


# Implementation of medication reconciliation at admission and discharge in Ministry of Defense Health Services hospitals: a multicentre study

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## ABSTRACT

There is potential for many medication errors to occur due to the complex medication use process. The medication reconciliation process can significantly lower the incidence of medication errors that may arise from an incomplete or inaccurate medication history as well as reductions in length of hospital stay, patients' readmissions and lower healthcare costs.

The quality improvement collaborative project was conducted as a pilot study in two hospitals, then implemented on a broader scale in 18 hospitals in Saudi Arabia. The goal of the project was to reduce the percentage of patients with at least one outstanding unintentional discrepancy at admission by 50%, over 16-month period (July 2020–November 2021). Our interventions were based on the High 5's project medication reconciliation WHO, and Medications at Transitions and Clinical Handoffs toolkit for medication reconciliation by Agency for Healthcare Research and Quality. Improvement teams used the Institute of Healthcare Improvement's (IHI's) Model for improvement as a tool for testing and implementing changes. Collaboration and learning between hospitals were facilitated by conducting learning sessions using the IHI's Collaborative Model for Achieving Breakthrough Improvement. The improvement teams underwent three cycles.

By the end of the project significant improvements were observed. The percentage of patients with at least one outstanding unintentional discrepancy at admission showed a 20% reduction (27% before, 7% after;  $p$  value  $<0.05$ ) (Relative Risk (RR) 0.74) with a mean reduction in the number of discrepancies per patient by 0.74. The percentage of patients with at least one outstanding unintentional discrepancy at discharge showed 12% reduction (17% before, 5% after;  $p$  value  $<0.05$ ) (RR 0.71) with a mean reduction in the number of discrepancies per patient by 0.34.

Compliance to medication reconciliation documentation within 24 hours of admission and discharge showed significant improvement by an average of 17% and 24%, respectively. Additionally, the implementation of medication reconciliation had a negative correlation with the percentage of patients with at least one outstanding unintentional discrepancy at admission and discharge.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ An effective medication reconciliation process can significantly lower the incidence of medication errors that may arise from an incomplete or inaccurate medication history.

## WHAT THIS STUDY ADDS

⇒ One of the project's significant strengths is the implementation across multiple hospitals with different populations, sizes and levels of leadership and team engagement. In addition, most of the enrolled hospitals achieved the target percentage for reconciliations that were successfully completed.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ By the end of the project significant improvements were observed. The percentage of patients with at least one outstanding unintentional discrepancy at admission showed a 20% reduction (27% before, 7% after;  $p$  value  $<0.05$ ) (RR 0.74) with a mean reduction in the number of discrepancies per patient by 0.74. This study presents an opportunity for hospitals to draw on strengths of member hospitals who might have access to different resources. It helps to also create a realistic comparative environment.

## PROBLEM

The purpose of this study was to evaluate the activities related to compliance with the implementation of medication reconciliation at admission and discharge of a group of hospitals within the Ministry of Defense Health Services (MODHS). The study was aimed at reducing the percentage of patients with at least one outstanding unintentional discrepancy at admission by 50%, between July 2020 and November 2021. The secondary objective was to study the effectiveness of different interventional strategies used by the participating 18 MODHS hospitals for the implementation of medication reconciliation.

As a result of an inaccurate or incomplete medication history, it is widely known that a thorough medication reconciliation process can significantly lower the incidence of medication errors.<sup>1,2</sup> The Institute of Healthcare Improvement (IHI) initiative concluded that preventing adverse drug events (ADEs) is the underlying reason for the medication reconciliation process.<sup>3</sup> The WHO High 5's project in Australian hospitals, through implementing a sustainable medication reconciliation process, achieved measurable and sustainable improvements in the accuracy of medication information on admission, reducing the potential for medication-related adverse events and harm. The mean number of unintentional and undocumented intentional medication discrepancies per patient decreased from 0.21 to 0.16 and 0.34 to 0.08, respectively. Unintentional discrepancies decreased from 15.2% to 11.1%.<sup>4</sup> In one study, a series of interventions, including medication reconciliation, introduced over a 7-month period, successfully decreased the rate of medication errors by 70% and reduced ADEs by over 15%.<sup>5</sup> Moreover, there is a growing body of evidence that the implementation of medication reconciliation results in reductions in length of hospital stay, patients' readmission and can lower healthcare cost.<sup>1</sup> A package of discharge services including medication reconciliation reduced hospital usage within 30 days of discharge.<sup>6</sup>

