Improving quality of fall prevention and management in elderly patients using information technology: The impact of computerized decision support
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The effect of a computerized decision support system on detection and management of falls in primary care: A prospective before-after study

“It is called automated decision support, but actually you still have to fill in the form and push the button yourself.”
-M. Askari

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In preparation
Abstract

Objectives: The provided medical care for falls and fall-related causes is inadequate. Support and proactive assessment of falls are necessary in order to improve the care of elderly patients at increased risk of falling in primary care. We therefore investigated the effect of a computerized decision support system (CDSS) on adherence to quality indicators (QI) pertaining to fall management and mobility problems in primary care.

Methods: We designed a before-after study to measure the general practitioner’s (GP) adherence to two fall-related QIs from the Assessing Care Of Vulnerable Elders QI set. We translated the QIs, which had the “If condition-Then action” form, to the form of Clinical Rules (CRs) which are usable for a computer. Based on these CRs we designed a CDSS and applied it as an intervention during seven months to 36 GPs registered at a network of 6 practices in Amsterdam. The CDSS gave non-interruptive and patient-specific feedback based on the CRs. Each time a GP opened the electronic medical record (EMR) of a patient 65 years and older, the CDSS provided a message containing two questions, meant to gather fall history, as well as mobility and balance problems. When the questions were answered by the GP, and if the patient had a fall or mobility problem, the CDSS provided a message containing information related to the demographics of the patient, number of falls in the previous year, mobility problems and an advice relevant for fall prevention. The baseline adherence was measured one and a half years before the start of the intervention based on a questionnaire administered to elderly patients of 20 GPs from 4 (out of the 6) practices. The questionnaire gathered the data relevant to the two fall QIs including number of falls, balance and mobility problems, and whether the GP performed related actions for fall management for patients 70 years or older.

The primary outcome measure was the adherence in terms of the mean and individual pass rates. The mean pass rate is calculated without distinguishing between specific rules, by dividing the number of times the two rules were followed by the number of times the CRs were eligible to be followed. Adherence per CR both before and after the intervention was also calculated in terms of pass rates. Pass rates were defined as the number of times the CRs were followed divided by the number of patients eligible for those rules. Eligibility was defined as having 2 or more falls, or a balance/mobility problem. Statistical proportion tests were performed to compare the pass rates before and after the intervention for patients who were 70 years and older.

Results: Out of 4,053 patients aged 65 years or above that visited the participating GPs during the intervention period 2,774 (68%) were 70 years
and older, which were included in the analysis. Our CDSS recorded one or more falls for 133 of these patients, and reported mobility and balance problems for 147 patients. Our baseline questionnaire had 950 respondents, of which 209 reported having sustained falls, and 214 reported having mobility or balance problems. The mean pass rates before and after the intervention were respectively 30% and 39% (p = 0.04). The adherence to the fall prevention and management quality indicators was 45% in the intervention period compared to 38% at baseline (p = 0.5). Adherence to the mobility/balance problem rule was 37% in the intervention period compared to 26% at baseline (p = 0.03).

Conclusions: This study demonstrated an improvement in the adherence to the fall CRs using a non-intrusive CDSS that provides timely, patient specific and proactive computerized feedback. Future studies should measure clinical outcomes of such interventions, explore the actual fall documentation and the reasons for not using or ignoring the system.

10.1 Introduction

Recurrent falls among the elderly individuals occur frequently and are an indicator of progressive deterioration in physical and mental functioning [1, 2, 3]. They may be the result of one or multiple factors including medical, geriatric and/or environmental factors that contribute to the risk of falling [2, 4, 5], leading to complex needs and high costs for medical care [6]. Since many of these risk factors can be modified [7], numerous opportunities exist for prevention, treatment and follow-up of falls [8].

