Decision support in hospital care for older patients

Medication, falls and delirium

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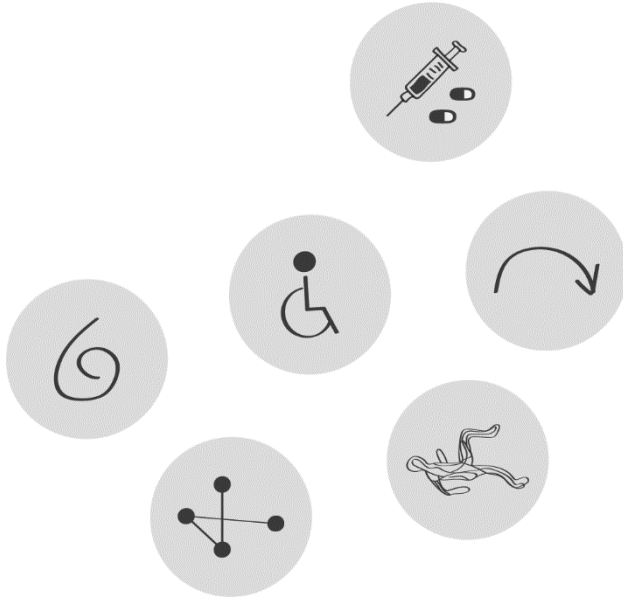
General introduction



Older population

Worldwide, life expectancy rise.[1–3] The proportion of people 60 years and older will increase from 12% to 22% between 2015 and 2050.[3] Prevalences of diseases also rise.[1,4] Globally, the number of people with a spectrum of different conditions is increasing.[4] The aging of the population comes with new challenges for the healthcare sector. In 2018, the WHO stated that countries need healthcare systems that are better organized around the needs and preferences of older people.[3]

Care for older patients can be complex due to geriatric syndromes, multiple chronic diseases, polypharmacy, multiple involved caregivers, and communication difficulties. Geriatric syndromes are defined as "common, serious conditions for older persons, holding substantial implications for functioning and quality of life" and include falls, delirium, pressure ulcers, incontinence, and functional decline.[5] Prevalences of multiple chronic diseases and polypharmacy are high in older persons. This is illustrated in recent studies from Italy and Korea in which, almost 90% of older persons (>65 years) had at least 1 chronic disease, over 60% had more than 1 chronic disease and almost 50% in a cohort of 3 million older people had polypharmacy (≥5 medications).[6,7] Multiple chronic diseases and polypharmacy are both risk factors for hospitalization.[6,7]

Like in other countries, the Dutch population is aging.[8,9] In the Netherlands, the proportion of people 65 years and older will increase from 19% to 23% between 2019 and 2030.[10] In Dutch general practices, 84% of the older patients had ≥1 chronic disease and 59% had multimorbidity (2 or more chronic diseases) compared to 34% and 13% in the total population.[11] This impacts the age distribution of the population in a hospital setting. The proportion of Dutch hospital admissions of people ≥65 years increased from 21% in 1981 to 45% in 2019.[12,13]

Hospital care for older patients

In hospitalized patients ≥65 years, the prevalence of multimorbidity was high with 63% of 2.8 million hospital admissions having 2 or more conditions.[14] The percentage of patients with multimorbidity was higher in the 80-84 years group (67%), compared to 65-69 years (56%).[14] Geriatric syndromes are also prevalent in older hospitalized patients.[15] Studies have reported an in-hospital fall prevalence of 6%, delirium prevalence of 13-24%, pressure ulcer prevalence of 5%, and a bladder incontinence prevalence of 37%.[15–17] After hospital stay, 32-35% of the older patients experienced functional decline compared to the period before hospitalization.[18]

