

The use of shared medication record as part of medication reconciliation at hospital admission is feasible

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ABSTRACT

INTRODUCTION: Medication reconciliation improves congruence in cross sectional patient courses. Our regional electronic medical record (EMR) integrates the shared medication record (SMR) which provides full access to current medication and medication prescriptions for all citizens in Denmark. We studied whether our SMR integration could facilitate medication reconciliation.

MATERIAL AND METHODS: Patients admitted to the emergency department for hospitalization were randomised to consultation using EMR with or without the integrated SMR access. Observed time used for medication reconciliation was the primary efficacy parameter.

RESULTS: A total of 62 consecutive patient consultations were randomised including 39 with more than five prescriptions. EMR had data from previous consultations for 46 patients, 59 patients provided information on medication. In all, 18 junior physicians in early postgraduate medical training each participated with a median of three consultations (range 1-9). Time expenditure for medicine reconciliation was 5:27 min.:sec. (range: 2:00-15:37) with access to SMR integration and 4:15 min.:sec. (1:15-12:00) without SMR access. The number of active medicine prescriptions was eight and nine, respectively. Incorporating SMR did not increase the work load. Physicians judged the SMR integration and workflow as being useful. Patients unambiguously supported physicians' use of SMR in this setting.

CONCLUSION: Integration of information on individuals' medication from a national SMR into a hospital EMR was feasible and useful, and it did not increase time expenditure for medication reconciliation.

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Reliable knowledge about the individual patient's medication is crucial for evaluation of the clinical presentation and choice of treatment because medicines may cause side effects. Unintended medication errors, many of which are due to slips in communication, are the cause of 10-15% of acute hospitalizations [1]. Yet, several clinical studies have demonstrated a low rate of congruence between physicians regarding patients' medication at the interface between primary care and hospitals and incomplete patient disclosure of medications at admission [2-5]. Structured interviews and the

use of pharmacy records improve medical history [4, 6, 7]. Shared electronic health records (EHR) and electronic medication reconciliation could help reduce the number of medication errors [8].

Transfer of information between individual health-care providers involved in a patient course has previously been based on exchange of messages. In an attempt to migrate to a service-based information technology, the National eHealth Authority, Statens Serum Institut, launched a shared national service, the Shared Medication Record (SMR), which hosts information on active medication and prescriptions for all Danish citizens. Medication reconciliation at transition of care is to be documented in the SMR by the end of 2013, and the SMR is to be used by district nurses by the end of 2014. We examined the time expenditure and influence on workflow related to medicine reconciliation at hospital admission using an SMR integration in the EMR of a regional EHR.

MATERIAL AND METHODS

Shared medication record

The SMR is a national registry of current medication use and pharmacy records of medication prescribed to each inhabitant in Denmark within the preceding 24 months. All details of each prescription and the date of the latest medication reconciliation are provided. Patients have on-line internet access to their SMR data and to an access log.

Any physician involved in the patients' clinical course has access to the SMR data from the hospital-based EMR and the family doctors' electronic medical records. The purpose of the SMR is to provide a shared overview of medication at transition of care, and medication orders are exchanged between the SMR and the local EMRs.

The clinical setting

The study was performed on three consecutive weekdays in June 2010 from 08.00 through 22.00 at the emergency department receiving all acute patients admitted to Køge Hospital, a 320-bed university hospital. Prior to the test, we demonstrated the SMR integration and introduced the study purpose, design and practicalities related to the test.

ORIGINAL ARTICLE

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TABLE 1

Patient characteristics, number of medications and sources of information^a.

	EMR	SMR
Patients randomised, n	28	34
Patient age, median (range), yrs	66 (25-94)	64 (23-88)
Patient gender (female/male), n	15/15	17/14
Patients with ≥ 5 active medicine orders, n	18	21
Prescriptions within the preceding 2 yrs in the SMR, median (range), n	16 (3-68)	16 (3-60)
Active medications in the SMR, median (range), n	6 (1-16)	6 (1-17)
Medications used and not in the SMR, median (range), n	0 (0-4)	1 (0-11)
Medications in the SMR and not used, median (range), n	1 (0-4)	1 (0-4)
Medication orders in the EMR from prior hospitalization, median (range), n	5 (0-20)	5 (0-24)
<i>Information on medication available from, n</i>		
Patient	30	29
Accompanying person	5	4
Family doctor	9	7
Primary care nurse	2	1

EMR = electronic medical record; SMR = shared medication record.

a) The figures do not differ statistically between groups.