The serious short- and long-term consequences of falling in old age such as mobility problems, fear of falling, loss of independence or of quality of life and demanding high cost medical care [6, 9, 10, 11] have highlighted the importance of optimizing care for elderly people who are at higher risk of falling. Although many efforts have been made to improve the care of elderly patients, it is known that the quality of care for elderly patients, and especially the most vulnerable ones, is still low for geriatric conditions compared to non-geriatric conditions [12, 13]. An example of a geriatric condition is falls, which has been shown to have sub-optimal and insufficient quality prevention and management [14, 15]. Management of fall-related care delivered to patients might be improved by providing timely and proactive computerized feedback to their physicians based on generally agreed upon standards of care. We used the Assessing Care of Vulnerable Elders (ACOVE) quality indicators (QIs) as the basis for our intervention in this study. The ACOVE quality indicator set [9, 16] was originally developed in
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2000 and consists of explicitly phrased IF-THEN rules that are intended to represent the minimal standard of the care for elderly patients, and evaluate care processes by means of gauging adherence to those rules. We hypothesized that using a computerized clinical decision support system (CDSS) to provide active, timely, and patient-specific feedback to clinicians based on the ACOVE quality indicators could improve the quality of fall care for elderly patients. We used two out of a set of nine fall-related QIs that were previously translated to and validated for the Dutch primary care setting [6].

The aim of this study was to investigate the effect of providing timely feedback, using a CDSS based on the ACOVE fall-quality indicator set on adherence to these rules on patients who are 70 years old or older.

10.2 Methods

10.2.1 Study design and setting

A prospective before-after study was designed to evaluate the effect of an intervention using a CDSS for fall management and prevention. All general practitioners (GPs) in the Gezondheidscenra Amsterdam Zuid-Oost (GAZO) practices were asked to participate in this study. GAZO is an organization comprised of six primary care practices in the southeast region of Amsterdam. A total of 36 general practitioners (GPs) work in the GAZO centers (full and part time). There is an average of 7,450 (range: 3,285 to 10,055) registered patients in each center. About 10% of the patients are 65 years or older and about 5% are 75 years or older (data originating from 2010). All practices used the same electronic medical record system (EMR).

Participants and regulatory aspects for the CDSS intervention

For the intervention using a CDSS, the medical ethics committee of the Academic Medical Center confirmed that the Medical Research Involving Human Subjects Act (WMO) does not apply to this intervention and waived an official approval of this study by the committee. The main reason was that the intervention was simply a means of giving information to physicians to improve adherence to the quality indicators which embody usual care. We included patients 65 years or older for this intervention. Data from the CDSS intervention was stored only in anonymized form. The trial has been registered within the Dutch Trial Register (www.trialregister.nl) under identifier NTR4107 since August 5, 2013.
Participants and regulatory aspects for the baseline

Four general practices of GAZO, including 20 general practitioners, participated in the baseline study (see chapter 8 of this thesis). All community-dwelling elderly persons, 70 years or older, registered in one of the participating general practices were identified through the electronic medical record (EMR) by their GP and received a letter with study information from their GP, along with a written informed consent form, a self-reporting questionnaire and a return envelope. The baseline study was part of a larger study and was approved by the Medical Ethics Committee of the Academic Medical Center, University of Amsterdam, in the Netherlands [16].

10.2.2 Clinical rules

Both the baseline assessment and the CDSS intervention were based on the fall-related ACOVE QIs that had been translated and validated for Dutch primary care [17]. All nine QIs were used for the baseline measurements. We used a modified Delphi method to select the most relevant QIs from the original set of nine fall QIs for the intervention [18]. To take into account the social and user preference aspects, GPs from the participating practices were invited to help prioritize the QIs for the intervention. In this step they indicated whether they perceived a need for decision support, using questionnaires and focus groups [18]. Two QIs were selected to be implemented in the CDSS for fall management, covering history taking, mobility and balance evaluation for patients with a positive history of falling. We used the Logical Elements Rule Method (LERM) to identify the implementable QIs and translate them to clinical rules (CRs) which are formalized QIs in a form usable for a computer. The details are described elsewhere [18]. The first chosen QI was (hereafter referred to “fall prevention and management”)

- “IF a vulnerable elder reports a history of 2 or more falls (or 1 fall for which the elder visits the general practitioner) in the past year, THEN the general practitioner should document a basic fall history (including type and circumstances of the falls, and possible contributing factors like medication, chronic conditions, alcohol intake) within 3 months of the reported history (or within 4 weeks, if the most recent fall occurred in the past 4 weeks)”.

