From paper-based to electronic prescribing of multidose drug dispensing — effects on pharmacy workload

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Abstract
Since 2014, an electronic prescribing system has been piloted for patients receiving medications as multidose drug dispensing; a system commonly used in home care services. In this longitudinal study of 499 patients, we investigate workload at the pharmacies, measured as the number of times pharmacists assess prescriptions. In the 26-week period before the implementation, 17% of the patients got their prescriptions assessed by a pharmacist every 2 weeks, in the 42 weeks after, this increased to 47%. This considerably increases the pharmacy workload, with an estimated additional 602.000 pharmacist assessments every year if all eligible patients get the new prescribing system

Keywords
Multidose drug dispensing, e-prescribing, shared medication list

1 INTRODUCTION

Multidose drug dispensing (MDD) is an adherence aid commonly used for patients in home care services. MDD is machine dispensed solid medicines (tablets and capsules) in disposable plastic bags that replaces manually filled dosettes. MDD is common in hospitals across the world but is also used in primary care in the Scandinavian countries, Finland and the Netherlands [1]. In Norway, there are about 100.000 users of MDD, most of whom get it via home care services [2]. MDD is believed to reduce administration errors, improve medication adherence, save medication costs, save working time for nurses and reduce waste of unused medications [3-11]. However, the system is also associated with more inappropriate prescribing, increased risk of errors at care transitions and patients having fewer changes in their medication treatment, compared to patients with ordinary prescribing [12-16]. There are, however, very few studies on the effects of MDD systems in primary care in general [17, 18].

In Norway, the prescriptions used to dispense MDD differs from ordinary prescriptions. Firstly, the MDD prescriptions consist of a complete list of the medication use, which includes all regular medications (both those dispensed as MDD and those who are dispensed in their original packaging), *when needed* medications, medical devices and dietary supplements. Ordinary prescriptions only contain one medicine at a time and will not contain dietary supplements. Secondly, the MDD prescriptions are paper-based, usually printouts from the GPs medication journal, faxed or sent by fax to the pharmacy. Ordinary prescriptions are electronically transferred via a national database accessible to all pharmacies and prescribers in the country. Since 2014 an electronic prescribing system for MDD patients has been piloted, the implementation is, however, slow. At the time of writing, about 2300 patients are getting MDD based on electronic prescriptions [19].

1.1 The e-prescribing system

The electronic MDD system uses the same e-prescriptions as ordinary prescribing. However, the system also requires the GP to create a digitally shared medication list (SML) transferred via the same database. As for the paper-based MDD prescription, this SML contains a total overview of the patient's medications: regular medications, *when needed* medications and dietary supplements. Unlike the MDD prescription, however, the SML is not legally a prescription meaning that it cannot be used to dispense medications by itself. It is thus necessary with e-prescriptions for each medication on the SML to dispense medications. These accompanying e-prescriptions are identical to ordinary prescriptions and are therefore available for any pharmacy or physician in the country.

The electronic prescribing of MDD is not a new system, but rather a function in the existing electronic health record (EHR) systems the GPs are using. This function can be turned on at each installation. Once this is turned on, a GP can define a patient as using MDD. This means that the next time the GP prescribe medications for this patient, the system will automatically generate an SML for the patient along with the e-prescriptions.

We know from previous research that e-prescribing can introduce workarounds and change work practices for the personnel involved [20-22]. The physicians using the e-prescribing system for MDD have so far reported that the system is both less time-consuming and safer for the patients [23, 24]. Interviews with pharmacists and nurses have revealed that they experience the system to be more time-consuming, specifically the pharmacists described having to assess prescriptions more frequently [20].

