One-Stop Dispensing: Hospital costs and patient perspectives on self-administration of medication

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Abstract: 1) Objective: To assess staff time and hospital medication costs between One-Stop Dispensing (OSD) and the Traditional Medication System (TMS), and to evaluate patient perspectives on OSD. 2) Methods: The study was conducted at Hvidovre Hospital, University of Copenhagen, Denmark in an elective gastric surgery and acute orthopedic surgery department. The study was designed as an intervention study with a historical control group receiving TMS. The intervention group included adult patients able to self-administer medication. Time measurements included time used by nurses and pharmacy staff to dispense and administer medication as well as medication dialogue. Medication costs with two days of discharge medication were compared between OSD and TMS. Patient satisfaction related to OSD was evaluated by a questionnaire based on a five-point Likert scale ('very poor' (1) to 'very good' (5)). 3) Results: Seventy-eight elective and 70 acute patients were included. Compared with TMS, OSD significantly reduced used staff time by an average of 12 minutes (P< 0.0001) per patient per hospitalization. Overall, there was no significant increase in medication cost per patient for OSD (1.68 € [CI 95 -0.51 — 3.87]) (P=0.13). Mean scores for the OSD satisfaction questionnaire ranged from 4.3—4.8. OSD was associated with significantly lower used staff time. 4) Conclusion: Staff time in OSD was significantly lower, there were no differences in medication costs and the patients were overall satisfied with OSD.

Keywords: One-Stop Dispensing; Medication System; Self Medication; Self Administration; Patient Medication Knowledge; Patient Satisfaction; Pharmacy Service, Hospital; Workload; Patient involvement.

1. Introduction

Medication errors occur in half of all hospitalized patients and can be associated with adverse drug events [1,2]. Common reasons for medication errors include incomplete medication history [3-6], mistakes when dispensing or administering medication [7,8], suboptimal discharge processes [9,10], and lack of patient medication information at discharge [11,12]. These challenges must be...
addressed by future medication systems, and the solutions must be feasible for both existing and newly built hospitals.

In the Traditional Medication System (TMS), medication is dispensed and administered manually by hospital staff on the wards. Medications are dispensed from large original containers into a cup and manually transported to the patient in a trolley. Various ward-based and hospital centralized systems for packing, dispensing and administering medication are used internationally without patient involvement. Examples included computer-controlled automated dispensing cabinets [13] and automated dose dispensing, where medication is machine-packed into patient-specific bags [14]. However, a new approach is to increase patient involvement in the system [15–17]. Patients are likely to know about their own medications used prior to hospitalization, and allowing patients to continue administering their own medication when hospitalized is suggested to could prevent disruption of daily practices and may reduce medication errors [15,18,19]. A systematic literature review found significant improvement in patients’ medication knowledge and compliance when medication was self-administered [20]. However, findings on used staff time, patient satisfaction and medication costs are inconsistent [20].

One-Stop Dispensing (OSD) is a bedside medication system in which patient involvement is an essential component [16,17]. In OSD, patients’ own medication (POM) is used during hospitalization and the patients self-administer the medication when assessed to be safe. Patients are continuously informed and trained in how to manage their own medication during hospitalization and at discharge [16,17]. However, there is a lack of knowledge about hospital cost and patients’ perspectives on OSD for elective and acutely hospitalized patients. OSD has previously never been studied in a Danish context.

The objectives of this study were: (1) to compare total nurse and pharmacy staff time to dispense medication, administer medication and dialogue with patients about their medication in OSD and TMS; (2) to compare hospital medication costs in OSD and TMS (3); and to study patient perspectives on OSD, self-administration of medication and use of POM.

2. Materials and Methods

2.1. Ethics Approval

The study was approved by the Danish Capital Region’s Data Protection Agency (j.no. RAP2014-003). Patients included in the intervention signed a written informed consent at inclusion, while the control group receiving TMS was part of routine quality assurance corresponding to a Zelen randomization procedure [21].

All observations of staff were also performed in accordance with the Helsinki Declaration. The head nurse and head pharmacist received written and verbal information about the study and approved it prior to its start. All nursing and pharmacy staff involved in the study were provided with written and verbal information during at least two staff meetings. The staff was informed that participation was voluntary and they could withdraw from the study at any time. All data was anonymized before any analysis, and no personal data about the observed staff was collected.

