Successful Medication Reconciliation in an Acute Care Setting

Mackenzie Health

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Executive Summary

Mackenzie Health, an innovative, HIMSS Stage 7 hospital, operating two full-service hospitals including Mackenzie Richmond Hill Hospital and Cortellucci Vaughan Hospital and a network of community-based programs and services we serve a population of more than half a million people across western York Region which is in the Greater Toronto Area in Ontario, Canada. Both hospitals offer a range of core services with specialized programs at each. Between the two hospitals, we see over 200,000 Emergency Visits and 48,999 admissions annually. The organization employs 5200 staff and has 550 physicians credentialed. The hospital is committed to its corporate digital strategy focusing on opportunities to improve clinical patient outcomes through technology. Medication Reconciliation is a critical function aimed at reducing potential adverse events due to discrepancies during the ordering of medications at transitions of care. To optimize effectiveness, reconciliation should be completed as close as possible to the time of admission. In Canada, resource limitations make it challenging to achieve proactive medication reconciliation. In 2017, Mackenzie Health implemented a new electronic medical record (EMR) leveraged a proactive model of medication reconciliation with

integrated admission medication reconciliation workflows.   Low compliance rates unmasked the lack of proactive workflows and misalignment with the best practices built into the EMR. Using an interdisciplinary process improvement approach, the organization systematically identified change ideas to improve overall compliance with medication reconciliation at admission and, more specifically, compliance within 24 hours of admission. Initial change ideas targeted clarification of EMR workflows to reflect and support provider practices and then further evolved to policy changes and mechanisms to drive accountability and sustainability using compliance metrics and real-time dashboards.   With these efforts, 2019 post-EMR implementation medication reconciliation compliance rates of 33% improved to over 85% in 2022. Medication reconciliation compliance within 24 hours of admission of 37% in 2019 has also surpassed the 70% target Medication Reconciliation corporate quality aim, year-to-date. Through these efforts, the organization has demonstrated a reduction in length of stay of 1.94 days (1.30-2.58, 95% CI, $P<0.05$), in patients whose medications were reconciled within 24 hours (versus patients whose medications were reconciled more than 24 hours after admission), implying that early medication reconciliation is associated with an overall reduction in length of stay.   As the proportion of patients whose medication reconciliation was completed within 24 hours improved, medication discrepancies were identified and addressed closer to the time of admission improving the patient outcome.

Define the Clinical Problem and Pre-Implementation Performance

Medication-related errors continue to be the leading cause of morbidity and mortality in healthcare. Within the hospital setting, medication errors occur at transitions of care. Over the last decade, several national accreditation bodies, including Accreditation Canada, have mandated medication reconciliation as a mitigating patient safety strategy aimed at reducing discrepancies that lead to medication-related errors. Medication reconciliation involves generating a Best Possible Medication History (BPMH) that is used by a healthcare professional to ascertain whether a medication can be continued, suspended or modified in order to prevent and resolve any discrepancies in what the patient reports they are taking compared to what they should be taking. Medication reconciliation detects duplications, omissions, interactions and lack of medication adherence. Despite the positive outcomes associated with medication reconciliation, adherence continues to be poor in a publicly funded health care environment as we have in Ontario due to the extensive time and human health resources required to engage in medication reconciliation. Voluntarily reported medication incidents are a source of information about potential adverse events. These are tracked and trended routinely at the organization's medication safety committee, consistently ranking as the 3rd most common type of reported incident. It is very challenging to use the number of reported incidents to reflect adverse event rates due to the voluntary nature of this reporting. It was identified that staff were reporting only approximately 45 incidents per year. The Canadian Institute of Health Information's hospital harm project required the mandatory

coding of adverse events as an indicator from physician documentation. This information will later be showcased to demonstrate the impact of the interventions discussed in this case study on the frequency of adverse events experienced by patients in our organization.

