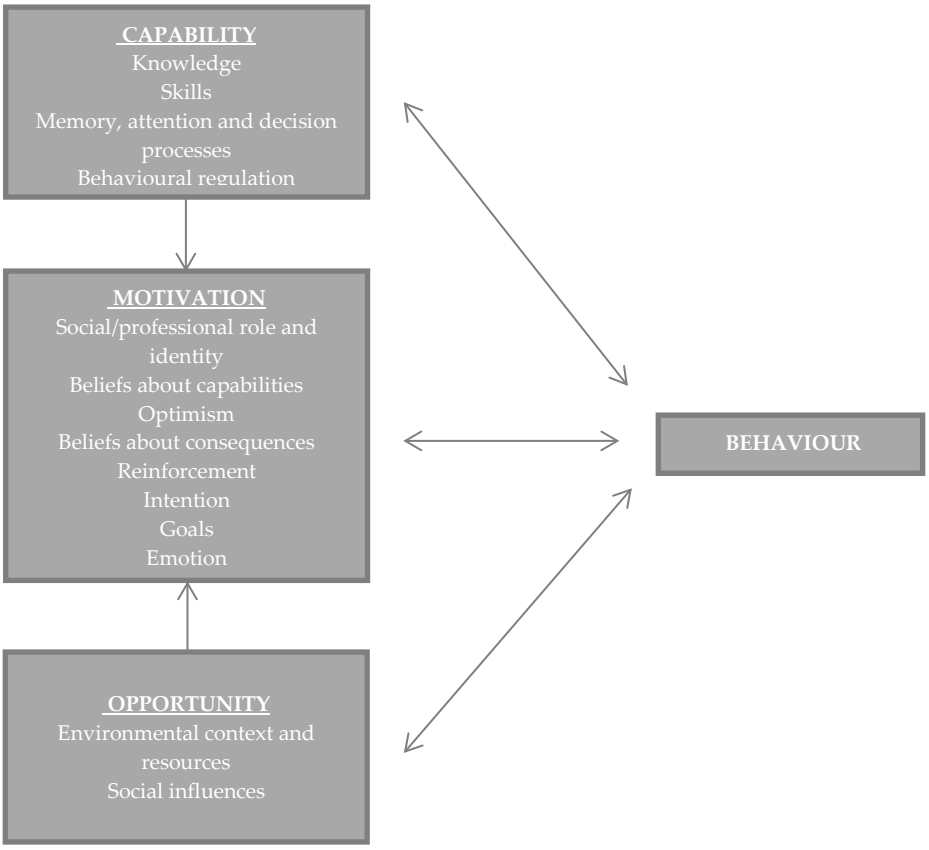
As our study into the effects of e-learning on delirium care has shown, education of healthcare professionals can be an important part of quality improvement projects. However, education alone should not be expected to automatically lead to better care. This is made clear by the Theoretical Domains Framework on behaviour change, which includes 14 theoretical domains that play a role in the process of behaviour change (Cane et al. 2012, Michie et al. 2005). These domains range from knowledge and skills to emotion and environmental context, which illustrates that changing people's behaviour is a complex process, involving many different aspects of the individuals, organisations and interventions involved. Virtually all research on behaviour change and implementation agrees that the context in which a quality improvement project is undertaken has significant impact on the results of the project (Bate et al. 2014, Grol & Wensing 2004, Berwick 2003, Pettigrew & Whipp 1993). In the COM-B model by Michie et al., the context of behaviour is represented in the component opportunity (see Figure 8.1). The COM-B model shows that human behaviour results from the interaction between an individual's physical and psychological capabilities, their opportunities – or context – , and their motivation (Michie et al. 2011).

In the case of our study into the effects of e-learning, the participating hospitals were already involved in a national quality improvement project, FEP. This meant two important things for the context in which we introduced the delirium e-learning course:

A. There was external pressure on hospitals, through the Healthcare Inspectorate, to successfully implement FEP and change delirium care.
B. Hospitals had already made organisational changes aimed at improving delirium care.

The external pressure on hospitals to successfully implement all parts of the national Patient Safety Programme, including FEP, meant that, at least on the management level, a sense of urgency was created and hospitals were willing to change clinical practice.