As a result of the complexity of their conditions and care, older patients stay longer in the hospital and suffer from more preventable adverse events compared to patients who are younger.[19] Most healthcare professionals in hospitals are not specifically trained to recognize and treat geriatric syndromes, multimorbidity, polypharmacy, vulnerability, and preventable adverse events of older patients. Geriatricians, geriatric nurses, hospital pharmacists, and other experts can be consulted in case of specific questions or individual patients. Several initiatives have successfully been developed to improve care of hospitalized older patients, including geriatric wards and hospital programs.[20]

Not all older patients can be treated by geriatricians due to limited time and limited number of geriatricians.[21,22] Frail patients of 85 years and older with complex care might benefit most from the care of geriatricians.[23] All clinicians treating in-hospital older patients should therefore have general knowledge in geriatric care.[24] A recent survey in 10 Dutch hospitals found large differences in the geriatric knowledge of nurses.[25] The authors stated that there is a need for education in geriatric knowledge. Barriers to increase geriatric training include insufficient resources, marked variance in prior geriatric knowledge, little curricular time, and lack of teachers.[26,27] To increase this geriatric knowledge and support clinicians in the care for older patients, efficient and effective ways and innovations are needed.[21,22] Clinical Decision Support Systems (CDSSs) can be developed to efficiently and effectively support clinicians in the care for older patients. Geriatric problems are complex, but certain problems and patterns are more common and can be identified by algorithms or clinical rules.

Clinical Decision Support Systems (CDSSs)

Electronic Health Records (EHRs) give new possibilities for providing support and advice at the point of care. CDSSs integrated within the EHR can transfer geriatric knowledge from guidelines and experts to all healthcare professionals.[28,29] A CDSS can, for example, combine patients' characteristics and make recommendations based on guidelines. CDSSs can also support clinicians by making calculations, organizing information and structure workflows.[30,31]

For the care of older patients, CDSSs can, for example, support clinicians in conducting a medication review or starting fall prevention interventions. A medication review includes the evaluation of prescribed medication by reviewing its appropriateness, interactions, and indication, in order to optimize the use of medication and health outcomes.[32]

A 2018 systematic review found that computerized interventions can support clinicians to reduce potentially inappropriate prescriptions (PIPs) in older hospitalized patients.[33] CDSSs can identify PIPs or give advice for medication changes or monitoring. PIPs can be identified using a (de)prescribing tool such as the STOPP/START criteria. For fall prevention, a CDSS can help to identify patients with a high fall risk or in starting personalized fall-risk interventions. For example, in a 2010 study, a CDSS supporting personalized interventions reduced the fall rate in hospitals.[34]

CDSS development

The Grol and Wensing implementation of change model describes 7 steps for development and implementation of innovations.[35] A possible implementation strategy (step 4) is a CDSS intervention.[35] The development of a CDSS is hence part of the implementation plan to increase geriatric knowledge of hospital healthcare professionals. Factors that can influence the uptake of a CDSS are described in the GUIDES checklist and the Two- Stream Model.[36,37] The Two-Stream Model suggests that successful decision support needs to offer advice tailored to the clinical situation of the patient (clinical stream), but also tailored to the user's decision-making process (cognitive stream). The GUIDES checklist supports the development and implementation of a CDSS. The CDSS development consists of various stages and should account for the various potential factors as described in GUIDES checklist and the Two-Steam Model in order to develop a useful and effective CDSS.[36,37]

Overall, and not limited to geriatric care, a CDSS intervention was effective in 52-64% of the trials.[38] In order to be effective, a CDSS has to address the preferences and needs of users. A recent article described common pitfalls of CDSSs including fragmented workflows (disruptions), alert fatigue (too many, not useful alerts), incorrect alerts (poor data quality), and content maintenance.[39] A 2021 systematic review found that factors related to usefulness and relevance (irrelevant alerts) were barriers for acceptance of medication-related CDSSs.[40] Irrelevant alerts can be due to for example low quality of the clinical knowledge underlying a CDSS. Examples of clinical knowledge are guidelines and protocols. The quality of the clinical knowledge can potentially contribute to the success of a CDSS.