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Description of step	Paper-based	Electronic
Transmit Prescription sent from prescriber to the pharmacy and linked to a patient in the pharmacy dispensing program.	Prescription transmitted via fax or mail. A pharmacy employee manually link prescription and patient	Prescription transmitted via the national prescription database. Prescription automatically linked to a patient via social security number
Transcribe Prescription entered into the pharmacy dispensing program	Manual transcribing of the entire prescription: medication, dosing schedule, prescriber, reimbursement.	Semi-automatic transcribing. A pharmacy employee chose what prescription to transcribe, and most information is automatically entered except the dosing schedule
Pharmacist check A pharmacist assesses the clinical appropriateness and validity of the prescription. Contact the prescriber or home care services if there are problems.	Includes double-checking the transcription from the previous step. Should be done by another pharmacist than the one doing the transcribing.	Same as for the paper-based, but less need to check for correct transcribing.
Order The pharmacist sends an electronic order to the MDD supplier.	Sent per patient group/home care service, not per patient	Same as for the paper-based

Table 1: Steps in the prescription handling at the pharmacy

The aim of this study is to investigate whether the electronic system for MDD affects the pharmacist workload by analyzing the number of times they needed to assess the MDD prescription.

2 METHODS

We conducted a longitudinal study using the MDD prescriptions from the main MDD supplier in Norway.

2.1 The work process at the pharmacy

To dispense a medication, a pharmacist needs to check the prescription. This check includes a clinical evaluation of the appropriateness of the treatment in relation to the patient's age, gender and indication for the medication, as well as checking the validity of the prescription and ensuring that the patients get appropriate information about how to use the medications [25, 26]. For ordinary prescriptions, this assessment is done every time a medication is dispensed (usually every 3 months for regularly used medications), and only for the prescriptions that are dispensed at a given time. For MDD, however, this is done the first time a prescription is included on the MDD prescription, and then only when there are changes to the treatment [26]. The pharmacist also assesses the entire MDD prescription, regardless of whether the medicines are actually dispensed at the time of the check. Before the prescription can be checked by a pharmacist, the prescription needs to be transmitted to the pharmacy and transcribed into the MDD dispensing system. Table 1 describes these different steps, and how they differ between the paper-based and electronic MDD systems.

2.2 Data collection

We contacted the MDD supplier who started pilot testing electronic MDD in 2014 and asked for the prescriptions used in the period from June 2012 to August 2020. The supplier provided us anonymous data for all patients in the municipalities where the electronic system had been piloted.

The data contained information about when the prescription was checked by a pharmacist and for what period MDD was dispensed for each patient. Regarding the patients, the data contained age and gender. Regarding medications the prescriptions contained details of medication names, strength and formulation, in addition to dosing schedule and dispensing type (MDD medications, regular medications not dispensed as MDD and *when needed* medications).

2.3 Analyses

For each individual, we defined the index date as the first time MDD had been dispensed on an electronic prescription. Because MDD is usually dispensed for 2 weeks at a time, we divided each patient into 2 weeks intervals, from 26 weeks before the index date to 42 weeks after.

We excluded patients if they did not have data for all intervals, i.e. patients with more than a 2-week stop in their MDD dispensing. If the patient started directly with electronic prescribing or went back to the paper-based system before 42 weeks, they were excluded. So were patients who were transferred to nursing homes during the study period.

We used Stata Stata/MP 15 for the analyses. The main outcome measure was the number of patients where a pharmacist had checked the prescription from one period to the next.

2.4 Ethics

This study was approved by the Data Protection Officer at Apotek 1 AS. The data were anonymised by the pharmacy before being given to the researchers, and the study did not require approval from the Regional Ethics Committee.

3 RESULTS

The original dataset consisted of 2102 patients who had received MDD based on electronic prescriptions at least once during the 8-year period. We excluded 1603 patients who did not have enough data before or after the interventions, and the final dataset consisted of 499 patients.