Figure 8.1 COM-B model for understanding behaviour, combined with the domains from the Theoretical Domains Framework (Cane et al 2012, Michie et al. 2011)



The organisational changes hospitals made in order to implement FEP generally involved creating risk-screening forms and delirium observations forms to include in patient records – either on paper or electronically – and rewriting care protocols to take into account the FEP delirium guideline. This created an environment in which nursing staff could more easily change their behaviour and follow the delirium guideline, after completing the e-learning course which advised them to do so.

Overall, it appears that the organisational and national context in Dutch hospitals paved the way for the e-learning course and ensured it had a good chance of successfully changing nursing staff's behaviour.

3. *Acknowledge the views of healthcare professionals involved in the improvement projects.*

Other aspects of the context in which FEP was introduced, however, were less conducive to change than the organisational context described above. In our interviews with healthcare professionals, it became clear that there was a discrepancy between what the FEP delirium guideline recommended, and how nursing staff viewed their professional role and what they considered to be their core business. Nurses did not consider delirium risk screening to be an intrinsic part of their job, and there was an apparent lack of clarity of the benefits and goals of screening. Added to this, the screening instrument was sometimes seen as limiting nurses' autonomy, while they had little faith in the usefulness of the instrument itself. In addition, we found that there is a sense among nursing staff that caring for older patients and dealing with specific geriatric syndromes is not their core business. Similarly, Andrew Teodorczuk and colleagues found a lack of ownership of confused older patients in hospital staff (Teodorczuk et al. 2013). How healthcare professionals define their work and which core activities make up their profession influences how those professionals respond to certain guidelines and patient groups.

Policymakers need to take healthcare professionals' perceptions of their professional roles and of patient care into account when formulating new guidelines, to ensure expectations of guideline adherence are realistic and professional autonomy is respected. Otherwise, resistance to the guideline is to be expected, as well as a lack of motivation.
This aspect of the social context into which FEP was introduced created obstacles for a successful implementation of FEP and might explain why, even though the e-learning course had a significant positive effect, guideline adherence still remained relatively low.

4. *Focus on improving care for older patients in general, instead of on identifying patients at risk for preventable adverse events (AEs).*

We were unable to develop a reliable model to predict the risk of preventable AEs, showing that the ability to identify older at-risk patients is limited when using only routinely collected data that are available on admission. Other information, which is more difficult or costly to measure, might contain stronger predictors of preventable AEs. For instance, more

detailed information on the frailty of older patients (Avelino-Silva et al. 2014, Martocchia et al. 2013, Jones et al. 2005) and specific laboratory results regarding physical fitness or disease severity (Knaus et al. 1985) could provide better predictors, if they were available on, or directly after, admission. However, taking these extra measurements for every older patient would include additional investments of time, money and effort on the part of healthcare professionals. An alternative approach would be to investigate more specific types of preventable AEs. However, developing separate predictive models for the numerous types of preventable AEs would not only require substantial research, but would hardly simplify life for clinicians.

All in all, perhaps the focus should not be on attempting to create or to perfect ways of identifying patients at risk of preventable AEs during hospitalisation, but on improving care for all older patients. Such a broad approach would be relatively simple to implement in daily practice, and could help prevent many different geriatric syndromes. Improving care for older patients should in that case at least include making an effort to improve the general condition of older hospitalised patients – treating malnutrition and dehydration, increasing the use of hearing and visual aids, decreasing polypharmacy, et cetera –. When the physical condition of older patients improves, the risk of developing geriatric syndromes such as delirium and falls decreases.

Methodological considerations

Stepped wedge trial

An important element of this thesis was the cluster randomized stepped wedge trial focusing on the effects of e-learning on delirium care. The number of studies using a stepped wedge design in order to evaluate the effectiveness of an intervention in routine practice is steadily increasing (Mdege et al. 2011). The defining feature of this design is that the intervention will be introduced to all clusters – or in this instance, hospitals – in a sequential order (Mdege et al. 2011, Hussey & Hughes 2007). At the start of the study, no hospital had access to the intervention, while at the end all hospitals had been given access. In a `traditional' parallel trial, hospitals in the control group would not have received the intervention.

The reasons for using the stepped wedge design in our study were varied: first, it offered an opportunity to introduce the intervention to all participants, which had the ethical advantages of withholding the potentially beneficial intervention from no one. Second, the fact that the intervention was made available to all participating hospitals made participating in the study more attractive, ensuring sufficient hospitals could be included in this study. Third, because the stepped wedge design resulted in gathered data from all hospitals for both the control and the intervention group, each hospital acted as its own control, thereby reducing contamination bias (Brown & Lilford 2006).

