

Multi-dose drug dispensing is a challenge across the primary-secondary care interface

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ABSTRACT

INTRODUCTION: Multi-dose drug dispensing (MDDD) signifies that the patient's medicine is packed in disposable bags corresponding to the dose that should be taken. The purpose of the present study was to investigate how a hospital MDDD instruction was followed.

MATERIAL AND METHODS: All patients receiving MDDD on admission to the acute medical admission ward at Bispebjerg Hospital in the period from 1 January to 30 June 2010 were prospectively included in the study. An audit of the medication lists and hospital case records covering the period from admission to discharge was performed. A proportion of patients received a post-discharge home visit. An interview in both sectors was carried out to determine whether the instructions had been followed.

RESULTS: Almost 9% of the patients were receiving MDDD on admission. Information on MDDD was recorded in the physician case record for 3.4% of patients and in the nurse case record for 12.9% of patients. Changes in MDDD during hospitalization were made for 58.3% of patients. General practitioners and/or the community pharmacy were notified of changes in MDDD at discharge for 13.6% of the patients. The post-discharge visits and the interview revealed potential issues of concern regarding patient safety.

CONCLUSION: MDDD is frequent. Identification and registration of MDDD is only performed sporadically. Changes in MDDD are frequent, but they are rarely accompanied by information to the general practitioner or the community pharmacy.

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TRIAL REGISTRATION: The study was approved by the Danish Data Protection Agency.

Multi-dose drug dispensing (MDDD) signifies that the patient's medicine is packed in one unit, a disposable bag, corresponding to the dose he or she needs to take during the course of one day. Each dose unit bag contains all drugs intended for that dose occasion and is labelled with patient data, drug contents, and date and time of intake.

In Scandinavia, this service is offered as an alternative to ordinary prescription. MDDD is most suited for persons who consistently use several drugs and whose medication is not often changed. Some drugs may not

be supplied as MDDDs, e.g. antibiotics, and most patients are therefore given both MDDD and ordinary prescriptions.

The MDDDs are packed by a machine at a pharmacy specifically authorised by the Danish Medicines Agency to provide automated dose dispensing. The MDDD is administered to the patient's home address by the community pharmacy every two weeks. The patient pays part of the cost of the medicine plus a weekly fee for dose dispensing, currently approx. 8 Euro (60 DKK) and the fee is reimbursable. In Denmark, termination of MDDD requires a prescription with the word "stopped/discontinued"; otherwise, the supply will continue unaltered for a total of two years. The electronic personal medication system (EPM) at the hospitals in the Capital Region allows physicians to issue a prescription that halts MDDD, but a telephone call to the community pharmacy is also required to ensure correct information to the packaging pharmacy.

It has been suggested that MDDD reduces medication errors, increases drug adherence and decreases waste of unused drugs [1], but a health technology assessment (HTA) report from 2005 [2] and other evidence suggest that MDDD can be a challenge when patients are crossing the primary-secondary care interface.

MDDD was launched in Denmark in 2001 and the number of users rose during the following years. By December 2010, 46,500 Danish citizens were receiving MDDD with a large difference in the distribution of MDDD from one municipality to the other. The Capital Region of Denmark is of one of the regions in Denmark that makes most frequent (90/1,000 inhabitants over 74 years of age) use of MDDD. Within the region, the Municipality of Copenhagen is one of the largest MDDD users with a MDDD frequency of 143/1,000 inhabitants over 74 years of age in 2008.