The central goal of this project was preventing harm from medication errors. Medication reconciliation is a key component in reducing medication errors and to preventing ADEs.<sup>7</sup> Several international organisations, including the WHO, Joint Commission International (JCI), the Institute for Safe Medication Practices (ISMP)

and the IHI have campaigned to increase the focus on accurate information transfer at all transitions in care.

A pilot study was conducted in two MODHS hospitals; Madinah and Dhahran (AB), in 2019. The baseline percentage of implementation of medication reconciliation at admission and discharge varied from 0% to 10% and 0% to 85%, respectively. The baseline mean number of outstanding unintentional discrepancies per patient at admission and discharge varied from 1.4 to 3.5 and 1.3 to 4, respectively. The pilot study showed that the medication reconciliation implementation at admission and discharge had a negative correlation with the mean number of outstanding unintentional discrepancies per patient (ie, the meaningful implementation of a medication reconciliation process at these transitions in care has been shown to positively affect patient outcomes).

The project was implemented at a broader scale in 18 Saudi hospitals under the General Directorate of Health Services, a governmental healthcare system that provides integrated healthcare services to the Ministry of Defense (MOD) employees and their dependents. The project included 18 governmental hospitals with a cumulative 5666 beds across 15 cities, including Madinah, Dhahran, Riyadh, Jubail, Najran, Wadi Aldawasir, Taif, Tabuk, Jizan, Alkharj, Jeddah, Hafer Albatin, Khamis Mushait and Sharurah. Table 1 describes the location and number of beds for the enrolled hospitals. The leadership of the General Directorate of Health Services identified medication reconciliation as a priority for measurement and improvement in early 2019, as part of the national vision realisation programme and MOD transformation programme. An enterprise-wide improvement project

**Table 1** Details of hospitals enrolled in the project

Hospital	City	Location	Ownership	Beds (n)
A	Madina (Pilot 1)	Urban	Governmental	90
B	Dhahran (AB) (Pilot 2)	Suburban	Governmental	222
C	Riyadh (1)	Urban	Governmental	1606
D	Jubail	Urban	Governmental	118
E	Najran	Urban	Governmental	100
F	Riyadh (2)	Urban	Governmental	186
G	Wadi Aldawasir	Suburban	Governmental	105
H	Taif (AB)	Urban	Governmental	110
I	Tabuk	Urban	Governmental	542
J	Dhahran	Suburban	Governmental	335
K	Taif (M)	Urban	Governmental	116
L	Jizan	Urban	Governmental	70
M	Alkharj	Suburban	Governmental	168
N	Jeddah	Urban	Governmental	530
O	Hafer Albatin	Urban	Governmental	299
P	Taif (Alhada)	Urban	Governmental	371
Q	Khamis Mushait	Urban	Governmental	562
R	Sharurah	Suburban	Governmental	136

was commissioned to implement medication reconciliation at admission and discharge and reduce medication discrepancies at MODHS hospitals. The improvement team who are subject matter experts at governance level designated the project as 'Implementation of Medication Reconciliation at Admission and Discharge'.