2.2. Setting

This study was performed at an elective gastric surgery (elective) ward and an acute orthopedic surgery ward (acute) at Hvidovre Hospital, University of Copenhagen, Denmark. The elective ward
treats lower gastrointestinal diseases with surgery and medication in a 22-bed unit. The acute ward performs non-traumatic lower limb amputations, minor surgery and pain management in a 26-bed unit.

2.3. Design and Patients

This study was designed as an intervention study with a historical control group (TMS group). Data regarding hospital costs and patient perspectives was collected in two different sub-studies. In the first sub-study, staff time and medication costs were compared between OSD and TMS. Staff time used in OSD was compared to simulated TMS time use for the same patients. Likewise, medication cost for OSD was compared to simulated TMS costs. In the second sub-study, patient perspectives on OSD were assessed by questionnaire.

In the first sub-study, data for the TMS group was collected from both wards in February 2015 and for the OSD group was collected from April to June 2015. Data for the second sub-study was collected from September 2015 to November 2015. Inclusion criteria for OSD patients in both: age ≥18 years. Exclusion criteria were: inability to self-administer medication prior to admission, inability to understand Danish, history of medication abuse, terminal disease, suicidal ideation, isolation, and use of patient-specific automated packed medication prior to hospitalization (a uni-dose medication packing service sold by primary Danish pharmacies). Information about exclusion criteria was collected from patient records and patient interviews. Patients were excluded if there was any doubt about meeting the exclusion criteria.

Pharmacy staff recruited patients at both wards. Elective patients were recruited during an initial interview before hospitalization, while acute patients were recruited directly upon admission.

2.4. Intervention

Patient lists for both wards were screened for potential OSD participants by pharmacy staff. Elective patients were asked to bring their own medication in original containers prior to hospital admission, while acute patients were asked to bring their own medication within 24 hours after admission. Upon inclusion, pharmacy staff recorded an updated medication history for all patients and conducted quality control of POM in accordance with the criteria described by Nielsen et al. [22]. In case of discrepancies between the recorded medication history and the patient’s electronic medication record, a physician performed medication reconciliation. Pharmacy staff checked each patient’s ability to self-administer medication based on criteria from Edelberg et al. [23]. Patient’s ability to identify, access, dosage and time their own medication was reviewed and approved by pharmacy staff. A senior nurse or physician evaluated each patient’s cognitive function with regards to their ability to self-administer during hospitalization. If cognitive function was decreased during hospitalization, e.g. due to surgery or pain, the patient was excluded.

Patients began to self-administer medication from the first day after surgery. Self-administration of medications included both POM for chronic conditions and medication prescribed during hospitalization (e.g. proton pump inhibitors, analgesics, and antibiotics). Pharmacy staff distributed the smallest available original containers and resupplied POM when necessary. Each patient received a medication list including indication, dosage, and duration of treatment for each medication at day one or after any prescription changes. All medication included in OSD were stored in a lockable bedside locker accessible to patients at all times. Medications
prescribed “as needed” during hospital admission or stored in a refrigerator were still administrated by the staff. The TMS group received standard care as described previously.

One-Stop Dispensing from day 2 to discharge

Patients included in OSD were attended to by nursing or pharmacy staff on ward rounds. The patients’ medications were continually supplied, and prescriptions were updated when necessary. If dosages of any self-administered medication were changed containers were re-labeled. Medication changes were systematically reviewed with patients and supported with an updated medication list. Patients were encouraged to ask questions about their medication during hospitalization. At discharge, patients received an updated medication list after a physician, in cooperation with pharmacy staff, conducted medication reconciliation. Patients were discharged with at least ten days’ supply of all current medications, including both chronic conditions and acute conditions acquired during hospitalization.

2.4. Data collection and calculation

Descriptive data regarding patient characteristics was collected from patient records. This data included age, sex, number of medications before hospitalization, number of medications dispensed per day during hospitalization, and length of hospitalization.

Time measurements and procedure for nursing and pharmacy staff

Time measurements in TMS and OSD was performed with a stopwatch by an observer between 06:30 — 23:30 during five consecutive days.

In the TMS group we measured all staff time to dispense and administer medication as well as time to dialogue with the patient about their medication. At the elective ward, these medication processes were always performed by nursing staff. At the acute ward, the medication processes was performed by pharmacy staff between 07:00 — 14:00 Monday to Friday and nursing staff the rest of the time. Time measurements for TMS included all medications except of “as needed” medication and intravenous formulations. Medications at the hospital were as standard given at 8:00; 12:00; 17:00 and 22:00. Staff time used to administer medication was only measured for patients who according to the electronic patient journal were able to self-administer medication prior to admission.