Identifying patients who are receiving MDDD on their admission to hospital may be difficult despite a good medical history, even where it includes information from relatives, home care or nursing home. Some cases may be ultimately identified by looking-up the relevant data in the patient's personal electronic medication profile (PEM) which contains information about prescription medicine purchased by the patient for the preceding two years. By law, access can [3] be obtained

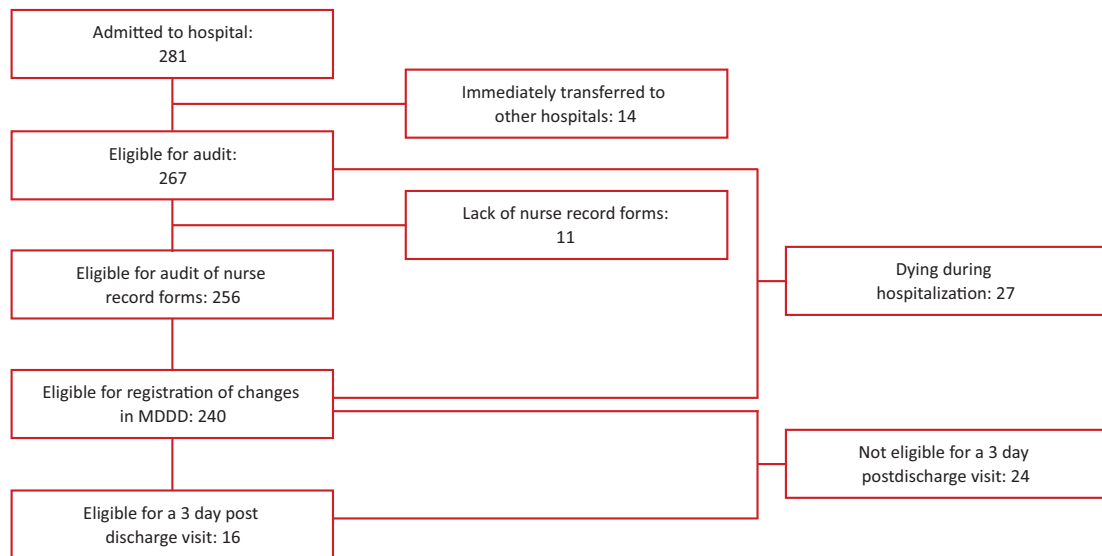
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FIGURE 1

Trial profile.
Data are number of
patients receiving
multi-dose drug
dispensing (MDDD).



by the treating physician without the patient's consent when it is necessary for the current treatment. Such access can also be delegated to an assistant.

In order to be able to identify MDDD patients across the primary-secondary care interface, the Capital Region has issued an instruction on how to identify and handle patients receiving MDDD on admission to hospital, during hospitalization and at discharge. This instruction is accompanied by a cooperation agreement between the municipality of Copenhagen and Bispebjerg and Frederiksberg Hospitals.

However, no research has so far sought to determine to which extent patients admitted to these hospitals are receiving MDDD and how the instruction has been implemented in practice.

Thus, the purpose of the present study was:

- to investigate how many patients are receiving MDDD on admission to hospital and to register to which extent the MDDD instruction was followed,
- to visit a proportion of the patients receiving MDDD after hospitalization to identify potential problems in their handling of MDDD after discharge,
- to interview health-care providers from both sectors to identify potential provider problems with regard to the handling of MDDD.

MATERIAL AND METHODS

All patients receiving MDDD on admission to the receiving medical ward at Bispebjerg Hospital in the period from 1 January to 30 June 2010 were prospectively included in the study:

- An audit of medication lists from patients and nursing homes and from hospital case records was performed.
- A post-discharge visit was made to part of patients.
- A tracer in the form of an interview with the involved health-care providers in both sectors was carried out to determine if the instructions had been implemented and were being followed.

Ultimate MDDD identification was made for all patients by checking their PEM. Patients immediately transferred to other hospitals were not eligible for audit of medication lists records from patients and nursing home, neither from hospital case record forms. Similarly, contact to the delivering primary pharmacy on admission to hospital was not possible for this group of MDDD patients. Furthermore, registration of changes in MDDD medication was not possible for patients who died during hospitalization.