## BACKGROUND

There are many potential reasons for medication errors to occur due to the complex medication use process, including drug–drug or drug–disease interactions, inappropriately prescribed drug, omission and duplication errors.<sup>2</sup> Prescribing errors are potentially the most serious type of medication errors, and lead to patient harm. If they remain unnoticed, the prescriber may continue repeating the same error over a considerable period of time, until discovered by healthcare providers, or patients. According to Institute of Medicine the incidence rate of prescribing errors was reported ranging between 19% and 58%.<sup>8</sup>

In Saudi Arabia, 70% of patients in medical wards experienced medication discrepancies, and 18% of them had at least one unintentional discrepancy.<sup>9</sup> Mazhar *et al* found a 30% incidence of medication discrepancy at admission, and the most frequent type of discrepancy was omission.<sup>10</sup> Inaccurate medication histories at admission are common in Saudi hospitals.<sup>11</sup> A review of the literature in Australian facilities found that two medication errors occur for every three patients on hospital admission, with 60%–80% of patients having one or more unintentional discrepancies between their medication history and initial medication orders.<sup>4</sup>

One way to minimise medication discrepancies and improve patient safety is to perform medication reconciliation. ISMP in Canada is an independent not-for-profit organisation that partners with organisations, practitioners, consumers and caregivers to advance medication safety in all healthcare settings. They define medication reconciliation as

a formal process in which healthcare providers work together with patients, families and care providers to ensure accurate and comprehensive medication information is communicated consistently across transitions in care. It requires a systematic and comprehensive review of all the medications a patient is taking (known as a best possible medication history (BPMH)) to ensure that medications being added, changed or discontinued are carefully evaluated.<sup>12</sup>

The best possible medication history (BPMH) is the cornerstone of successful medication reconciliation. It is not a routine primary medication history; rather, it is comprehensive, and should include a variety of data sources. The benefit of using BPMH is to identify discrepancies found between the BPMH and admission medication orders. These medication discrepancies can be divided into three main categories intentional,

undocumented intentional and unintentional.<sup>12</sup> In addition, this comprehensive list is not only important for the medication reconciliation process but also for the review of medication management for patients.<sup>7</sup> Most organisations acknowledge that the patient must be included as a source of medication information in the medication reconciliation process in order to have the gold standard medication list.<sup>7</sup>

Pharmacists have a fundamental role in the medication reconciliation process. The American Society of Health-System Pharmacists has defined the key responsibilities of pharmacists as; designing the patient-centred medication reconciliation systems, providing education to patients as well healthcare providers, and participating in patients transition in care.<sup>13</sup> There are two key elements based on which medication reconciliation could be improved (ie, pharmacist led medication reconciliation and appropriate patient interview). Medication safety officers (MSOs) play an important leadership role to ensure all hospital professionals view medication reconciliation as a medication safety issue and not an added chore. The majority of Saudi hospitals rely on doctors or medical students with taking medication histories. Pharmacists' participation in this process has the potential to increase medication lists completeness and accuracy.<sup>11</sup> A recent systemic review supports the implementation of pharmacist-led medication reconciliation programmes that include components aimed at improving medication safety. A reduction in rate of readmission by (19%), emergency department visits by (28%) and ADE-for hospital revisits (67%) had been reported.<sup>1</sup>

## MEASUREMENT

The outcome measure for this study was the mean number of outstanding unintentional discrepancies per patient at admission and discharge, and percentage of patients with at least one outstanding unintentional discrepancy at admission and discharge. Unintentional Discrepancies are discrepancies in which the prescriber unintentionally changed, added or omitted medication that the patient was taking prior to admission or during hospitalisation. Outstanding discrepancies are discrepancies which were identified by audit teams at hospitals who act as independent observers.

The process measures included the percentage compliance to medication reconciliation documentation within 24 hours of admission, and percentage compliance to medication reconciliation documentation at discharge.

Medication reconciliation compliance is achieved through a formal process of creating the most complete and accurate BPMH of a patient's current medications by the doctor and comparing the list against the admission, and discharge medication orders. Compliance at admission is measured based on patients whose medications have been reconciled within 24 hours of admission. Compliance at discharge is based on all discharged (alive) patients from inpatient units within



the measurement period. The result should be a reduction in unintentional outstanding medication discrepancies at admission and discharge. This process will be measured through the identified process and outcome Key performance indicators (KPIs). Online supplemental appendix 1 describes the operational definition of our selected measures.