Patient record review

A data collection method often used in this thesis was the patient record review. While this research method can offer us a wide range of data on patient characteristics, provided care and patient outcomes, there are some obvious limitations to using patient records as a data source. It is for instance reliant on not only how well healthcare professionals recognize and diagnose medical conditions, but also on how well they record these conditions in patient records. This makes it difficult to use patient records as a means of generating data on delirium occurrence rates. Several studies have found that delirium was poorly documented in patient records, even for patients with a confirmed diagnosis of delirium (Milisen et al. 2002, Hey et al. 2015, Hope et al. 2014).

Different methods of using patient records as source of information are currently being explored. This is especially relevant, given the rise of electronic patient records, potentially offering not only researchers but also healthcare organisations a readymade database from which to gather data.
A recently validated chart abstraction method for retrospectively diagnosing delirium in hospitalised patients based on symptoms recorded in the patient record might offer a means of gathering more reliable data on delirium rates using patient records (Kuhn et al. 2014). This method is still dependent on the quality of record keeping. However, an important benefit of using patient records as a data source is that it is less labour-intensive and less invasive for the patient than for instance gathering data directly at the bedside.

Implications and recommendations

Based on the research presented in this thesis, several recommendations can be made for practice, policy, and future research.

Implications for practice

When healthcare organisations want to improve care for older patients, several actions can be taken to improve their chance of success. Based on this thesis, four recommendations can be made for healthcare organisations planning or starting quality improvement projects:

1. Invest in knowledge
   As we have shown, educating professionals on specific risks or healthcare problems can help improve the care provided. Education can give them the knowledge they need to be able to perform new behaviour, but can also help convince professionals of the benefits of changing their behaviour and create a sense of urgency.
2. Make sure the organisational context is ready
   Knowledge alone is probably not enough to ensure a change in practice. The organisation needs to be ready for professionals to show the new behaviour and, where possible, needs to support and encourage professionals to change their practice. This can mean ensuring management is supportive of the changes taking place, but also providing practical tools and materials to support the behaviour change.
3. Take into account the attitude of healthcare professionals
   While knowledge and organisational context are important, if the attitude of healthcare professionals is not conducive to the implementation of the quality improvement project, its success might still be limited. Healthcare organisations should explore the attitudes of their staff towards the topic or patient population at which the project is aimed, and take these attitudes into account when formulating project goals and guidelines. It might also be worthwhile to try to influence these attitudes – if necessary – as part of any educational efforts taking place.
4. Invest in the quality of documentation in patient records
   The use of electronic patient records offers healthcare organisations working on quality improvement an important source of information on patients, provided care and healthcare outcomes. Using this information would offer these organisations a means of monitoring

their quality of care, making the effects of quality improvement efforts visible for the professionals involved. However, such use of electronic patient records requires that the data collected from the records is reliable. Organisations should therefore pay attention to the quality of documentation in electronic patient records, to ensure results can be measured and disseminated properly.

Implications for policy

When formulating nationwide policy or guidelines, policymakers need to take healthcare professionals' perceptions of their professional roles and of patient care into account, to ensure that expectations of guideline adherence are realistic and the professionals' autonomy is respected. Otherwise, resistance to the guideline is to be expected, as well as a lack of motivation.

Policymakers should not underestimate the impact national attention can have on an improvement project. This attention can help local project leaders in gaining support from management and convincing management and colleagues of the importance of the project. Added pressure on organisations to implement the improvement project, for instance through the attention of the Healthcare Inspectorate, can add to a sense of urgency within management levels of healthcare organisations regarding the project.

Recommendations for future research

The rise of electronic patient records in hospitals potentially offers hospitals and researchers alike a readily available source of information on patients, provided care and healthcare outcomes. This could offer hospitals an opportunity to monitor their quality of care on specific healthcare problems or patient groups, such as delirium in older patients. However, such use of electronic patient records requires not only that the technical side of the records needs to support such use, but also that the data collected from the records is reliable. As studies on documentation of delirium in patient records have shown, delirium diagnosis are not always recorded in patient records. Future research should therefore look into other ways of using data from patient records to gather information on delirium occurrence. A recently validated chart abstraction method for retrospectively diagnosing delirium in hospitalised patients, using symptoms recorded in the patient record instead of recorded diagnosis (Kuhn et al. 2014), might offer an interesting starting point for research into the use of electronic records as source of information on quality of delirium care.