TABLE 2

Time expenditure for medication reconciliation and the complete consultation for all patients and for those without existing information in the electronic medical record^a.

	EMR	SMR
Patients randomised, n	28	34
Consultation time, median (range), h:min.	1:10 (0:32-2:40)	1:05 (0:30-2:25)
Medication reconciliation, median (range), min.:sec.	4:16 (1:15-12:00)	5:27 (2:00-15:37)
After access to the SMR, median (range), min.:sec.	+1:30 (0:30-2:40)	–
Patients randomised and naive in the EMR, n	8	8
Medication reconciliation, median (range), min.:sec.	4:03 (2:20-10:12)	2:48 (2:00-5:27)
After access to the SMR, median (range), min.:sec.	+1:15 (0:10-2:30)	–

EMR = electronic medical record; SMR = shared medication record.

a) Results are not statistically different for EMR and SMR, respectively.

Design

The study was an open randomised controlled trial of time spent on medication reconciliation for patients admitted to the emergency department. The medication reconciliation performed at admittance was randomised 1:1 to the use of the regional EMR with all available information (including patient history, medication lists, information from the admitting physician and information, if any) or to this with the additional access to the SMR integration. Upon finishing a consultation without access to the SMR, the physician was given access to the SMR and repeated the medication reconciliation. Patients were followed up for the entire hospitalization, and all medication changes made within the first 24 h of hospitalization were registered.

Randomisation was by computer generated random number in blocks of four for each stratum. We used sealed and consecutively numbered envelopes and stratified for active use of < 5 and ≥ 5 medications in

order to obtain an even distribution of patients with a large number of active medicine orders. Non-capable patients, patients aged < 18 years, patients with cardiac arrest and trauma, and patients without any active medication were excluded. A senior medical doctor not involved in the clinical encounter reviewed the SMR prior to the consultation and generated a list of likely active medications on the SMR.

The consultation was observed by senior physicians, trained nurses or clinical pharmacists. The observers recorded time used for medication reconciliation including order entries and for the complete consultation. Following the consultation, both the physician and the patient completed a one-page questionnaire using a visual analogue (Likert) scale ranging from zero to ten. Questions for the physicians included the subjective workload assessment. All sources of information on medication available at the consultation were noted. The number of active medication orders stated by the patient and the number new and adjusted prescriptions in the acute ward were noted. At the end of the study, the involved physicians were asked about their overall opinion of the SMR integration into the EMR.

The primary effect parameter was time used for medication reconciliation. The secondary parameters were total duration of the consultation, number of changes in medication during the first 24 h in hospital, the physicians' experience of strain related to work load associated with obtaining information on medication during each consultation, their overall assessment of the SMR integration, and the patients' opinion about the physicians' access to SMR.

Ethics

The study assessed a new functionality in our EMR and changes in workflow, and it included only capable patients. The trial was therefore not registered. Our regional ethical committee notified us that the study met the criteria for exemption from ethical review according to our institutional policy in The Region of Zealand. Informed consent was obtained from all participating physicians and patients and none refused to participate.

Sample size calculation and data presentation

We estimated time spent on performing medication reconciliation including medical history and order entry and any changes in orders remaining in the EMR from a previous hospitalization to be ≥ 8 min. in 60% in the control group and in 30% in the group using SMR. With an $\alpha = 0.05$ and a $\beta = 0.80$, a minimum of 39 patients in each group needed to be randomised. The results are given as medians and ranges. Statistical comparisons were performed using the Man-Whitney unpaired test and $p = 0.05$ as level of significance.

Trial registration: not relevant.

RESULTS

A total of 18 physicians participated in the test. One had more than three years clinical postgraduate experience, five had less than three years, eight less than one year and three were medical students. Each participated with a median of three consultations (range 1-9). Five physicians started with either the SHR or the EMR at all their consultations. A total of 62 consecutive consultations were observed and another 48 were not included due to lack of observers or to patients having trauma or cardiac arrest.

Details of patients and their medications are given in **Table 1** and time expenditure in **Table 2**. The differences were small and not statistically significant. The time used for medication reconciliation was shorter in patients without data in the hospital EMR from a previous consultation or hospitalization. Multiple medication orders were handled in most patients without differences between groups. Orders transferred from the SMR were two (0-9) and zero (0-1) with and without primary access to the SMR. Five (0-14) existing medication orders in the EMR were changes in each group. There were no differences in the number of new medication orders after transfer to stationary wards. The work load did not differ between the groups (**Table 3**) or with the doctors' clinical experience and number of consultations. The SMR integration was judged feasible and easily incorporable into the physicians' workflow (**Table 4**). Patients had a median age of 65 years. They unanimously stated that physicians in the emergency department should have access to their SMR data and should use this information (**Table 5**).