The OSD time measurements also entailed all staff time used to dispense and administer medication and daily dialogue with the patient about their medication. The dispensing process included quality check of POM, labeling, print of medicine list and supplying bedside lockers with medication. The administration process included checking of patient’s ability to self-administer. At both wards pharmacy staff was in charge of medication processes related to OSD between 08:00 — 15:00 Monday to Friday, while nursing staff covered these responsibilities at all other times. “As needed” medication and intravenous formulations were not at part of the OSD system and were not included in the measurements.

For both TMS and OSD medication was available at the wards in a medication room. Ordering and refilling the medication room was not included in the time measurements. At all time-measurements, the time was paused if staff was interrupted by events not related to the specific process. Finally, in the time measurement for both TMS and OSD, we also included nursing staff time used on medication dialogue with patients while pharmacy staff was on the ward. Staff time
used for OSD was compared to simulated TMS time used for the same patients on an individual patient level. Staff time used to dispense and administer medication in the TMS group was used in the simulation calculations and number of medication dispensed per day during hospitalization and length of stay was also taken into account.

Medication cost
Pharmacy staff recorded all medications dispensed and used by patients during hospitalization. Medication costs in OSD and TMS were calculated individually for each patient based on the hospital pharmacy’s medication prices. Medications in TMS normally cover 2 days after discharge, while medications in OSD can cover weeks after discharge depending on medication container size and duration of treatment [16,17]. Costs for OSD were calculated in four ways: total costs during hospitalization plus two days after discharge with and without nutritional supplements, and total costs during hospitalization plus ten days after discharge with and without nutritional supplements. Calculations with ten days of discharge medication were performed to explore the cost of this service improvement.

Patient perspectives and satisfaction
Patient’s perspectives and satisfaction related to OSD were assessed by a questionnaire in the second sub-study. The questions were related to use POM, bedside lockers, medication containers, medication information, responsibility of self-administration, handling of medication after discharge, and ability to self-administer medication at future hospitalization.

The design of the questionnaire was based on 1) literature exploring patient perspectives on OSD, self-administration of medication, and use of POM [24–26], and 2) thematic analysis of 35 telephone interviews with OSD patients (unpublished feasibility study). The questionnaire was pretested for reliability and validity by using a convenience sample of 12 patients. At discharge, patients were asked to fill in the ten item questionnaire. A five-point Likert scale ranging from ‘very poor’ (1) to ‘very good’ (5) was used to assess eight items, while two questions could be answered with ‘yes’ or ‘no’. ‘Do not know’ was an acceptable answer for all questions.

2.5. Statistics
Chi-square test was used for statistical comparisons between sexes. Two-sided Mann-Whitney test was used to compare median values between age, number of medication before hospitalization, number of medication dispensed per day during hospitalization, and length of hospitalization. Unpaired t-test was used to compare staff time in the medications process during hospitalization for OSD and TMS as well as medication costs between OSD and TMS. The main outcome for the staff time was OSD compared to TMS based on pooled data from elective and acute patients. In addition, the main outcome for medication cost was OSD with two days of discharge medication without nutritional supplements compared with TMS also based on pooled data from elective and acute patients. All analyses were performed with pooled data from both wards and individually for elective and acute patients. Answers to Likert scale questions are presented in percentages and mean values. IBM SPSS Statistics 22.0 (IBM, Armonk, NY, USA) was used for all statistical analyses. A p-value of <0.05 (two-sided) was considered to be statistically significant.
3. Results

Inability to self-administer medication prior to admission was the primary reason for exclusion among both elective (45%) and acute (54%) patients (Figure 1). A total of 148 patients participated in the OSD intervention – 78 from the elective ward and 70 from the acute ward. Combined patient characteristics for both sub-studies are presented in Table 1. No differences were found in patient characteristics between the first and second sub-study for elective (all \( p \geq 0.10 \)) or acute patients (all \( p \geq 0.11 \)). Eighty-seven patients were included in the TSM group comprising, 31 patients from the elective ward and 56 patients from the acute ward.

Total staff time used per patient in OSD during hospitalization was significantly lower (\( P<0.0001 \)) in both wards compared to TMS (Table 2). On average, time spent per patient in OSD was 12 minutes lower for the combined group of elective and acute patients. Time spent by staff per medication dispensation in TMS was on average 0.70±0.13 (\( n=651 \)) and 0.57±0.10 minutes (\( n=1896 \)) in the elective ward and acute ward, respectively. The administration process of medication in TMS took on average 0.34±0.09 (\( n=151 \)) and 0.27±0.07 (\( n=281 \)) minutes per patient per administration time for patients in the elective ward and acute ward, respectively.