	Female N (%)	Male N (%)	Total N (%)
Sex	283 (57%)	216 (43%)	499
Age	78 (18)	66 (20)	73 (20)
Number of drugs	10.8 (5.7)	8.9 (4.7)	10.0 (5.3)

Table 2: Study population characteristics

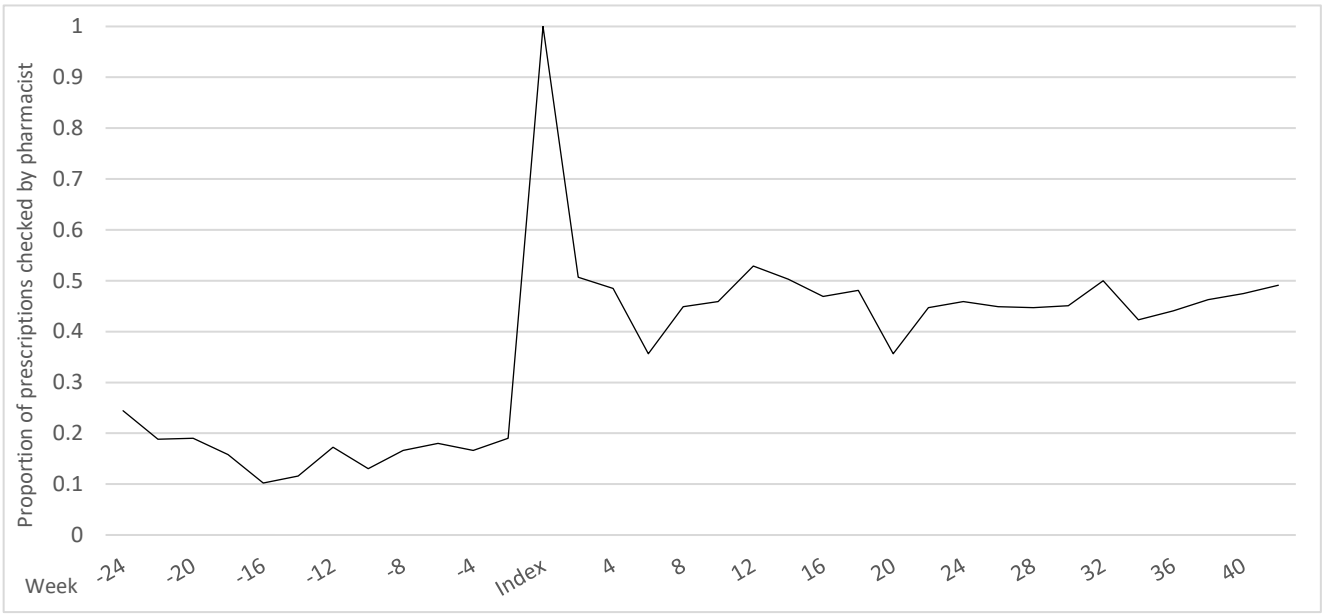

Figure 1: Number of prescription changes

From Table 2 we see that the patients were on average 73 years old, the majority were women and they had on average 10 mediations on their prescriptions.

The proportion of patients who got their prescriptions assessed by a pharmacist between each MDD dispensing is shown in Figure 1. At the index date, all patients went from having paper prescriptions to electronic prescriptions, and thus all prescriptions needed to be checked by a pharmacist. From -24 to -2 weeks we find that an average of 17 % of the patients had their prescription assessed by a pharmacist between each MDD dispensing; from week 2 to 42, the average was 46%.

Given this increase, this results in an estimated 602.000 additional pharmacist checks per year if all 80.000 users of the paper-based MDD system in home care services [2] get the electronic prescribing system. In order for the electronic system to be equally efficient for the pharmacists, the process of transcribing and checking prescriptions needs to be 16/46 = 0.36 times as efficient in the electronic system compared to the paper-based.

4 DISCUSSION

In this longitudinal study, we find a temporal association between the start of the electronic prescribing of MDD and increased number of pharmacist checks. The degree of checks is maintained throughout the 42 weeks follow-up. In terms of pharmacist checks on the prescriptions, this increased from 17 every 2 weeks per 100 patients, to 46, resulting in an estimated 602.000 additional pharmacist checks per year if all eligible MDD patients get the electronic prescribing system.

The number of pharmacists checks on the prescriptions is a reflection of the number of times the medication treatment is changed by a physician. There are several reasons why the electronic prescribing system may increase the number the prescription changes: 1) failures with the transmission are less likely 2) the GP has to send all prescriptions 3) the pharmacy is notified of all changes on a patient 4) increased renewing of prescriptions and 5) changes in prescribing patterns. Each will be discussed in more detail below.