The second QI (hereafter referred to as “mobility and balance problem”) was:

- “IF a vulnerable elder reports a history of 2 or more falls (or 1 fall for which the elder visits the general practitioner) in the past year, or has wors-
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enening difficulty with ambulation, balance, or mobility, THEN the general practitioner should document a basic gait, balance, and strength evaluation within 3 months of the reported history (or within 4 weeks, if the most recent fall occurred in the past 4 weeks).”

Although these two QIs were meant for vulnerable elders, both of the selected QIs are relevant to all elderly patients, vulnerable or not. Adherence to the CR was calculated based on the pass rate of the CR. The pass rate of a rule was defined as the number of times the rule was followed by the GP while the rule was eligible, meaning that the logical condition in the IF part of the CR is true. In this study, eligibility was defined as 1) having two or more falls, or 2) having mobility/balance problems. Although the IF-parts of the original QIs allow for more conditions than these latter two conditions, we consider, and hence test, only these two conditions in the QIs.

10.2.3 Baseline measurements

Prior to the start of our CDSS intervention, we determine GPs’ baseline adherence to the fall-related ACOVE rules using patient reported data. We used a questionnaire distributed by mail among elderly patients of the 4 GP practices under study, one and a half years prior to our intervention (see chapter 8 for details). Briefly, we designed a questionnaire to obtain relevant information for determining the pass rates of the fall-related QIs. The questionnaire was structured in two parts. The first part elicited information regarding the participants’ general demographics and medical conditions. The second part of the questionnaire covered questions to test the eligibility of the QI for the patient and whether his or her GP undertook the required actions related to fall management and detection according to the THEN-part of the QI. The pass rates of the fall prevention and management and mobility and balance problem rules were respectively 38% and 26%. The adherence in terms of the mean pass rate was defined without distinguishing between specific rules by dividing the number of times the two rules were followed by the number of times the rules were eligible to be followed. The mean pass rate was 30% percent for the two QIs and was used for the power analysis for this intervention study.

10.2.4 Technical design and implementation of the CDSS

Architecture and communication

According to the classification proposed by Musen et al. [19], our CDSS can be classified as an active, patient-specific consulting system. The system was de-
signed as a “non-interruptive” CDSS, which has been proposed to help reduce alert fatigue [20, 21]. The triggering points for activating the decision support system (i.e., the events which trigger the CDSS to process patient data when they occur in the EMR) were: opening the patient file, having two or more falls recorded, and having a mobility or balance problem recorded.

On opening a patient record, data was sent to the remote server (called the clinical rule engine, or CRE) as an XML (Extensible Markup Language) file. The XML file included the patient’s age, the number of falls (if known), presence of mobility and balance problems (if known), medications and diagnoses. The CRE evaluated this information and if applicable, sent a response back in the form of an XML file to a “plug-in”, which is a software module built within the EMR of the GP. This XML file contained information on the rules that applied to this patient. Based on the received XML file, the plugin placed a sidebar on the left edge of the GP’s screen with an alert in the form of an icon. Initially it was minimized to a 1 cm bar (a dynamic floating list [DFL]) showing a three-letter abbreviation of the alert title. When the user moused over the bar, it expanded to show the full titles. When a GP clicked on a title, the text of the alert appeared in a dialog-screen. Depending on the type of dialog, a user could fill in a form and choose to save the given answers in the forms by clicking on the save button for the fall prevention and management rule; or accept the message (by clicking on the accept button), or reject it (by clicking on the “ignore” button) for the mobility/balance problem rule. The GP should fill the whole fall form if s/he wanted to save the answers or give reasons for rejecting the message. All information exchanges took place through a secure channel. The architecture of the CDSS is explained in more detail elsewhere [18].