Overall, no difference (\( P=0.13 \)) was found in medication costs between OSD patients with two days of discharge medication without nutritional supply compared to TMS (Table 3). In OSD, there was a mean additional cost per patient of 1.68 € (CI 95: -0.51 — 3.87). Of all medications used prior to hospitalization, POMs accounted for 87% of items in elective patients’ and 67% in acute patients.

Patients perspectives related to OSD are given in Table 4. Mean scores for the eight questionnaire items ranged from 4.3 to 4.8. In addition, 39% of elective patients and 50% of acute patients answered that OSD had improved handling of their own medications after discharge. Eighty-seven percent of acute patients and 78% of elective patients wished to receive information about their medication from pharmacy staff in the future.
3.1 Figures, Tables and Schemes

Figure 1. Flowchart of inclusion of OSD patients in the study (total N= 148). Elective patients on the left side of the slash and acute patients on the right side marked with bold font.

- Patients fulfilling the inclusion criteria
  (Sub-study one 120/218; Sub-study two 150/186)

  - Excluded: (Sub-study one 69/162; Sub-study two 95/139)
    - Not able to understand/speak Danish
      (Sub-study one 7/15; Sub-study two 10/16)
    - Not able to self-administrate medication prior to admission (Sub-study one 55/117; Sub-study two 67/100)
    - Patients using primary care patient-specific automated dose dispensed medication (Sub-study one 3/8; Sub-study two 6/8)
    - Isolation required (Sub-study one 4/13; Sub-study two 7/8)
    - Terminal diseases (Sub-study one 0/4; Sub-study two 4/3)
    - Suicidal patient (Sub-study one 0/1; Sub-study two 0/2)
    - Earlier abuse of medication (Sub-study one 0/4; Sub-study two 1/2)

- Eligible patients
  (Sub-study one 51/56; Sub-study two 55/47)

  - Declined to participate
    (Sub-study one 9/15; Sub-study two 14/15)

- Granted approval
  (Sub-study one 42/37; Sub-study two 41/32)

  - Not cognitively able to self-administrate during hospitalization (Sub-study one 0/1; Sub-study two 1/2)

- Analysed
  (Sub-study one 42/36; Sub-study two 40/30)
Table 1. Patient characteristics, represented as median values with range (minimum-maximum).

<table>
<thead>
<tr>
<th></th>
<th>TMS</th>
<th>OSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elective (n=31)</td>
<td>Acute (n=56)</td>
</tr>
<tr>
<td>Age, years</td>
<td>50 (23-84)</td>
<td>60 (29-94)</td>
</tr>
<tr>
<td>Female sex, n (%)</td>
<td>21 (68)</td>
<td>34 (60)</td>
</tr>
<tr>
<td>Medications before hospitalization</td>
<td>3 (0-9)</td>
<td>4 (0-9)</td>
</tr>
<tr>
<td>Medication dispensed/day during hospitalization</td>
<td>14 (7-22)</td>
<td>18 (4-26)</td>
</tr>
<tr>
<td>Length of stay, days</td>
<td>3 (1-9)</td>
<td>5 (2-13)</td>
</tr>
</tbody>
</table>

TMS Traditional Meditation System, OSD One Stop Dispensing
Table 2. Staff used in medication processes compared between OSD and TMS, represented as mean values (minutes) with SD.

<table>
<thead>
<tr>
<th></th>
<th>Combined</th>
<th>Elective</th>
<th>Acute</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TMS</strong></td>
<td>(n=87)</td>
<td>(n=31)</td>
<td>(n=56)</td>
</tr>
<tr>
<td>Time to dispense and administer medication to each patient per day</td>
<td>16.2±6.61</td>
<td>14.1±6.40</td>
<td>17.2±6.72</td>
</tr>
<tr>
<td><strong>OSD</strong></td>
<td>(n=24)</td>
<td>(n=11)</td>
<td>(n=13)</td>
</tr>
<tr>
<td>Start of OSD, day 1 per patient</td>
<td>12.8±4.35</td>
<td>12.2±4.41</td>
<td>13.1±4.32</td>
</tr>
<tr>
<td>Daily continuation of OSD on day 2 per patient</td>
<td>5.75±1.66</td>
<td>5.03±2.02</td>
<td>6.11±1.43</td>
</tr>
</tbody>
</table>