Case records were investigated on admission to the hospital in order to identify whether the hospital had been able to collect all information on MDDD supplementary to PEM identification and medication lists from nursing homes, the patients' homes and the hospital (physician and nurse). Case records were investigated on admission to hospital. It was registered if the delivery of MDDD to the patient's home was actively stopped during hospitalization as stated in the instruction. Changes in MDDD (dose adjustments, discontinuation and analogue substitution) were recorded. Changes were identified by comparing data on MDDD at admission and/or PEM data with MDDD data at discharge. Changes in

MDDD in relation to length of hospital stay, consumption of ordinary prescription drugs and admission to hospitals in the preceding year were also registered. Furthermore, it was registered if the health-care providers at the hospital informed the general practitioner (GP) and or the community pharmacist of any MDDD changes at discharge. Finally, it was audited if patients were offered medicine covering a period of seven days after discharge as recommended in the instruction as community pharmacies are required to deliver new dose unit bags within seven days following discharge.

After giving their consent, part of the patients ≥ 65 years of age (the Health and Care Management only provide services to citizens of such age) who had been included in the period from 15 March to 30 June 2010 were consecutively visited in their homes a maximum of three days after their discharge. This period was chosen for practical reasons. The number of patients was determined by inviting all patients discharged in this period and by including all patients for whom a visit could be carried out a maximum three days after their discharge. The purpose of the post-discharge visit was to reduce any intervention in MDDD by the patients' GPs. The visits were carried out by the municipal project nurse either alone or accompanied by a physician from the project.

Existence of MDDD bags delivered to the patients during hospitalization was recorded. The medication lists issued by the hospital at discharge were compared with the home medication list to estimate agreement regarding MDDD. We also recorded changes in MDDD and the ensuing consequences if the community pharmacy was not informed about these changes at discharge. The consequences were divided into two categories: workflow unsuitable for the actors of the MDDD and medication errors. With regard to medical errors, any potential clinical consequences of medication errors were assessed according to Lisby et al's scale of predefined criteria for potential clinical consequences [4] and validated independently by two project group physicians. In case of disagreement between the two physicians, the category with the lowest potential risk was chosen.

If potential problems were registered, the project nurse would recommend that the health-care provider or the patient contacted the GP.

At Bispebjerg Hospital an interview was done at the receiving medical ward and at another medical ward comprising an interview with five nurses. Furthermore, in the Municipality of Copenhagen two nurses from the Home Care Services and two nurses from two nursing homes were interviewed. The interviews were carried out by three persons from the project group and evaluated by the project group.

Finally all medication errors from Bispebjerg Hospital in a period around the project period (1 June 2009-31 May 2011) were studied to determine if medication errors involving MDDD had been reported.

Statistical analysis

Confidence intervals were calculated using the Confidence Interval Analysis (CIA) software, 2000.

Ethics

The project was approved by the Danish Data Protection Agency but did not require the approval of an ethical committee.

Prior to the project, we obtained permission from the participating Acute medical admissions wards and from the Board of Bispebjerg Hospital.

Patients who received a post-discharge visit gave their informed consent prior to the visit.

The project was supported by the Ministry of Health and Prevention & by Compliance-puljen 2009.

Trial registration: The study was approved by the Danish Data Protection Agency.

RESULTS

Among the 3,245 patients admitted to the Acute medical admissions ward at Bispebjerg Hospital during the study period, 281 patients, equivalent to 8.7% (95% confidence interval (CI): 7.7-9.9%), received MDDD. This corresponds to an average of one or two MDDD patients being seen daily at the receiving medical ward. Fourteen patients were immediately transferred to other hospitals and 27 patients died during hospitalization. This left 240 patients to be followed during hospitalization (**Figure 1**).

Table 1 shows the basic characteristics of the included patients. Almost 62% of the patients were admitted from nursing homes. Fifty percent of the patients had been admitted to hospital in the preceding year and 75% were consuming additional, ordinarily prescribed drugs.

Table 2 presents the results of the audit. Information on MDDD was recorded in the physician case record for 3.4% of patients and in the nurse case record for 12.9% of the patients. Delivery of MDDD to the patient's home was actively stopped during hospitalization for 1.1% (95% CI: 0.4-3.3%) of the patients. Changes in



Multi-dose drug dispensing.
Photo: Niels Falbe.