DISCUSSION

Congruence and accuracy of the shared medication record

Medication reconciliation is a clinical process for improving quality, safety and congruence [9] and therefore a key standard in the accreditation processes. Several intervention studies have demonstrated that focused efforts to improve and validate medication history at transition of care yields more correct and congruent medication lists. The majority of these studies were performed in emergency department settings and involved primarily pharmacists. However, no study has unequivocally demonstrated that these interventions improve the quality of diagnosis, care or outcome [10]. Studies of effect should be performed simultaneously in real time rather than as before-after studies, since both EHR, EMR, SMR and workflows evolve continuously. The SMR integration facilitates congruence by providing access to a shared platform for all information on any citizen's

TABLE 3

Physicians' statements^a of work load associated with completing medication reconciliation stated after each consultation (n = 59). The results are medians (ranges) of statements on a Likert scale^b.

	EMR	SMR
Were you burdened?	4 (1.5-10)	6.5 (1.5-10)
Did the SMR help you in the process?	1.5 (1.5-9.5)	2 (0-9.5)
How mentally demanding was the task?	6.5 (1.5-9.5)	8 (3-9.5)
How physically demanding was the task?	8 (3-10)	9 (4.5-10)
How hurried or rushed was the pace of the task?	5.5 (0.5-10)	6.5 (1.5-9.5)
How successful were you in accomplishing the task?	1.5 (0-5.5)	1 (0-3.5)
How hard did you have to work to accomplish your level of performance?	5.5 (1.5-10)	6.5 (0.5-9)
How insecure, discouraged, irritated, stressed and annoyed were you?	7 (2.5-10)	8 (0.5-9.5)

EMR = electronic medical record; SMR = shared medication record.

a) The statements do not differ statistically between groups. 2 physicians did not return the questionnaire.

b) 0-10: yes, to a high extend-no, not at all.

TABLE 4

The overall opinion of the involved physicians on the use of the shared medication record integration^a. The results are medians (ranges) of statements on a Likert scale^b (n = 16).

Is the SMR a useful tool for obtaining a medication history?	1 (0-4.5)
Is the SMR a help in performing a medication reconciliation?	1 (0-4.5)
Does the SMR influence your medicine orders?	3 (0.5-8)
Does the use of the SMR influence your work flow?	3 (0.5-8)
Does the use of the SMR influence your communication with the patient?	4.5 (2.5-9.5)

SMR = shared medication record.

a) 2 physicians did not return the questionnaire. b) 0-10: yes, very much so-no, not at all.

TABLE 5

Patients' opinion on physician access to and use of information on their medication in the SMR. The results are medians (ranges) of statements on a 0-10 scale (n = 55)^a.

Should physicians who take care of your health problem have access to information on your medication? ^b	0.5 (0-8.5)
Do you expect that the physician taking care of you right now has access to and uses information on your medication? ^b	0.5 (0-10)
What is your opinion on the fact that the physician taking care of you right now has access to a list of all prescriptions issued to you during the last two years? ^c	0.5 (0-5.5)

SMR = shared medication record.

a) 5 patients were unable to participate and one did not return the questionnaire.

b) 0-10: yes, very much so-no, not at all.

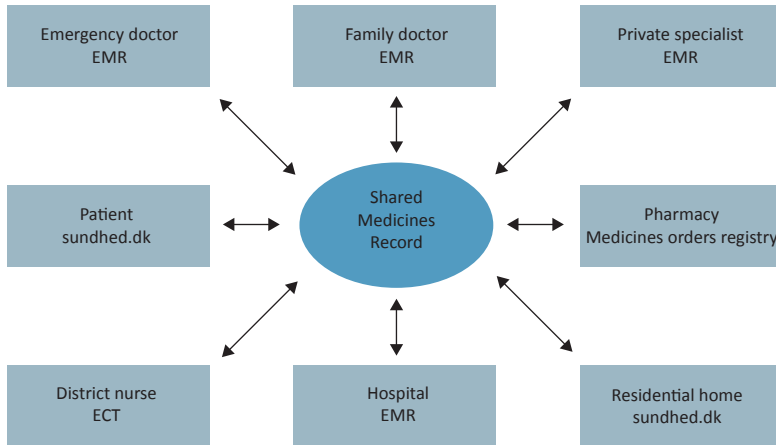
c) 0-10: very good-completely wrong.

medication and by integrating this into the local EMR. However, consensus on changes in workflow and culture are crucial for achieving the anticipated benefits [11, 12].