Quality of delirium care can be divided into different aspects, including recognition of delirious patients and proper documentation of symptoms and diagnosis in order to communicate findings with other members of the healthcare team. International studies have shown that both of these aspects of delirium care – recognition and documentation – leave something to be desired (Hope et al. 2014, Rice et al. 2011, Flagg et al. 2010, Milisen et al. 2002). It is unclear how Dutch hospitals perform on these two aspects of delirium care, while this would provide valuable information for future quality improvement projects aimed at delirium care. Research into the recognition of delirious patients by nurses and physicians, and the documentation of delirium, could help determine where further improvement efforts should be focused.

While our study focused on delirium in hospitals, the increasingly frail population of Dutch nursing homes means that delirium is a relevant topic for these organisations as well (Boockvar et al. 2013, Boorsma et al. 2012, Han et al. 2009). It would be worthwhile to investigate whether delirium in nursing homes can be prevented by improving knowledge and awareness of delirium among staff, family and informal caregivers. If this is the case, such an improvement could potentially help prevent hospital admittance of nursing home residents due to delirium or the consequences of delirium – such as falls and physical injuries –, leading to a reduction in healthcare costs.

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Summary

The growing number of older people within most western countries leads to this subpopulation receiving increasing attention from politicians, policy makers and researchers. Studies regarding patient safety have shown that older hospitalised patients are at greater risk for adverse events, such as delirium. These increased risks mean that hospitals have to take action to prevent an aging population from resulting in an increase in adverse events in hospitals, and an increase in the healthcare consequences and costs associated with these events. In the Netherlands, efforts have been made to improve care for older hospitalised patients in the Frail Elderly Project (FEP), one of the projects of the national Patient Safety Programme. As part of FEP, hospitals worked on improving care for older patients regarding falls, malnutrition, functional decline, and delirium.
This thesis focuses on patient safety and quality of care for older hospitalised patients at-risk for delirium, and specifically on the effects of e-learning on the implementation of FEP.

The general research question of this thesis was:

How can safety and quality of care for older hospitalised patients at risk of delirium be improved?

This general question was divided into 5 specific research questions:

1. **Which barriers exist to adherence to the FEP delirium guideline by nurses?**

In a qualitative study we aimed to identify and classify barriers to guideline adherence by nurses by exploring the perceptions of nurses and other professionals regarding the implementation of the FEP guideline on delirium care. We conducted open-ended interviews between June and September 2011 with 28 nurses, 18 physicians and 17 policy advisors working in 19 hospitals in the Netherlands.
Barriers to guideline adherence that were identified in this study could be grouped into four themes: motivation and goals, knowledge and skills, professional role and identity, and context and resources. While the interviews with nurses, physicians and policy advisors produced similar views of the current situation, physicians and policy advisors placed a higher importance on education as a means of stimulating adherence.
This study illustrates that individual, social and organisational factors play a role in nurses' adherence to a delirium guideline. The potential benefits of

following a guideline, both for patients and for nursing staff, need to be highlighted in order to motivate nurses. When formulating new guidelines, nurses' perceptions of their professional role and patient care need to be taken into account, to ensure that policy makers and managers are realistic about guideline adherence and engage with nurses from a position of mutual respect and trust.

2. Does the use of e-learning improve nurses' delirium knowledge?

While the first research question aimed to identify barriers to adherence to the FEP guideline, questions two and three looked at a possible means of neutralising some of these barriers: adding an educational intervention to FEP. Our aim was to assess the effect of an e-learning course, based on nationally recommended guidelines for delirium care including the FEP guideline, on nurses' delirium knowledge. In addition, we looked at the association between participant demographics and baseline delirium knowledge, as well as between demographics and the effect of the course on delirium knowledge.

We conducted a before-and-after study, with an e-learning course on delirium as intervention. The course was introduced to all nursing staff (n = 1,196) of internal medicine and surgical wards of 17 Dutch hospitals.