Data were analysed using control charts and a before and after comparison of a calculated mean difference using t-test with a significance level p value of  $<0.05$ . A comparison was calculated for the baseline (which is the first four data points) and the 12 months following the intervention. Multiple correlation analysis was conducted to investigate further the relationship between the outcome measures and other measures.

## DESIGN

Our interventions depended on the High 5's project medication reconciliation WHO,<sup>14</sup> and medication at transitions and Medications at Transitions and Clinical Handoffs (MATCH) toolkit for medication reconciliation by Agency for Healthcare Research and Quality (AHRQ).<sup>15</sup> The first change package started with the creation of a policy including forms and KPIs of interest, and establishing multidisciplinary audit teams, educating the staff throughout the audit process the team should provide ongoing onsite training for all involved healthcare providers (physicians, nurses, pharmacists) about the medication reconciliation process and assessing current practice. The second change package included re-orientation using workshops and education materials to encourage the staff engagement. Table 2 provides a description of the implemented interventions.

Each hospital established audit teams that included physicians, nurses, pharmacists and quality coordinators. The improvement teams at hospital level were led by pharmacy departments, the audit teams met once a week to discuss the outcomes of the interventions and monitor the development of their action plans. The IHI's Collaborative Model for Achieving Breakthrough Improvement was used to enhance collaboration and learning between different hospitals through collaborative learning sessions (LSs).

Project interventions needed to be the daily clinical workflow by the healthcare providers, however, the role and responsibilities were not clear initially for the multidisciplinary team, consequently the improvement team at governance created team roles and responsibilities at admission and discharge. In addition, resistance to change was anticipated from physicians. This was mitigated by having executive oversight for implementation by medical administration, and the director of pharmacy. The process also included a communication plan development for all hospital staff involved in the medication reconciliation process to reassure medical staff and hospital executives that the new process is for improvement and patient safety (not punitive or

judgemental) the long-term added value, and the evidence behind each intervention.

Unified measures were created and used throughout the hospitals. Process and outcome measures were assessed pre-implementation and post implementation, ensuring qualitative monitoring, and highly visible units and end user performance analysis in order to ensure accountability. This assisted in creating an environment in which teams had a direct line of sight to the organisation's overall efforts to improve medication reconciliation implementation.

## STRATEGY

Each hospital established a multidisciplinary audit team, that included physicians, nurses, pharmacists (where possible these were clinical pharmacists) and quality experts (coordinators). There were two teams or more based on the size of the hospital. In addition, clinical leadership and hospital executives (medical director, pharmacy director, nursing director, quality director) were appointed to oversee and support teams, who are the hospital level improvement team.

The key stakeholders of the reconciliation process are the medical staff, pharmacists, nursing staff, a quality representative and the patient. The doctor took the BPMH by interviewing the patient, and deciding what to continue, discontinue or change, and then initiating order accordingly. Pharmacists compared and reviewed the order against historical record, assuring the completeness of the medication reconciliation form within 24 hours after admission and before discharge. Pharmacists communicated with the doctor any discrepancies that need to be corrected in order to prevent omission and commission by ensuring that the doctor decision in the medication reconciliation form is correctly transcribed in order. Nurses were expected to ensure administration of the correct medications and audit teams will ensure compliance to the whole process.

To evaluate and implement changes, improvement teams used the IHI's improvement model as a tool. Using the IHI's Collaborative Model for Achieving Breakthrough Improvement (online supplemental appendix 2), collaborative LSs were held to encourage cooperation and learning among the hospitals. Every 6 weeks, teams were required to submit progress reports in between these LSs. Team members shared their accomplishments, barriers and lessons learnt through general sessions, workshops, presentations, as well as informal dialogues and exchanges to benefit everyone.

The hospital improvement teams underwent three LSs and an additional three action periods. Each hospital implemented and presented at least three improvement cycles. Table 3 summarises strategies for change in each cycle and lessons learnt.