**Comparison of TMS and OSD**

<table>
<thead>
<tr>
<th></th>
<th>Combined</th>
<th>Elective</th>
<th>Acute</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMS time per patient during hospitalization</td>
<td>42.8±28.5</td>
<td>34.3±22.5</td>
<td>46.8±31.3</td>
</tr>
<tr>
<td>OSD time per patient during hospitalization</td>
<td>30.7±11.8</td>
<td>24.4±7.87</td>
<td>33.7±13.5</td>
</tr>
<tr>
<td>P-values, comparison of TMS and OSD</td>
<td>P&lt;0.0001</td>
<td>P&lt;0.0001</td>
<td>P&lt;0.0001</td>
</tr>
</tbody>
</table>

Combined, represent pooled data of elective and acute patients.
*TMS Traditional Meditation System, OSD One Stop Dispensing*
Table 3. Additional medication cost per patient for OSD compared to TMS, represented as mean differences±SD (95 % confidence interval).

<table>
<thead>
<tr>
<th></th>
<th>Combined (n=82)</th>
<th>Elective (n=42)</th>
<th>Acute (n=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>During hospitalization and 2 days after discharge without nutritional supply</td>
<td>€ 1.68±9.97 (-0.51;3.87) P=0.13</td>
<td>€ 1.21±10.8 (-2.16;4.58) P=0.49</td>
<td>€ 2.17±8.43 (-0.53;4.87) P=0.104</td>
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<tr>
<td>During hospitalization and 2 days after discharge</td>
<td>€ 2.24±9.59 (0.13;4.35) P=0.044</td>
<td>€ 1.91±9.67 (-1.10;4.92) P=0.22</td>
<td>€ 2.60±9.51 (-0.44;5.64) P=0.084</td>
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<tr>
<td>During hospitalization and 10 days after discharge without nutritional supply</td>
<td>€ 2.59±9.83 (0.46;4.72) P=0.017</td>
<td>€ 1.23±10.8 (-2.14;4.59) P=0.47</td>
<td>€ 4.01±8.70 (1.23;6.79) P=0.004</td>
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<tr>
<td>During hospitalization and 10 days after discharge</td>
<td>€ 3.15±9.66 (1.02;5.27) P=0.003</td>
<td>€ 1.93±9.64 (-1.07;4.93) P=0.21</td>
<td>€ 4.44±9.69 (1.31;7.54) P=0.005</td>
</tr>
</tbody>
</table>

Combined (n=82) represent pooled data of elective (n=42) and acute (n=40) patients.
Table 4. Patient perspectives on OSD. Percentages of respondents answering on Likert scale questions.

<table>
<thead>
<tr>
<th>Items</th>
<th>Very good</th>
<th>Good</th>
<th>Uncertain</th>
<th>Poor</th>
<th>Very poor</th>
<th>Do not Know</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elective (n=36)</td>
<td>Acute (n=30)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction with using POM</td>
<td>46</td>
<td>46</td>
<td>23</td>
<td>8</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>Satisfaction with bedside locker</td>
<td>50</td>
<td>10</td>
<td>18</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Satisfaction with medication in original containers</td>
<td>56</td>
<td>77</td>
<td>27</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Satisfaction with responsibility for SAM</td>
<td>50</td>
<td>70</td>
<td>33</td>
<td>23</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Safety with responsibility for SAM</td>
<td>56</td>
<td>60</td>
<td>33</td>
<td>33</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Satisfaction with medication information during hospitalization</td>
<td>50</td>
<td>57</td>
<td>33</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Satisfaction with medication information at discharge</td>
<td>50</td>
<td>57</td>
<td>33</td>
<td>26</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Advantage with medication to 10 days at discharge</td>
<td>67</td>
<td>76</td>
<td>27</td>
<td>17</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

POM Patients Own Medication, SAM Self-Administration of Medication
4. Discussion

Our study shows that staff time used in medication processes was significantly lower in OSD compared to TMS. We found no significant difference in medication cost for OSD with two days discharge medication without nutritional supply compared to TMS. Patients in OSD rated the system with an overall high average score of satisfaction and safety.

We found that OSD significantly reduced staff time by an average of 12 minutes per patient per hospitalization. Results from other studies are vary [27–30], but is too difficult directly compare results due to differences between patient groups, setups and methodology. We found that it took staff 0.57 — 0.70 minutes to dispense one medication in TMS, which is consistent with findings by Buck et al. in a geriatric ward [31]. We found that from day two of OSD to discharge, hospital staff spent an average of 5 — 6 minutes per patient per day. This result is in contrast to Grantham et al, which found that staff used 20 minutes per patient per day for ongoing assessment and education.