Medication reconciliation provides an essential input to the interpretation of the clinical problem because the medication list provides implicit information on important medical conditions and possible medication side effects. Patients may change medication between physician visits and use over-the counter medicines. It is

FIGURE 1

Communication between health-care sectors, health-care persons and patients by means of sharing and updating information in the shared medication record.



ECT = electronic care record; EMR = electronic medical record; SMR = shared medication record.

therefore essential to view the SMR as a list that is to be discussed with and confirmed by the patient at all physician encounters [8, 13, 14].

Usefulness of shared medication record integration and workload

Performing medicine reconciliation is time consuming [13, 14]. Implementing the SMR as the tool for this task therefore depends on physicians' accept of changes in the clinical workflow, a reasonable time expenditure and workload and a belief that it provides benefit to the patient [9, 10, 15-17]. This study set out to test whether providing access to a national SMR for the individual patient in our existing EMR could facilitate the process of medication reconciliation. Time expenditure for obtaining a medicines history and completing medication reconciliation was approximately 5 min. and did not increase significantly (Table 2). Time expenditure was 2.2 min. in a recent Danish study in a similar setting and 10-15 min. in a pharmacist intervention study [18, 19]. The time recorded in our study included physician medication order entries, which were facilitated by computerised standard medication orders. Total physician time expenditure for each patient was approximately 1 h (Table 2) and included all clinical tasks and the generation of a complete report for the EHR online. The clinical experience of the physicians involved did not affect the time used for medication reconciliation. We did not study the extent to which the information in the SMR was used for expanding the medical history.

We focused on time expenditure as this is a relevant and measurable parameter, and we stratified for

the number of medications. We did not reach the calculated number of consultations, but the results indicate that a larger sample would not have dramatically changed our conclusions. We deliberately chose not to measure quality parameters, as these are affected by more factors than we would be able to control for.

The EMR can facilitate medication reconciliation [6-8] given that the solution facilitates physician workflow [17]. The physicians involved in our study worked with a single sign-on EHR including the EMR. Their workload did not increase when using the SMR integration (Table 3). The SMR provides a structured platform, which was readily adopted and used during the consultation (Table 4). The youngest physicians did not differ from their slightly older colleagues. The design secured that the SMR information was assessed for all patients, which precluded an assessment of the impact of SMR on the course of hospitalization or medicine reconciliation at discharge.

Acceptance and patient involvement

The medication reconciliation process stimulates patient involvement [14] and has the potential to increase congruence between physicians and their patients in addition to stimulating patient involvement and furthering patient empowerment. Patients expected that information on their data in the SMR was used by their attending physician and health-care providers (Table 5). However, in general patients may be more concerned with data protection and security [14, 20]. Based on the clinical experience and national demands, the SMR integration has been improved successively. As of October 2013, approximately 70% of the patients in The Region of Zealand have their SMR updated when admitted to and discharged from hospitals, and 70% of the family doctors have implemented an SMR integration. Patients have been given access to their SMR data and a log of those that have assessed it, and they can ask that any one of their medicine orders be hidden for all others than the prescribing physician.

Perspective

This study demonstrates that the SMR integration into a regional EMR is readily accepted and that it supports a rational workflow at hospitalization. The SMR integration is being improved to allow for simultaneous entries, changes and documentation in both the EMR and the SMR. The SMR is also planned to include information on allergy and various decision support including a check for interaction between medicines.

It remains to be demonstrated that the use of the SMR for medication reconciliation at interchange between hospital and primary care may improve congruence and communication between the involved health

workers and between these health workers and the patient (**Figure 1**).

It also needs to be demonstrated that quality of medication and the complete patient course may be improved. To obtain these goals, medication reconciliation should be integrated into several clinical encounters along the patients' course including visits to the outpatient clinic and to the family doctor. The potential for using SMR to involve patients more actively in a dialogue about their medication and on their adherence to the medication plan should be examined.

Finally, it should be acknowledged that the introduction of clinical IT solutions carries a risk of introducing new unintended errors.

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