## RESULTS

### Outcome measure

The percentage of patients with at least one outstanding unintentional discrepancy at admission showed a 20%

**Table 2** Details about project interventions

Intervention	Description
Standardise the medication reconciliation process throughout the hospital	<ul style="list-style-type: none"> <li>▶ Effective and efficient policies and procedures (standard and evidence based, addressing patient needs with clear responsibilities and lean steps). <b>Action:</b> Approved medication reconciliation policy.</li> <li>▶ Standardised medication reconciliation form as a single medication list (one source of truth), regardless of the format (electronic or paper-based). The list should be easy to access and updated by all disciplines and represent the reference point for ordering decision and reconciliation. <b>Action:</b> Approved uniform medication reconciliation template.</li> <li>▶ Develop effective prompts or reminders for consistent behaviour. <b>Action:</b> Hard stops, or reminders before ordering, and pharmacy interventions before dispensing.</li> </ul>
Develop oversight for implementation	<ul style="list-style-type: none"> <li>▶ Assign the governing body (high-level leadership team including (medical administration, nursing director, pharmacy director, IT director and CEO as appropriate). <b>Action:</b> Approved leadership terms of reference with clear structure and responsibilities.</li> <li>▶ Assign a leader for direct oversight (eg, project manager). <b>Action:</b> Project manager job description.</li> <li>▶ Assign professional discipline teams (medical and surgical teams with each team composed of physician, nurse and pharmacist). <b>Action:</b> Professional discipline team structure and job responsibilities team training programme.</li> <li>▶ Assign a facilitator (eg, quality representative). <b>Action:</b> Facilitator job description.</li> </ul>
Develop communication plan for all hospital staff involved in the medication reconciliation process	<ul style="list-style-type: none"> <li>▶ Announce the organisation decision and commitment. <b>Action:</b> Top management sponsored conference for all involved staff for project kick off.</li> <li>▶ Provide rationale for participation. <b>Action:</b> <ul style="list-style-type: none"> <li>▶ Description of the problem to be addressed (types and rates medication errors and discrepancies at transitions) and the impact of medication reconciliation proposed solution.</li> <li>▶ Highlight the cost and benefits (eg, improved safety for patients, efficiencies and lower risk exposure for staff) of participation.</li> <li>▶ Linking medication reconciliation to other initiatives accreditation requirements, and patient experience.</li> <li>▶ Develop education and training programme for front line staff to engage them. <b>Action:</b> Education programme curriculum, materials, handouts and brochures.</li> <li>▶ Provide regular updates to all staff on the progress and the results of measurement data collected. <b>Action:</b> Communicate reports through emails and conferences.</li> <li>▶ Recognise the contributions and successes of all staff. <b>Action:</b> System for recognition and incentives.</li> </ul> </li> </ul>
Develop measurement and monitoring strategy including baseline and regular monitoring	<ul style="list-style-type: none"> <li>▶ Develop process and outcome key performance indicators (KPIs).<sup>16</sup> <b>Action:</b> Stewardship and KPI profile (Med-Rec 1, 2, 3, 4, 5 and 6), and data aggregation sheets.</li> <li>▶ Ensure qualitative monitoring through. <b>Action:</b> Open file review tracers and process verification audit by the professional discipline teams with direct communication with the main responsible physician (MRP).</li> <li>▶ Highly visible units and end user performance analysis to ensure accountability. <b>Action:</b> Design the data analysis strategy to granulate to the level of unit and end provider.</li> </ul>
Patients and family's involvement	<ul style="list-style-type: none"> <li>▶ Continuous patient and family education about their role. <b>Action:</b> Patient education materials and handouts, and brochures.</li> </ul>
Involve information technology as appropriate	<ul style="list-style-type: none"> <li>▶ Identify tools/tablets/phone applications that support medication reconciliation process and enhance patient ability to communicate their home medications. <b>Action:</b> <ul style="list-style-type: none"> <li>▶ Electronic reconciliation form.</li> <li>▶ Reminding messages/hard stop for physicians before ordering.</li> </ul> </li> </ul>

reduction after implementation of the project (27% before, 7% after; p value <0.05) (RR 0.74) with a mean reduction in the number of discrepancies per patient by 0.74. Furthermore, the control chart shows a downward

shift in data starting on the first week of May and the first week of September (online supplemental figure 1).