Test scores on the final knowledge test (mean 87.4, 95% CI 86.7 to 88.2) were significantly higher than those on baseline (mean 79.3, 95% CI 78.5 to 80.1). The e-learning course significantly improved nurses' knowledge of delirium in all subgroups of participants and for all question categories. At baseline, nursing staff had the most difficulty with questions related to the definition of delirium: what are its symptoms, course, consequences and which patients are at risk. The mean score for this category was 74.3 (95% CI 73.1 to 75.5). Contrary to other studies, the baseline knowledge assessment showed that, overall, nursing staff were relatively knowledgeable regarding delirium.

3. Does the use of e-learning improve the provision of delirium care by nurses according to the FEP delirium guideline?

After looking at the effects of e-learning on knowledge, we focused on the effects of e-learning on the implementation of the delirium part of FEP. The objective was to determine whether e-learning can be an effective means of improving adherence to the FEP delirium guideline by nurses, specifically

focusing on preventive screening of older patients for risks, observing at-risk patients for delirium, and taking preventive or curative measures.
In a stepped wedge cluster randomised trial, an e-learning course on delirium was introduced aimed at nursing staff. The trial was conducted on general medical and surgical wards in 18 Dutch hospitals.
The e-learning course on delirium had a significant positive effect on the risk screening of older patients by nursing staff (OR 1.8, p value <0.01), as well as on other aspects of delirium care. The number of patients diagnosed with delirium was reduced from 11.2% in the control phase to 8.7% in the intervention phase (p=0.04).
Nurses who undertook a delirium e-learning course showed a greater adherence to the FEP delirium guideline. This improved the recognition of patients at risk and demonstrated that e-learning can be a valuable instrument for hospitals when implementing improvements in delirium care.

4. What can delirium rates based on patient records tell us about the occurrence of delirium in the Netherlands?

After using patient records to answer the two previous research questions, this question looked more in detail at the usefulness of patient records as a source of information on delirium occurrence. Patient records are an essential part of the care process, facilitating communication of information on patients and patients' care between professionals and between hospital wards. Increasingly, patient records are also being used as a source of data, to assess quality of care or to conduct research. Both uses of patient records – as part of the care process and as data source – rely on the accuracy of the documentation within these records. To examine whether patient records can provide useful information on delirium occurrence rates, this study aimed to determine delirium rates among hospitalised surgical and non-surgical inpatients in Dutch hospitals, as documented in patient records. In addition, we looked at the extent to which recorded delirium rates vary between hospitals and hospital wards, after correcting for patient and admission characteristics.
Data was collected during the course of a national study on adverse events among hospitalised patients in the Netherlands, consisting of retrospective patient record reviews using 4,048 patient records from 2011/2012, from patients aged 12 months and over.
After adjusting for patient, admission and hospital characteristics, we found a corrected delirium occurrence rate of 3.5% in surgical patients and 5.5% in

non-surgical patients, and for patients aged 70 and over, a delirium occurrence rate of 6.3% in surgical patients and 5.5% in non-surgical patients. Recorded delirium rates did not vary between hospitals (ICC 0.0) and varied little between wards (ICC 5.3 surgical, 9.3 non-surgical).
The delirium occurrence rates found in this study were significantly lower than expected based on the literature. This study made clear that using only delirium as recorded in patient records can provide information on delirium rates, but there are doubts about the reliability of this information given the fact that other studies have found that delirium diagnosis was poorly documented in patient records.

5. **Can preventable adverse events in older patients be predicted using a predictive model?**

After focussing specifically on delirium, this thesis concluded by looking at the prediction of adverse events in general, as a possible alternative approach to improving patient safety and quality of care for older hospitalised patients. In this final study we aimed to develop and validate a predictive model for preventable adverse events in older hospitalised patients. Such a model would use clinically important risk factors that are readily available on admission. Our intention was to design a model that could be used by healthcare providers in hospitals, so they could identify older high-risk patients for preventive measures or closer clinical attention.
In order to develop a predictive model for preventable adverse events, we used data from two retrospective patient record review studies on adverse events – from 2004 and 2008 – using patient records from patients aged 70 and over. Risk factors included in the analysis were patient characteristics as well as admission and organisational characteristics.
We found that in 2004, predictors of preventable adverse events in patients aged 70 years or over were: increased age (OR 1.04 CI 1.01 - 1.06); elective admission (OR 1.65 CI 1.14 – 2.40); and admission to a surgical department (OR 1.53 CI 1.08 – 2.16). The area under the receiver operating characteristic curve for the 2004 sample was 0.60, and for 2008 this was 0.59. This indicates that the model fitted the data poorly and the model had low discriminatory power.
This study showed that several expected risk factors for preventable adverse events in older patients, including comorbidity, were unable to predict these events. It was not possible, using in-patient data available on admission and collected during the course of two patient record review studies, to develop

a satisfactory predictive model for preventable adverse events in older patients.