TABLE 1

Basic characteristics of the included patients.

Age, mean (range), years	80 (24-103)
Age ≥ 65 year-old, n (%)	251 (89)
Females, n (%)	185 (66)
Males, n (%)	96 (34)
Admitted from nursing home, n/N (%; CI)	165/267 (61.8; 55.8-67.4)
Admitted from own home, n/N (%; CI)	102/267 (38.2; 32.6-44.2)
Admitted to hospital in the preceding year, n/N (%; CI)	134/267 (50.2; 44.2-56.1)
Consumption of ordinarily prescribed drugs, n/N (%; CI)	180/240 (75.0; 69.2-80.1)
Length of stay at hospital ≤ 1 day, n/N (%; CI)	59/281 (21.0; 16.6-26.1)

CI = 95% confidence interval.

TABLE 2

Audit of the patients.

	n/N (%; CI)
Information on MDDD recorded in physician case record at the hospital	9/267 (3.4; 1.8-6.3)
Information on MDDD recorded in nurse case record at the hospital	33/256 (12.9; 9.3-17.6)
Delivery of MDDD from the community pharmacy stopped by hospital during hospitalization	3/267 (1.1; 0.4-3.3)
Changes in MDDD during hospitalization	140/240 (58.3; 52.0-64.4)
Discontinuation as a cause of change in MDDD	117/140 (83.6; 76.7-88.8)
Changes in MDDD for patients hospitalized ≤ 1 day	17/59 (28.8; 18.8-41.4)
GP and/or the community pharmacy informed of changes in MDDD at discharge	19/140 (13.6; 8.9-20.2)

CI = 95% confidence interval; GP = general practitioner; MDDD = multi-dose drug dispensing.

MDDD during hospitalization were made for 58.3% (95% CI: 52.0-64.4%) of the patients, among whom 83.6% (95% CI: 76.7-88.8%) had discontinued one or more MDDD drugs. Data not shown. Changes were made for 28.8% (95% CI: 18.8-41.4%) of the patients who were hospitalized for one day or less. The GP and or the community pharmacy were informed of changes in MDDD for 13.6% (95% CI: 8.9-20.2%) of the patients.

Sixteen citizens received a visit a maximum of three days after their discharge, one citizen in his home and 15 citizens at their nursing home. None of the patients had been discharged with medication for seven days. Dose unit bags delivered to the patient during hospitalization were found in 14 of 16 cases (87.5%; 95% CI: 64-97%). Agreement on MDDD information between medication lists from the hospital at discharge and medication lists at home were registered for 8/16 (50.0%; 95% CI: 28.0-72.0%) patients.

Table 3 shows the specific findings recorded at each post-discharge visit. The workflow was found to be unsuitable for the actors of the MDDD in 15 of 16 cases (93.8%; 95% CI: 71.7-98.9%) where patients were visited after discharge. Medication errors with potential clinical consequences were documented in ten of the 16 (62.5%; 95% CI: 38.6-81.5%) patients.

The two interviews revealed large challenges in MDDD handling. At the hospital, the terminology used regarding MDDD was inconsistent which led to problems with the distinction between, e.g. "MDDD" and "medicine in a dosage package". Furthermore, the health-care providers assessed that compliance with the instruction on MDDD (contact to the community pharmacy, dispensation of drugs at discharge covering a period of seven days, as well as information of MDDD to the patients) raised work load at discharge.

Similarly, the municipal health-care workers stressed the increased work load caused by MDDD (contact to the citizen's GP) when patients were discharged from hospital.

Five medication errors involving MDDD were revealed at Bispebjerg Hospital.

DISCUSSION

The study shows that MDDD was frequent as almost 9% of the patients received MDDD on admission. Information on MDDD was recorded in the nurse case record for 12.9% of the patients and in the physician case record for 3.4% of the patients. This shows that identification and registration of MDDD only occurred sporadically. Changes in MDDD were frequent, even in cases with a short length of stay at hospital, especially discontinuations which resulted in continued delivery of the drugs meant to be discontinued. This created potentially dangerous situations for patients.