The percentage of patients with at least one outstanding unintentional discrepancy at discharge showed 12%

**Table 3** Summary of strategies for change and lessons learnt during the learning sessions

Cycle no.	Strategy for change	Key learning from the cycle
First learning session	<ul style="list-style-type: none"> <li>▶ Establish hospital teams.</li> <li>▶ Assign a pharmacist to review admission, and discharge medication reconciliation.</li> <li>▶ Implement project interventions.</li> <li>▶ Get feedback from physicians and pharmacists to update and simplify the system.</li> <li>▶ Auditing and follow-up with physicians for discrepancies.</li> <li>▶ Monitoring and assuring that physicians follow medication reconciliation process.</li> <li>▶ Sending regular feedback from the pharmacy to other departments.</li> <li>▶ Conduct mandatory training for new residents as well as physicians; priority for surgery department.</li> <li>▶ Train pharmacists for medication reconciliation review at admission and discharge.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Engage hospitals leaders' medication reconciliation process is essential expedite practice change.</li> <li>▶ Feedback about the common mistakes of medication reconciliation process to the physicians and pharmacists may help in improvement.</li> <li>▶ Training the involved staff is essential in compliance to medication reconciliation process.</li> </ul>
Second (second) learning session	<ul style="list-style-type: none"> <li>▶ Sample size: allocate more data collectors to increase sample size for more accuracy.</li> <li>▶ Communication: ensure proper communication with head of departments for high discrepancies rate.</li> <li>▶ Give re-orientation and educational workshops for all departments.</li> <li>▶ Modify the electronic system (if available) for force functions.</li> <li>▶ Delay in submitting the results: specify submitting day for all data to the supervisor of the area.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Medication reconciliation is not a straightforward success.</li> <li>▶ Continuous coaching of physicians is one of the factors that has a remarkable result on medication reconciliation.</li> <li>▶ Complete medication reconciliation did not necessary lead to less discrepancy; therefore, the team has to continuously work on improving accuracy.</li> </ul>
Third learning session	<ul style="list-style-type: none"> <li>▶ Focus and consider the common identified discrepancies such as wrong decisions, duplication therapy, skip copying some medication from medication history.</li> <li>▶ Evaluate physicians through the ongoing professional practice evaluation (OPPE) through submitted reports.</li> <li>▶ Train more pharmacists for medication reconciliation review at admission and discharge.</li> <li>▶ Feedback about medication reconciliation results to safety project leaders.</li> </ul>	<ul style="list-style-type: none"> <li>▶ There was a general appreciation for the value of medication reconciliation, yet there is unclear and inconstant practice among healthcare providers.</li> <li>▶ Pharmacists are playing a significant role in improving the discrepancies at both admission and discharge.</li> <li>▶ Identified discrepancies by the pharmacists would enhance the opportunity to understand the limitation on the current system and overcome it by re-designing the system.</li> </ul>

reduction (17% before, 5% after;  $p$  value  $<0.05$ ) (RR 0.71) with a mean reduction in the number of discrepancies per patient by 0.34.

### Process measure

Compliance to medication reconciliation documentation within 24 hours of admission showed significant improvement across all enrolled hospitals by an average of 17% (8%–26%;  $p$  value  $<0.05$ ) (73% before, 90% after). Similarly, compliance to medication reconciliation documentation at discharge showed improvement across all enrolled hospitals by an average of 24% (14%–35%;  $p$  value  $<0.05$ ) (68% before, 93% after) (online supplemental figure 2).

Correlation analysis showed that there is a significant correlation between medication reconciliation and reduction in percentage of patients with at least one outstanding unintentional discrepancy at admission and discharge (online supplemental figure 3). Online

supplemental appendix 3 details results of before and after hospital results and calculated mean difference.