However, patients in Grantham et al. were in a Nursing Convalescent Unit with mean age of 68 years, so these patients may have needed more support to handle their own medications compared with patients in our study [27].

Overall, we found medication cost in OSD insignificantly higher, 1.68 € (CI 95 -0.51—3.87). € per patient, for the patients with 2 days of discharge medication without nutritional supply compared to TMS. Discharge with 10 days with medication and/or nutritional supply resulted in additional costs in OSD compared to TMS. Finally, we observed a tendency for an additional cost in OSD for acute patients compared to elective patients. The literature provides contradicting results about how use of patients own medication and elements of OSD affects hospital medication costs [30,32–34]. Possible reasons for different findings in medication costs between studies can be explained by differences in medication cost among groups of patients, different access to patients own medication or different amount of medication waste between groups’ patient and setups. Stable medication therapy results in less medication waste [23].

In our setting, the POMs were provided for 87% of all prescribed medication in elective patients and 67 % for acutely hospitalized patients. Nielsen et al found that 59 % of all patients in the emergency department independently brought their own medications to the hospital [22]. In the United Kingdom, a “green bag scheme” encourages all patients and ambulance staff to bring POM to the hospital [16,17]. Implementation of a similar scheme in Denmark could increase the number of medications provided by patients. Lastly, medication prices in Denmark are currently only negotiated for medications in large package sizes, but price negotiations for medications in all package sizes will support the full economic potential of the OSD intervention.

In this study, we found a high average score for patient perspectives on satisfaction, safety and responsibility related to OSD. Similar results have been found among patients who self-administer medication in other studies [25,27,30,35,36]. However, our findings are in contrast to a study from the United Kingdom by Tan et al, in which 19 % of participants were dissatisfied with the concept. The main reason for the dissatisfaction in that study was difficulty with bedside lockers [37]. Some patients in our study reported similar problems, with six percent of elective patients rating “poor” satisfaction with bedside lockers. We believe that three findings from our patient questionnaire are particularly important for designing future medication systems: first, 93 — 94 % of patients were satisfied with the responsibility of self-administering their own medication; second, 83 — 93 % of patients were satisfied with medication information; third, 39 — 50 % of patients found the system
had improved handling of their own medications after discharge. Given these patient reports, implementing OSD on hospital wards has the potential to increase patient knowledge, compliance and quality of medication histories across sectors, as well as reduce medication errors. Taken together, our findings indicate that OSD with self-administration of POM can improve patient care and reduce staff time used in medication processes, in both elective and acute hospitalized patients, despite small increases in medication cost. Considering the potential costs saved by reduced staff time, OSD could potentially even reduce total hospital costs. This element is central because self-administration of medication must reduce hospital costs and/or improve health outcomes in order to be used broadly in daily hospital practice. An example of improved health outcome by self-administration of medication is reduced pain identity in orthopedic patients who self-controlled analgesics [38].

The primary strength of our study is that it was conducted under daily context-specific conditions in both an acute and elective hospital ward. Time measurements from both departments show that medication dispensing and administration in the hospital is a time-consuming process. However, one limitations of our study is that we did not consider medications prescribed “as needed”, or medication given at discharge. Several studies have previously shown that OSD reduces staff time at discharge [16,27], but we did not include this analysis in our study. We also did not investigate patients’ perspectives on TMS or staff perspectives, which should both be considered in comparison to OSD. Another important limitation of the study is in our study design, in which we compare OSD in an intervention group with TMS in a historical control group. Using a historical control group increases the risk of biased results caused by other changes in the department in the time between the data collection time points, though we did not observe any organizational changes in the time period. A third limitation is that our study has not been powered to show a difference in medication cost between medication systems on a ward level. Differences in hospital costs between countries due to medication pricing, subsidies and dosing guidelines should also be considered. Finally, we do not know the possible long term effects of OSD and its impact on medication errors, compliance, treatment effect and health. In the future, these outcomes must be measured in randomized controlled trials in different patient groups, particularly in patients receiving polypharmacy.

5. Conclusions

Staff time to dispense medication, administer medication and dialogue with patients about their medication was significantly lower in OSD compared to TMS. This study found no significant differences in medication cost per patient in OSD compared to TMS. Patients rated OSD with an overall high average score of satisfaction and safety.

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