4.1 Fewer errors in the transmission of prescriptions

In the paper-based system, the medication lists are usually faxed or sent by post to the pharmacy. These are manual processes that might fail or be forgotten. Parts of the increase in prescription checks we see in this study might thus be that the electronic system reduces errors in the transmission step. Insufficient communication regarding a patient's medication treatment and manual routines in updating the medication lists are major causes of discrepancies in medication lists [27-33], and reducing errors in transmission probably increases medication safety for MDD users.

4.2 The GP has to send all prescriptions

In the paper-based system, the GP might also choose not to send prescriptions to the MDD pharmacy. This might happen if they know the medicines will not be dispensed in MDD, either because the medicines should be taken when needed, because the formulations are not dispensable as MDD (e.g. creams, liquids and eye drops) or because the medicine should not be dispensed as MDD of other reasons (e.g. antibiotics). With the electronic system, the GP no longer has this option and all medications must be sent.

In interviews with the pharmacists piloting the electronic system, they described how they in the paper-based system typically were not notified if the patient was prescribed e.g. a course of antibiotic, while in the electronic system they would be notified about all changes regardless of whether it would be dispensed in MDD or not [20]. The current MDD dispensing system is designed so that the pharmacist at the MDD pharmacy checks the entire MDD prescription, including those medicines that are not dispensed in MDD. This enables the pharmacist to assess the entire treatment and check for drug-drug interactions of all prescribed medicines. This has previously been described as one of the benefits of the MDD system that helps improve safety [4, 34-37]. However, this is not a legal requirement [38]. Legally, only the prescriptions that are dispensed (i.e. the MDD medications) need to be assessed by a pharmacist at this stage, as the other prescriptions will have to be checked again by a pharmacist when they are actually dispensed in their original packaging at a later time. Since the pharmacy

gets notifications about all changes on a patient, including those that do not directly affect the medicines dispensed as MDD, this might also contribute to the increased number of pharmacist checks we find in this study.

4.3 Notifications about all changes

Similarly, the pharmacy is notified about all changes to the patient's medication treatment, also those done by doctors other than the GP. That the MDD pharmacy does not get automatically updated about prescriptions from e.g. the hospital is a known weakness of today's MDD system. Previous studies have shown many challenges with MDD patients during care transitions [27, 34, 39-42], and it has been shown that MDD patients have between 3 and 18 times increased risk of errors in this process [13, 14, 43]. When the MDD pharmacy is not notified about these prescriptions the home care services might have to manually correct the MDD bags, which is a time-consuming process that is also prone to errors [44-46]. Having direct access to the prescriptions from other prescribers than the GP has been described as one of the benefits of the electronic MDD system in Norway in terms of increasing medication safety [20]. However, the pharmacists also described it as being a major cause of increased workload because it results in a lot more clarifications and checks [20].

4.4 Renewing prescriptions

A fourth cause of the increased number of prescription changes we see in this study is the design of the electronic prescribing system when it comes to the validity of prescriptions. In the paper-based system, there is one MDD prescription, valid for one year supply for all the medications on the prescription, and with one expiry date. In the electronic system, there are individual e-prescriptions for each medicine, all with potentially different expiry dates. In addition, e-prescriptions contain a quantity that can be dispensed, meaning that the prescription can be emptied out before a year has passed. In fact, prescribing the wrong quantity has been shown to be among the most common errors on e-prescriptions [47-49]. When a prescription is renewed, despite the medicine, dosing schedule and prescriber being identical to the expired prescription, this requires a new check by the pharmacist as it is formally a new prescription. Expired prescriptions were described as one of the major causes why both nurses and pharmacists found the electronic MDD system more time-consuming than the paper-based system [20].