Online supplemental appendix 4 control charts for all medication reconciliation measures (pooled result for all enrolled hospitals) showed new performance levels after implementation. By the end of the third LS, most hospitals were able to achieve the target.

To ensure staff compliance to medication reconciliation we reviewed a number of patient records using proportional stratified quality random sampling by unit (online supplemental appendix 5). To avoid any measurement tool errors (eg, validity or sensitivity errors) we used evidence base KPI from the Canadian Patient Safety Institute (Measures: Medication Reconciliation MedRec).<sup>16</sup>

### LESSONS AND LIMITATIONS

In this improvement project correlation analysis showed that there is a significant correlation between medication

reconciliation and reduction in percentage of patients with at least one outstanding unintentional discrepancy at admission and discharge (online supplemental figure 3).

The accuracy and completeness of medication histories that is, BPMH acquired by doctors on hospital admission is essential. Most importantly, we learnt that numerous clinically significant discrepancies were found and corrected by the reconciliation process. Supported by Abuyassin *et al* and Vira *et al*.<sup>11 17</sup> The majority of these discrepancies consisted of omission, commission, dosing and frequency errors. The reasons for these discrepancies included incorrect abstracts of patients' medication lists from the health information system, or patients/families, not asking patients about their medications, and a lack of knowledge about the correct doses for prescribed medications. Discrepancies have been documented to show negative impact on health outcomes. The current study did not evaluate health outcomes which presents future research opportunities. If discrepancies occur at admission, physicians are prepared to change medication orders according to pharmacist recommendations, nursing staff will administer the correct medications after medication order review. However, after discharge, patients are often left alone to deal with medication discrepancies without the support of healthcare providers, so there may be greater potential for ADEs, and patient harm. Consequently, there is a need to contact patients after discharge, this step needs further exploration.

Establishing hospital audit teams and implementing the interventions, which include implementing the High 5's project medication reconciliation WHO, and MATCH toolkit for medication reconciliation by AHRQ, resulted in initial improvements in medication reconciliation. However, hospital teams faced difficulties in implementing some interventions due to unclear roles. The improvement team developed a standard policy and form for medication reconciliation, which improved and standardised team activities. Furthermore, the medication reconciliation process and responsibilities were not always clear to the teams conducting the activities, which led the improvement team to develop written responsibilities to clarify and standardise medication reconciliation process for each healthcare profession. This resulted in further improvements in medication reconciliation at the second LS.

Hospital teams faced difficulty at the start of the project in completing the medication reconciliation within 24 hours of admission. The main reason was resistance from main responsible physicians due to multiple factors such as the patient's age (paediatric and elderly), and education level, physician interviewing skills, and medical staff turnover or shortage. The improvement team at governance developed a poster and booklet in order to facilitate physicians work, as well as pharmacist feedback and ongoing monitoring. In addition, the improvement team overcome this barrier by encouraging teams to share their experiences, and solutions with other MODHS hospitals,

and to be open to asking for advice and sharing success stories.

Commitment to the change package was an issue half-way through the project, which required the improvement team to visit some hospitals to assure compliance to the audit process and conduct site audits and further training for them.

While the concept of medication reconciliation seems relatively straightforward, its implementation has proved in different studies to be complex and challenging for healthcare providers.<sup>7</sup> The present study showed that the medication reconciliation process is indeed difficult and time consuming. This was reflected in comments from hospital representatives in the improvement team LSs and was confirmed through some observation by the improvement team while visiting the hospitals.

Moreover, the completeness of the medication reconciliation form does not necessarily lead to less discrepancy. To help achieve this well-trained teams have to continuously work on improving accuracy. The teams identified common discrepancies such as wrong decisions, duplication therapy, skipping or missing copying some medications from the medication history. Through training more pharmacists on medication reconciliation review. Pharmacists showed that they play a significant role in improving medication reconciliation processes and decreasing discrepancies at both admission and discharge.