Medication reconciliation on admission is defined as the percentage of admissions where all patients' medications are reconciled. As an Accreditation Canada Required Organizational Practice (ROP), the expectation is that reconciliation is completed for all patients for whom medication management is a major component of care during admission. In alignment with that expectation, medication reconciliation compliance is captured for all admitted patients except newborns. Patients with a length of stay less than 24 hours are also excluded because the short duration is unlikely to lead to a significant discrepancy that would lead to significant harm during their short admission.

Prior to implementation of the EMR, by 2016, focused efforts to improve admission medication reconciliation compliance at Mackenzie Health resulted in reported compliance rates of over 80%. These pre-EMR compliance metrics captured BPMH completion by pharmacy personnel. Due to the complexities of manual data capture, assumptions were made that completion of a BPMH was good enough to represent completion of a full medication reconciliation because the discrepancies were being addressed by the pharmacists. Environmental scans of peer organizations validated that most organizations use this logic in their medication reconciliation reporting.

Post-EMR implementation in 2017, compliance with medication reconciliation at admission was reported to be significantly lower at 33%. Investigation into these low compliance rates revealed drivers related to workflow challenges as well as drivers related to the capture of medication reconciliation. Firstly, the EMR was designed to support a proactive medication reconciliation process and this was not reflective of primarily retroactive reconciliation workflows which is common in our Canadian hospital environment. This prompted the organization to increase its investment in pharmacy technicians to support proactive BPMH documentation before patients were admitted to hospital. However, there were also differences in infrastructure, primarily the lack of a single medication dispensing repository to carry patients' medication history into the EMR. The proactive workflows also led to a very long period of trying to understand and modify the build of the EMR to adapt them to suit our retroactive or hybrid model of medication reconciliation.

The second group of drivers for the low compliance were the lack of capture of medication reconciliation completion. The integrated workflows created visibility to gaps in practice that could potentially lead to patient harm. Prescribers were not reconciling or acknowledging every pre-admission medication, and, in some cases, prescribers were not following through on discrepancies that were identified and communicated by the clinical pharmacists.

Despite efforts to better align the EMR to user workflows, by 2020 compliance rates were still only at 54%, significantly lower than the 100% compliance that Accreditation Canada expected, and the hospital established a Medication Reconciliation corporate quality aim as it is high risk, high cost and high value. In the first year of the Quality AIM (2020/21), the overall medication reconciliation compliance at admission was set at a target felt to be achievable at 70%. Improved Medication Reconciliation within 24 hours was a quality aim that is part of the overall Quality Improvement Plan (QIP) of Mackenzie Health. QIPs are mandated by the Excellence Care for All Care Act, 2010 that all hospitals in Ontario have to develop on an annual basis. It is a publicly posted plan and is submitted to Ontario Health. The QIP is a documented set of quality commitments that healthcare organizations makes to improve specific quality issues through focused targets and actions. The goal of the QIP is to drive improvement broadly across Ontario to achieve better outcomes for all patients, families and providers. The QIP is endorsed by the Board of Governors at the hospital level and makes it a priority to improve. There is no additional funding assigned to items in the QIP but the organization ensures that resources are in place to make the Quality Aims successful.

Although the target was not achieved in year one, incremental improvements were made, and the focus shifted to driving medication reconciliation to be completed as close as possible to the time of admission. To that end, in the 2nd and 3rd years of the Quality AIM initiative, the hospital shifted the focus so that achieving medication reconciliation within 24 hours of admission. The target was defined at 70% which represented a 15% improvement.