Aim and objectives

The aim of this thesis is to study and generate new evidence that contributes to the development of effective CDSSs in the care of older hospitalized patients. To investigate this, we distinguish three research objectives:

1. The first research objective is to identify which areas of hospital care can be supported by a CDSS and which areas have the highest priority according to both experts and future users. For those areas, we investigate the differences in work-as-imagined as described in the guidelines and work-as-done in clinical departments, and how CDSS can support or improve work-as-done.

2. As the content of the CDSS is important for potential effectiveness, the second research objective is to study the quality of clinical knowledge in a large database with hospital admissions.

3. The third research objective is to assess the effectiveness of CDSSs in the care of older hospitalized patients and to assess the quality of the output of CDSSs.

Outline of the thesis

This thesis describes different phases of developing CDSSs for the care of older hospitalized patients. Figure 1.1 shows the outline of this thesis in the context of the Grol & Wensing implementation of change model, GUIDES checklist and Two-Stream model. In this figure, we combined the 4 domains of the GUIDES checklist with the factors described in the Two-Stream Model. As seen in figure 1.1, the studies are grouped into three parts: context, content, and validation & evaluation.

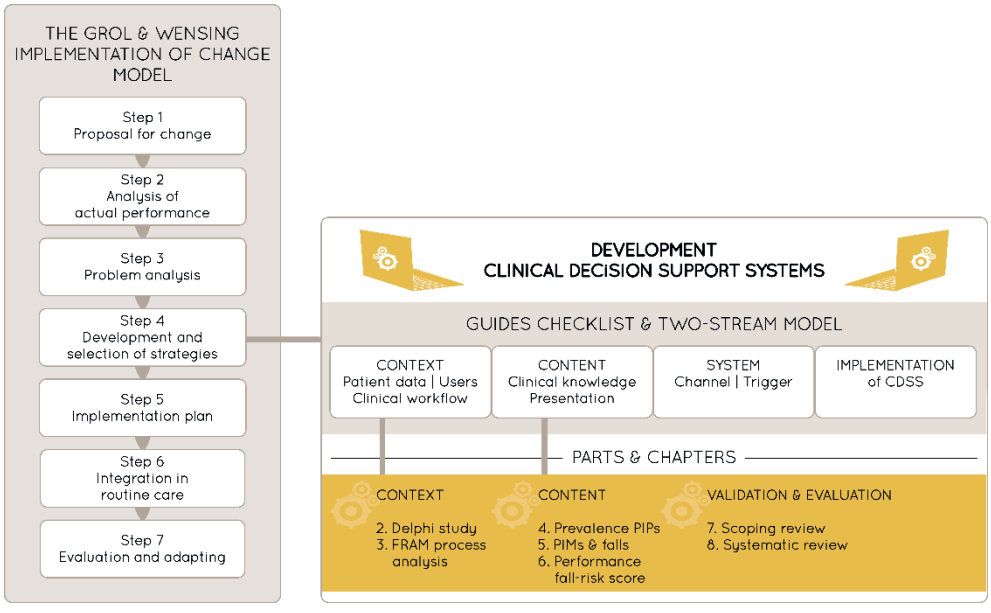


Figure 1.1. Outline of the thesis in context of the Grol & Wensing implementation of change model, the GUIDES checklist and Two-Stream Model.[35–37] FRAM = Functional Resonance Analysis Method, PIPs = Potentially Inappropriate Prescriptions, PIMs = Potentially Inappropriate Medications

Context: User preferences & workflow

In this part, we describe studies investigating the CDSS context. We focus on the potential CDSS factors "user preferences" and "incorporation into the workflow".