10.2.5 Operation of CDSS for falls

Prior to our intervention, no structured information about fall history and mobility/balance problems was available in the EMR. Without knowing this information we cannot test the eligibility of the CRs’ IF-parts and hence we do not know when to provide feedback to the GP. We gathered this information using a structured form shown on the screen. For each patient aged 65 years or older, when the GP opened the patient record, the fall history-taking alert appeared on the sidebar (DFL) as shown in figure 10.1. The GP was able to move the mouse cursor over the sidebar and click on the alert title to open the message. The fall history-taking message consisted of two questions related to the number of falls in the previous 12 months, and the mobility problems or decreased balance in the previous 6 months. The decreasing-balance-or-gait question was designed as a dichotomous question (see figure 10.1). Once the mobility question was answered, this
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question was suppressed. If a history of two or more falls was present, the CRE sent an alert for a fall prevention message (a form) in which the actions that were undertaken for fall prevention and management by the GP can be reported. If the GP clicked on the title of the “fall prevention” alert, a form was opened consisting of the patient’s age, the number of falls and the known mobility and balance problems, recommendations for fall prevention based on the THEN-part of the fall prevention and management QI. The GPs could indicate which actions they had done or intended to do by choosing from the following options: review of medication; review of chronic diseases; cognitive test; vision test; balance, muscle or and power test; recommendation or revision of a walking aid; alcohol use; and advice for safety in the house. The GP was able to choose “Performed by myself”, “Referral to other care giver” or “Not applicable” for each of the items and give their reasons when they chose “Not applicable” in this form (see figure 10.2).

If the answer on the decreasing-balance-or-gait question was positive, the CRE would send a balance and mobility evaluation message back to the plugin that recommended performing a balance, gait or strength of muscles test, which could be rejected or accepted by the GP.

10.2.6 Power analysis

Wenger et al. [22] in a paper-based intervention showed an absolute increase of 20% in the mean pass rates of the supported set of CRs for patients aged 75 years and older. The mean pass-rates (as was explained in 2.3) of the two CRs at our baseline were estimated as 30% before the intervention. Based on this effect size and the baseline measurement, and for a power of 0.80 and two-sided testing at the 0.05 significance level, and an estimated number of 7.5% of elderly patients aged 70 years and older in the practices, a total of 102 cases in each of the before and after period were required. This corresponded to duration of seven months to include these patients prospectively.

10.2.7 Outcome measures and statistical analysis

Both the mean pass rates and the pass rates per rule were calculated as primary outcome measures. The adherence in terms of the mean pass rate was defined without distinguishing between specific rules by dividing the number of times the two rules were followed by the number of times the rules were eligible to be followed. To calculate the pass rates per rule, we divided the number of times the rule was followed by the GP by the number of times the rule was eligible. Eligibility was defined as having two or more falls, or having mobility/balance
Figure 10.1: The DFL and the Fall-history taking message (in Dutch).
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Figure 10.2: The fall-prevention and management form (in Dutch)
problems. Following the “fall prevention and management rule” was defined as filling all items in the form (including the “not applicable” items). Following the mobility and balance rule was defined as accepting the recommendation to perform a muscle power or a balance test by clicking the “accept” button. The differences between the pass rates before (baseline) and after the introduction of the CDSS (intervention) were tested using a proportion test.

System usage was analyzed weekly, defined as the number of times the fall history-taking alert was opened divided by the number of times the fall history-taking alerts appeared on the DFL (Dynamic Floating List). Note that history-taking was triggered for all the patients who were 65 or older at the “open file” triggering point. The number of openwindow (occurs when the GP opens the message by clicking on it), mouseOver (occurs when the mouse pointer is over the selected alert) and mouseOut (occurs when a user moves the mouse pointer out of a alert) events were calculated.

Demographic data for the intervention including age, number of falls, gender, active medical conditions (calculated using the active ICPC codes, i.e., those present in the EMR at the time of the visit), and number of active medications (i.e., that had an end date in the future) are presented by using descriptive statistics. The baseline and the intervention cohorts were only compared based on age, gender and number of falls due to the lack of information on the number of active ICPC codes and medication information from the baseline cohort. All statistical analyses were performed by using the R statistical software environment version 2.11.1 (R Foundation for Statistical Computing, Vienna, Austria).