Changes in MDDD were rarely accompanied by information to the GP or community pharmacies. More than half of the patients had been admitted to hospital in the preceding year and most were consuming ordinarily prescribed drugs in addition to their MDDD. This begs the question if MDDD was a well-suited measure in these patients. The post-discharge visits demonstrated both the negative workflow effects for the staff supplying MDDD and potential issues regarding patient safety.

We limited ourselves to recording the observations made and avoided any intervention with the exception of one case in which a patient had been admitted three times in four months due to lithium intoxication caused by undiscovered MDDD [5].

Although it is well-known that medication errors can arise at the interface between hospital and primary care [6, 7], this study shows that MDDD can be another, previously undescribed, cause of medication error across the primary-secondary care interface. Likewise, we identified only five medication errors involving MDDD.

CONCLUSION

MDDD can be suited for persons who consistently use several drugs and whose medication is not changed very



TABLE 3

Findings from the 16 post-discharge visits.

Diagnosis	Changes in MDDD – or new prescriptions – during hospitalisation	Consequences that arose because the community pharmacy was not informed of MDDD changes at discharge	Consequences ^a
1. Deep vein thrombosis	Discontinuation of zolpidem during hospitalisation	Continued supply of zolpidem	1 and 2b
2. Fall at home and hypercalcaemia	Discontinuation of vitamin D and calcium	Continued supply of the two drugs	1 and 2b
3. Heart failure and second-degree atrio-ventricular block and pacemaker	Increasing the dose of furosemide and potassium and discontinuation of metoprolol	No increase in dose of furosemide and potassium and continued supply of metoprolol	1 and 2a
4. Fall at home	Analogue substitution of lansoprazole to pantoprazole	Continued supply of lansoprazole	1
5. Urinary tract infection and geriatric evaluation	Increased dose of vitamins and minerals	No increase in the dose of the two drugs	1
6. Fall at home	Discontinuation of bendroflumethiazide, zopiclone and tramadol	Continued supply of the three drugs	1 and 2b
7. Heart failure and lung oedema	No changes in MDDD New prescription of furosemide and potassium	1	
8. Unknown infection and dehydration	Decrease in the dose of furosemid and potassium	No decrease in the dose of the two drugs	1 and 2a
9. Urinary tract infection	Discontinuation of escitalopram	Continued supply of escitalopram	1 and 2b
10. Severe depression and chronic obstructive lung disease	Decrease in the dose of lamotrigin Discontinuation of mirtazapine	No decrease in the dose of lamotrigin and continued supply of mirtazapine	1 and 2b
11. Anaemia (bleeding)	Discontinuation of low-dose acetylsalicylic acid and zolpidem and acetaminophen New prescription of iron and Asasantin Retard	Continued supply of acetylsalicylic acid, zolpidem and acetaminophen	1 and 2a
12. Urinary tract infection and dehydration	No changes in MDDD New prescription of haloperidol		1
13. Gastrointestinal bleeding	Discontinuation of low dose acetylsalicylic acid New prescription of potassium and pantoprazole	Continued supply of low dose acetylsalicylic acid	1 and 2a
14. Hypertension	No changes in MDDD New prescription of amlodipine	1	
15. Urinary tract infection	No changes in MDDD Disagreement between on the schedule for drug intake for MDDD during the day	0	
16. Hypotension, heart failure	Discontinuation of enalapril and decrease in dose of digoxin	Continued supply of enalapril and no decrease in dose of digoxin	1 and 2a

MDDD = multi-dose drug dispensing.

a) 0 = no consequences;

1 = workflow unsuitable for the actors of MDDD; 2 = medication errors and potential clinical consequences;

2a = potentially serious; 2b = potentially significant.

often. Across the primary-secondary care interface MDDD can give rise to patient safety issues and cause an unnecessary increase in the work load of the health-care workers handling the patient. Consequently, the present study should give rise to a reassessment of how MDDD is handled when a citizen receiving MDDD is admitted to hospital.

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