It has previously been suggested that the decrease in prescribing quality that is seen in MDD patients over time, might be due to too automatic renewing processes for these patients [50, 51]. A more frequent renewing of prescriptions might thus improve prescribing quality as the GP more often review the treatment of the patient. However, renewing prescriptions can also be a technical task and does not have to include reviewing the treatment as a whole[52]. In a cross-sectional study of 336 patients testing the electronic MDD system, it was found that 23 % were missing prescriptions on regularly used medications after the transition to the electronic system [53]. Another study interviewing pharmacists and nurses involved in the pilot also described how the patients were more frequently missing medicines in the MDD bags after the transition to e-prescribing [20]. Considering the risk of the patients not getting prescriptions renewed in time for ordering MDD, and the time pharmacists, nurses and GPs use on the task of renewing prescriptions, it is uncertain whether the increased need for renewing prescriptions would increase medication safety, even if it results in the GP reviewing the medication treatment more frequently. A better approach to increase mediation safety would probably be to shift focus away from single e-prescriptions that need individual renewals, and rather focus on the medication treatment and the SML as a whole, and do a medication review of this complete list at set intervals.

4.5 Changes in prescribing patterns.

Lastly, the electronic prescribing system might change the prescribing patterns, which results in an increased number of prescription changes. The SML system seems to improve the overview of the patient's medication use, compared to the paper-based: there are fewer discrepancies between the medication lists at different care providers, and the list is more up-to-date, including prescriptions from hospital physicians as well as dietary supplements [53, 54]. This increased overview might affect the GP's prescribing. Because the e-prescriptions have quantities this also might make the GP more aware of the amount of medications they are prescribing. This might also affect the prescribing, especially for medications with the potential for abuse. Lastly, MDD prescribing has been described as more time-consuming and complex than ordinary prescribing [5, 34, 55], and studies have shown that MDD patients have fewer changes in their medication regiments (starts, discontinuations and dose changes) than patients with ordinary prescribing [50, 51]. Having the same prescribing procedures for patients with ordinary prescribing and MDD might thus also result in the GPs more frequently making changes to the prescriptions.

4.6 Workload

In this study, we have looked at the pharmacist's workload in terms of the number of times they assessed new or changed prescriptions. In order for a pharmacist to do this task, the prescription first has to be transmitted to the pharmacy and transcribed into the MDD dispensing system. As described in Table 1, these steps are more automatic in the electronic system, and are likely less time-consuming compared to the paper-based system. This is also consistent with the pharmacists' descriptions of the new system [20]. The step of checking and correcting the prescriptions, however, might be more time consuming because there seems to be an increased need to do clarifications and contact the prescriber compared to the paper-based system [20, 56]. The finding that e-prescriptions require more frequent contact with GPs than paper-based prescriptions, is in line with previous research [57, 58].

Given the increased number of pharmacist checks performed in the electronic system as shown in this study, the process of prescription management at the pharmacy needs to be almost 3 times as efficient for the pharmacists to use an equal amount of time in the two systems. Future studies should address how this increased workload affects the financial situation of the pharmacies.

4.7 Strengths and limitations

The main strength of this study is that we have used a complete data set for almost 500 patients spanning over 18 months. This makes us able to show a relatively stable trend, increasing the validity of the results. The patients included were older adults and had on average 10 mediations on their prescriptions reflecting the challenges with polypharmacy. One weakness of this study is the lack of a control group. However, we believe that the longitudinal data is solid and capture the trend in prescription changes before and after the implementation of electronic prescribing for MDD users.

5 CONCLUSION

Going from paper to electronic prescription of MDD, increased the number of prescription changes which considerably increased the workload for the pharmacy. This study does not investigate the nature of the prescription changes, but we propose several explanations for the increase. By automating or redesigning the e-prescribing system, especially regarding renewing prescriptions, the workload for pharmacists could likely be lowered. If the extra workload persists when the system is implemented at scale, we need to analyse the economic consequences for the pharmacies in more detail. The consequences for the home care services and GPs should also be investigated. Future studies are also needed to look into whether these prescription changes are clinically relevant.

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7 ACKNOWLEDGEMENT

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