10.3 Results

10.3.1 The cohort characteristics

All 36 general practitioners, registered at the GAZO centers participated in the prospective intervention phase. Table 10.1 describes the characteristics of our patient cohort.

Our baseline cohort consisted of 950 patients, aged 70 years or older (average age: 77.7 (SD: 6.1)), responding to our questionnaire (response rate 56%). In total, 209 (22%) of the respondents reported that they sustained falls during the previous 12 months. Of these, 103 (11%) reported two or more falls. Of the respondents, 410 (43%) were male and 214 (23%) reported having mobility problems. We also compared the demographic characteristics between the baseline and intervention cohorts for only patients aged 70 years and older (age, gender and number of falls) which showed a significant difference in only the number of falls (p < 0.05).
Table 10.1: Characteristics of our CDSS intervention cohort.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total participants in CDSS intervention (70 years or older)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median [IQR, year]</td>
<td>77 [72-84]</td>
</tr>
<tr>
<td>74 years or younger, no. (%)</td>
<td>1096 (40)</td>
</tr>
<tr>
<td>75-84 years or older, no, (%)</td>
<td>1133 (41)</td>
</tr>
<tr>
<td>85 years or older, no, (%)</td>
<td>545 (19)</td>
</tr>
<tr>
<td>Gender: male, no. (%)</td>
<td>1118 (40)</td>
</tr>
<tr>
<td>Number of medications, median [IQR]</td>
<td>3 [1-6]</td>
</tr>
<tr>
<td>Number of falls, no. (%)</td>
<td></td>
</tr>
<tr>
<td>One fall or more</td>
<td>133 (5)</td>
</tr>
<tr>
<td>Two or more falls</td>
<td>49 (2)</td>
</tr>
<tr>
<td>Multimorbidity:</td>
<td></td>
</tr>
<tr>
<td>Number of active medical conditions, median number of distinct ICPC codes [IQR]</td>
<td>2 [1-3]</td>
</tr>
</tbody>
</table>

No: number; SD: standard deviation; IQR: inter-quartile range; ICPC: The International Classification of Primary Care.

10.3.2 Effect of the intervention

Adherence before and after the intervention.

At baseline, the mean pass rate was 30% and the individual pass rates were 38% for the fall prevention and management rule, and 26% for the mobility/balance problem rule.

Out of 4,053 patients aged 65 years or above that visited the participating GPs during the intervention period 2,774 (68%) were 70 years and older. The fall history-taking form was completed for 610 patients 65 years and older. There were 65 patients who had a documentation of two or more falls. GPs had completed the fall prevention forms for 33 of these patients. The distribution of fall prevention actions reported by GPs is described in Table 10.2.

Mobility and balance problems were registered for 178 patients 65 years and older. The advice was accepted for 68 patients and was rejected by pressing the ignore button for 51 patients. In 59 cases, the GP documented the mobility or balance problem but did not acknowledge the advice by pressing the “ignore” or “accept” buttons.

Table 10.3 demonstrates the adherence to the fall prevention and management rule as well as the mobility and balance problem rule for different age categories.
### Table 10.2: The distribution of fall prevention actions reported by the GPs

<table>
<thead>
<tr>
<th>Fall prevention actions</th>
<th>Done by GP (%)</th>
<th>Referral to other care givers (%)</th>
<th>n.a. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication review</td>
<td>17 (52)</td>
<td>8 (24)</td>
<td>8 (24)</td>
</tr>
<tr>
<td>Chronic/geriatric</td>
<td>21 (64)</td>
<td>5 (15)</td>
<td>7 (21)</td>
</tr>
<tr>
<td>conditions review</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye-exam</td>
<td>8 (24)</td>
<td>7 (21)</td>
<td>18 (55)</td>
</tr>
<tr>
<td>Cognitive test</td>
<td>8 (24)</td>
<td>7 (21)</td>
<td>18 (55)</td>
</tr>
<tr>
<td>Balance and muscle power test</td>
<td>10 (30)</td>
<td>12 (36)</td>
<td>11 (34)</td>
</tr>
<tr>
<td>Alcohol use</td>
<td>13 (39)</td>
<td>2 (6)</td>
<td>18 (55)</td>
</tr>
<tr>
<td>Review/use of walking aids (%)</td>
<td>15 (45)</td>
<td>3 (9)</td>
<td>15 (45)</td>
</tr>
<tr>
<td>Advice for safe house</td>
<td>9 (27)</td>
<td>11 (33)</td>
<td>13 (39)</td>
</tr>
</tbody>
</table>