Recommendations for practice and policy

Based on the research presented in this thesis, several recommendations can be made for practice and policy.

1. Invest in knowledge
   As we have shown, educating professionals on specific risks or healthcare problems can help improve provided care. Education can give them the knowledge they need to be able to perform new behaviour, but can also help convince professionals of the benefits of changing their behaviour and create a sense of urgency.
2. Make sure the organisational context is ready
   Knowledge alone is probably not enough to ensure that a change in practice takes place. The organisation needs to be ready for professionals to demonstrate the new behaviour and, where possible, needs to support and encourage professionals to change their practice. This can mean ensuring management is supportive of the changes taking place, but also creating practical tools and materials to support the behaviour change.
3. Take into account the attitude of healthcare professionals
   While knowledge and organisational context are important, if the attitude of healthcare professionals is not conducive to the success of the quality improvement project, its success might still be limited. Healthcare organisations should explore the attitudes of their staff towards the topic or patient population at which the project is aimed, and take these attitudes into account when formulating project goals and guidelines. It might also be worthwhile to try to influence these attitudes – if necessary – as part of any educational efforts taking place.
4. Invest in the quality of documentation in patient records
   Using information from electronic patient records would offer healthcare organisations a means of monitoring their quality of care, making the effects of quality improvement efforts visible for the professionals involved. However, such use of electronic patient records requires that the data collected from the records are reliable. Organisations should therefore pay attention to the quality of

documentation in electronic patient records, to ensure that results can be measured and disseminated properly.

5. Create national attention
   National attention can help local project leaders to gain support from management and convince management and colleagues of the importance of the project. Added pressure on organisations to implement the improvement project or policy, for instance through the attention of the Healthcare Inspectorate, can add to a sense of urgency within management levels of healthcare organisations.

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About the author

Lotte van de Steeg (Amersfoort, 1983) graduated from 'gymnasium' (secondary education) at the Nieuwe Eemland College in Amersfoort in 2001. She received a bachelor's degree in Cultural Anthropology from Utrecht University in 2005, with a thesis on attitudes towards marriage and co-habitation in Sololá, Guatemala. In 2007 she received a master's degree in Sociology, with a thesis on the implementation of a falls prevention programme in care homes.

After graduating, Lotte worked at Perspekt, keurmerk in de zorg, an organisation for quality certification in healthcare. She then worked as a management trainee and junior consultant in healthcare for High Select.
In January 2010 she started her PhD trajectory at NIVEL, resulting in this thesis. She was a member of the research group Safety4Patients and her PhD project was part of the larger Dutch patient safety study 'Monitor Zorggerelateerde Schade'. Starting in 2014, Lotte has been involved in several NIVEL research projects, including the European Union Network for Patient Safety and Quality of Care (PaSQ) and a study on improving competency of users of medical devices.
Lotte held a position in the editorial office of the Dutch journal on quality and safety in health care (KIZ) from March 2011 until December 2015.

List of publications

Articles in peer reviewed journals

Presented in this thesis

Van de Steeg L, IJkema R, Wagner C, Langelaan M.
The effect of an e-learning course on nursing staff's knowledge of delirium: a before-and-after study.
BMC Medical Education 2015;15:12.

Van de Steeg L, Langelaan M, Wagner C.
Can preventable adverse events be predicted among hospitalized older patients? The development and validation of a predictive model.
International Journal for Quality in Health Care 2014; 26(5)

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Improving delirium care for hospitalized older patients: a qualitative study identifying barriers to guideline adherence.
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Can an e-learning course improve nursing care for older people at risk of delirium: a stepped wedge cluster randomised trial.
BMC Geriatrics 2014;14(69)

Van de Steeg L, Langelaan M, IJkema R, Wagner C.
The effect of a complementary e-learning course on implementation of a quality improvement project regarding care for elderly patients: a stepped wedge trial. Study protocol.
Implementation Science 2012;7(13)

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