Multidisciplinary audit team incompleteness was observed by the teams in most of the MODHS hospitals. In addition, teams experienced small sample size issue. Both issues were overcome by allocating more trained data collectors who share accountability which is crucial for a successful medication reconciliation process. As a result the sample size increased by maximising chart review, and accuracy was improved. This strategy is supported by MA Coalition for the prevention of medical errors.<sup>18</sup> The percentage of patients with at least one outstanding unintentional discrepancy at admission showed a 20% reduction after implementation of the project (online supplemental figure 1).

One of the project's significant strengths is its implementation across multiple hospitals with different populations, sizes, and levels of leadership and team engagement. In addition, most of the enrolled hospitals achieved the target percentage for reconciliations that were successfully completed.

If this project is undertaken again, further analysis for type and classification of medication errors is recommended.

A key barrier to medication reconciliation is unreliable sources of medication information. This can be due to patient memory failure; taking medication not as prescribed; literacy level, and absence of patient companions especially for elderly patient. Consequently, healthcare providers may not receive the complete BPMH. This could lead to staff stress and burn out, especially among physicians who are interviewing patients as this process is



associated with significant high risk of medication errors. This explains why the patient involvement is vital in the medication reconciliation process.<sup>19 20</sup> According to JCI patients must be informed about their medication and must be given an opportunity to inquire and to access educational support.<sup>21</sup>

In terms of data validation, the improvement team used a multilayered approach that used data abstraction and correlation of measures with related measures reported to the governance body.

It is essential to understand that a multitude of factors affect the success or otherwise of medication reconciliation. Major organisational level factors affecting the medication reconciliation process include hospitals resources, and unavailability of electronic medication reconciliation in some MODHS hospitals which help in medication reconciliation process at admission and discharge. At admission all active medications will be listed in the electronic medication reconciliation, doctor will interview the patient, and take a decision to stop, change or continue the medications, then start the admission order. At discharge all active medications in the last 24 hours will be listed, in addition to the medications stopped during admission. The doctor will take a decision from the lists, then will write the discharge order. Consequently, this will reduce the time consumed for auditing the manual record to get the BPMH.

Major individual level factors affecting the medication reconciliation process included healthcare professionals' perceived responsibilities as well as patient characteristics.<sup>1</sup>

In this study, the target was achieved and sustained over 5 months which was the period necessary to demonstrate change. Policy and procedures were created in order to integrate the medication reconciliation as part of the hospital admission and discharge policy. To further ensure that the results continue to be sustainable, the improvement team will use medication reconciliation as KPIs for pharmacy department in all MODHS hospitals to ensure that monitoring and improving medication reconciliation is part of the routine activities and to ensure sustainability.

## CONCLUSION

The quality improvement process for 18 MODHS hospitals showed a statistically significant difference in improvement after implementing medication reconciliation in the percentage of patients with at least one outstanding unintentional discrepancy at admission.

For this improvement project the implementation of multilayered strategies for intervention such as standardised medication reconciliation process throughout the hospitals, developing oversight for implementation, developing a communication plan for all hospital staff involved in the medication reconciliation process, developing baseline and regular monitoring strategy, involvement of patients and families, and use of information

technology as appropriate, can lead to improve compliance to medication reconciliation.

Significant improvements were observed in our project, within the MOD healthcare system due to implementing the interventions. Further work is underway by the improvement teams to ensure implementation of medication reconciliation, which include integration of medication reconciliation with their electronic health record, in order to improve medication reconciliation process by tracking medications across sites of care and allowing for an active comparison of medications and clarification of discrepancies. Moreover, hospitals need to add medication reconciliation to be part of the medication management system annual review. To understand the need and priority of medication reconciliation in the hospitals, all MODHS hospitals should assign MSOs, to enhance proper implementation of medication reconciliation. We recommend that the MSO role should be a pharmacist, as pharmacists have distinct knowledge, skills and position in the medication use process to facilitate implementation of effective medication reconciliation tools for both patient, and interdisciplinary use. Moreover, using the KPIs described will allow monitoring of the medication reconciliation process and target interventions to produce sustainable change long term.

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