*N.A.: Not applicable. By checking this radio button, the GP indicated that the item was not applicable to this patient.

### Table 10.3: Falls, mobility and balance problems, and adherence to the fall rules

<table>
<thead>
<tr>
<th></th>
<th>65 years or older</th>
<th>70 years or older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustained 2 or more falls in the previous year (N)</td>
<td>65</td>
<td>49</td>
</tr>
<tr>
<td>Reported mobility and balance problem in the CDSS (N)</td>
<td>178</td>
<td>147</td>
</tr>
<tr>
<td>Number of completed fall prevention forms</td>
<td>33</td>
<td>22</td>
</tr>
<tr>
<td>Number of times fall mobility and balance problems advice accepted</td>
<td>68</td>
<td>55</td>
</tr>
<tr>
<td>Pass rate fall prevention and management</td>
<td>51% (versus 38% at baseline)</td>
<td>45% (versus 38% at baseline)</td>
</tr>
<tr>
<td>Pass rate fall mobility and balance problem</td>
<td>38%</td>
<td>37%</td>
</tr>
<tr>
<td>Mean pass rates</td>
<td>42% (versus 30% at baseline)</td>
<td>39% (versus 30% at baseline)</td>
</tr>
</tbody>
</table>

* p-value < 0.05, cohort of 70 years and older was compared to the baseline.
10.3.3 System usage

In total 30,125 actions were logged, containing openWindow, mouseOver and mouseOut. There were 1,120 openWindows for fall rules. Table 10.4, shows the number of logs and alerts per message.

On average GPs received 637 (22,946/36) repeating fall related alerts on the DFL. A GP saw 112.6 patients (4053/36) on average. The GPs received 5.7 repeating alerts on average during the seven months of intervention per patient for fall management. Eight out of 36 GPs did not document any fall history or mobility/balance problem in our system during the seven months of the trial.

Table 10.4: The distribution of logs and alerts per message.

<table>
<thead>
<tr>
<th>Message</th>
<th>Logged</th>
<th>Alerts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall history-taking</td>
<td>26,976</td>
<td>21,976</td>
</tr>
<tr>
<td>Fall prevention/management forms</td>
<td>1,229</td>
<td>193</td>
</tr>
<tr>
<td>Fall mobility and balance problems</td>
<td>1,920</td>
<td>777</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>30,125</td>
<td>22,946</td>
</tr>
</tbody>
</table>

On average, it took 1 minute and 24 seconds (SD: 1.42) to fill in the fall prevention / management form, whereby the minimum was 28 seconds and the maximum was 9 minutes and 29 seconds. Figure 10.3 illustrates the system’s usage per week, based on the percentage of openWindows divided by the number of triggered history-taking alerts per week.

10.4 Discussion

The introduction of our computerized decision support system resulted in significant improvement in the mean adherence to the fall rules. There were improvements in adherence to both individual rules, this was significant for the mobility and balance problem rule but not for the fall prevention and management rule. Although this intervention was designed to be sustainable, our analysis showed a decrease in system usage over time. Our analysis also showed that 22% of the GPs did not register any fall history or mobility/balance problem at all.