In *chapter 2*, we describe a modified Delphi study using 3 rounds followed by a national survey. The objective of this study is to identify causes of suboptimal care for older hospitalized patients, and set priorities for CDSS development. Participants for the Delphi study are twelve experts from six hospitals in the Netherlands. The first round consists of semi-structured interviews, the second round is a consensus meeting and the third round consists of an online survey. Finally, a national follow-up survey is sent to geriatricians, nurses, internal medicine specialists, hospital pharmacists, and quality of care specialists.

In *chapter 3*, we describe a Functional Resonance Analysis Method (FRAM) of work-as-imagined and work-as-done for falls and delirium, both including medication review. In this study, we aim to understand the differences between work-as-imagined and work-as-done, and how these can impact the design of a CDSS. Our secondary aim is to describe a structured method for developing an initial design of CDSS from a user perspective. The setting of this qualitative study is an academic medical center located in Amsterdam, the Netherlands.

Content: Clinical knowledge underlying CDSSs

In this part, we describe two etiological studies and one prognostic study and investigate the quality of clinical knowledge for CDSSs supporting a medication review or fall prevention. We use a large database of admissions of older patients (70 years and older) extracted from the electronic health records (EHR) of an academic medical center located in Amsterdam, the Netherlands. Chapters 4 and 5 describe the etiological studies and chapter 6 the prognostic study.

In *chapter 4,* we explore the prevalence of potentially inappropriate prescriptions using the STOPP/START v2 criteria. The aim of this study is to investigate the prevalence, independent associations, and variation over time of potentially inappropriate prescriptions in a population of older hospitalized patients. We perform a longitudinal study with the EHR data from 2015-2019 and assess the associations and variation over time using univariate and multivariate logistic regressions.

In *chapter 5,* we aim to investigate the effect of potentially inappropriate medications (PIMs) on inpatient falls. Furthermore, we aim to identify whether PIMs as defined by two fall-risk-specific (de)prescribing tools (STOPPFall or STOPP v2 section K) have a stronger association with inpatient falls, compared to a general (de)prescribing tool (STOPP v2). To identify in-hospital falls, we use analysis of free text in the EHR. To study the effect of PIMs on falls, we match admissions with PIMs to those without PIMs on confounding factors. On the matched datasets, we apply multinomial logistic regression analysis and Cox proportional hazards analysis.

In *chapter 6*, we describe the validation of the John Hopkins Fall Risk Assessment Tool (JHFRAT). The aim of this study is to assess the performance of JHFRAT in a Dutch population of older inpatients. We investigate discrimination (over time), and calibration of JHFRAT. We use univariable logistic regression to assess the association between JHFRAT and falls. For discrimination, we calculate the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and the AUC for the total population. To assess the effects over time, we calculate the AUC per 6 months. For calibration, we predict the fall probability and plot this versus the actual fall probability.

Validation & evaluation

In this part, we describe scientific literature on the validation and evaluation of CDSSs.

In *chapter 7*, we review articles describing a clinical validation of a CDSS that support conducting a medication review. The aim of this scoping review is to summarize approaches and outcomes of clinical validation studies of CDSSs to support (part of) a medication review. We conduct a literature search in Embase and Medline and include articles describing clinical validation (assessing the quality of the output) of CDSSs for medication review. We assess the compliance of the included articles to the medication-related CDSS validation strategy of Scheepers-Hoeks et al.[41]

In *chapter 8*, we review studies with a controlled study design. The aim of this study is to systematically review the effect of CDSS interventions for older hospitalized patients. The secondary aim is to summarize implementation and design factors described in (in)effective interventions, and to identify gaps in current literature. We conduct a literature search in Embase, Medline and Scopus.

We structure the potential implementation and design factors using the Grol and Wensing implementation of change Model, the GUIDES checklist and the Two-Stream Model.[35,36,42]

In the discussion in *chapter 9*, we summarize the main findings of this thesis. We discuss these in a wider context of the hospital care of older patients, specifically of medication review and fall prevention. Finally, we discuss implications for clinical practice and future studies.