This was the first study to investigate the effect of a fall management CDSS in primary care for improving the adherence to clinical rules on falls. The system introduced proactive assessment for fall management. The implemented rules were prioritized for support on the basis of technical feasibility, and clinician choice by ensuring support of clinical tasks that the clinicians feel are important and
Figure 10.3: The percentages of openWindows divided by the number of triggered history-taking alerts. The median and first and third interquartile ranges were calculated per week. The beta of the regression line was -0.23, corresponding to a 2.3% decrease per week.

\[ y = 7.80 + -0.23 \times \]
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perceive the need for improvement [18]. The system was also designed to be patient specific and non-interruptive to allow the GPs to take an action based on the message whenever they want. This study has the following limitations. First, we did not investigate the possible effect on the number of actual (recurrent) falls or the cost-effectiveness of the introduction of an automated fall-management system. However, fall management and follow-up is shown to be a good strategy to reduce number of falls and fear of falling [23]. Further research is needed to investigate these aspects. Second, our intervention was part of a bigger intervention for improving care for elderly patients. The fall QIs were implemented along with 24 other CRs [18]. Too many new alerts at once may have led GPs to ignore or disregard the alerts. Future studies should investigate this association. Third, although we have investigated the adherence to the QIs before and after the intervention, the baseline measurement was based on data reported by patients using a questionnaire (for 4 of the 6 practice centers) and the data of the CDSS was used for measuring the adherence to the CRs during the intervention. Some of the differences in adherence could be attributed to this difference in measurement and questioning. Fourth, we did not reach the estimated number needed for patient inclusion. Reaching this number might have led to significant adherence improvements for both rules. We saw a decrease of 2.3% in system usage each week, which implies that continuation of the study for a reasonable amount of time will not likely lead to reaching the required number of participants. Fifth, for practical reasons we limited the number of questions in the fall-history form asking only about “having two or more falls” or “having mobility and balance problems” which we used in the eligibility criteria. This does not seem a big concern, as the patients who were eligible for both QIs overlap. In addition, we expect that the difference between the adherence before and after the intervention is an underestimation of the actual difference, because we expect GPs to be highly adherent in severe cases (such as having an injurious fall). Our analysis in the intervention showed that even by taking less severe cases as eligible, the adherence was still higher. Finally, the actual fall documentation in the EMR has yet to be assessed.

Our results showed that many GPs did not document any fall history in the CDSS. There are many reasons why a clinician might reject or disregard alerts. Clinicians may generally dislike the system or guidelines and clinical rules, due to a sense of loss of autonomy [24, 25]. Following the system may make them feel that they are practicing “cook-book” medicine [24]. The presence of too many alerts can lead to alert fatigue which leads to ignoring all alerts [26]. On average, 5.7 alerts (repeating alerts counted as independent ones) were generated per patient for the fall management rules, in addition to the other newly introduced decision support rules. Also, GPs needed to fill the whole form to be able to save it, which is time-consuming. Further research is needed to study the reasons why some
GPs did not want to document fall history using our system, or ignored or disregarded the advice.

In a previous study, Wenger and colleagues demonstrated in two large primary care practices that paper-based decision support can improve care for falls for patients 75 or older by using paper-based structured charts, with an increase in pass rate from 23 to 44% based on five fall-related ACOVE QIs in the control and intervention groups [22]. When conditioning our analysis to patients 75 years or older in our study we find that the mean pass rate changed from 34% to 38%, in contrast to a change from 21% to 45% for the patients aged 70 to 75 years old.

The CDSS was designed as a non-interruptive intervention, and provided timely, patient-specific support, which appeared to be effective, at least in the short term of introducing the system. The intervention introduced a structured means of documentation for falls, fall history, and balance/mobility problems. We recommend that software suppliers and policy makers consider utilizing computerized decision support in the GPs’ EMR for improving fall management and care. However, future studies are still needed to investigate the cost-effectiveness of utilizing such a system in reducing the number of falls and other clinical outcomes.

### 10.5 Conclusions

This study demonstrated significant improvement in the mean adherence to the fall clinical rules (and thereby the quality indicators) using a non-intrusive CDSS that provided timely, patient-specific and proactive computerized feedback. Future efforts should measure clinical outcomes of such interventions and reasons for GPs to use or ignore the system.
The effect of a computerized decision support system on detection and management of falls in primary care: A prospective before-after study

Bibliography