Design and Implementation Model Practices and Governance

The medication reconciliation quality aim was guided by a standardized process in collaboration with our stakeholders and the Office of Strategy Management at Mackenzie Health and is illustrated in Figure 1. In 2020, an interprofessional medication reconciliation quality aim committee, consisting of pharmacists, pharmacy technicians, physicians, clinical managers, EMR analysts, data analytic consultants, quality improvement (QI) specialists, patient partners and senior leaders was established to have oversight of improvement efforts associated with compliance of medication reconciliation and drive the improvement efforts of this organization-wide strategy.
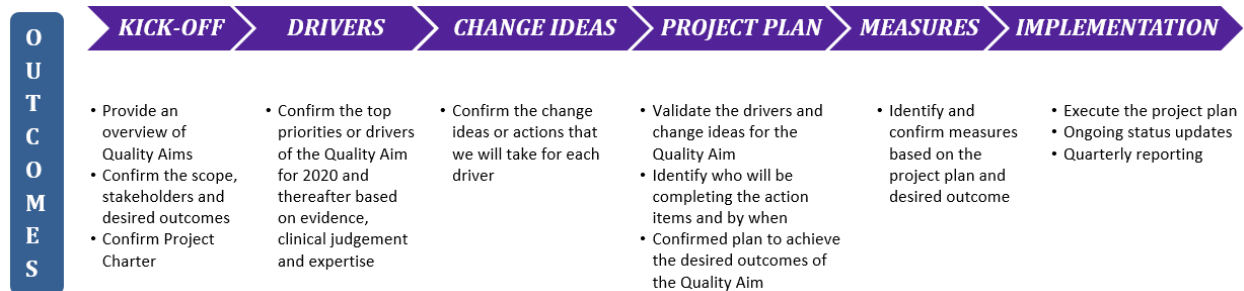
OUTCOMES	KICK-OFF	DRIVERS	CHANGE IDEAS	PROJECT PLAN	MEASURES	IMPLEMENTATION
	• Provide an overview of Quality Aims • Confirm the scope, stakeholders and desired outcomes • Confirm Project Charter	• Confirm the top priorities or drivers of the Quality Aim for 2020 and thereafter based on evidence, clinical judgement and expertise	• Confirm the change ideas or actions that we will take for each driver	• Validate the drivers and change ideas for the Quality Aim • Identify who will be completing the action items and by when • Confirmed plan to achieve the desired outcomes of the Quality Aim	• Identify and confirm measures based on the project plan and desired outcome	• Execute the project plan • Ongoing status updates • Quarterly reporting

Figure 1: Medication Reconciliation Zero Harm Quality Aim Implementation Process

Reporting to the organization's Medication Safety Committee and the hospital Quality Committee, the quality aim group meets on a monthly basis to monitor the impact of initiatives and determine whether the tested changes are resulting in improvement. Medication reconciliation is monitored quarterly at the Medication Safety Committee as well as on the hospital's Quality Improvement Plan (QIP) that is reported both to the hospital Board of Directors as well as Ontario Health.

A project charter was developed that included driver diagrams and change ideas based on evidence best practices and clinical expertise that outline the scope of the initiatives needed to achieve the quality aim. The committee prioritized change ideas and project plans were developed with leads assigned with identified measures for each change idea to capture whether tangible improvements occurred. The committee is also responsible for ongoing monitoring and evaluating the accuracy of data. Between the monthly meetings, the project groups meet as needed to plan, work through, problem solve, and update status on the respective change ideas. All process improvements that were designed within the EMR came directly from feedback from user groups that were assembled to tackle the identified issues. These user groups identified solutions and tested the outcomes. The Quality Improvement Plan (QIP) is listed below and includes all the change ideas reviewed.

MEDICATION RECONCILIATION QUALITY AIM

| YEAR 1 PRIORITIES - COMPLETED | YEAR 1 PRIORITIES | BEYOND YEAR 1 PRIORITIES | Mackenzie Health |

Aim
What we are trying to achieve

Primary Drivers
Key high-level factors of influence that need to change to achieve the aim

Secondary Drivers
More-detailed factors that break primary drivers down in to natural subsections

Change Ideas
The specific actions that can influence our drivers to achieve our aim

Aim: Increase compliance with medication reconciliation within 24 hrs of admission to 75%

Governance and Accountability

Medication Reconciliation Quality Aims Committee
- Establish a collaborative committee to provide oversight on medication reconciliation across the organization

Accountability
- Establish accountability for Chiefs/Physicians
- Incorporate community physicians and pharmacists into the medication reconciliation process
- Establish accountability for Nursing
- Establish accountability for pharmacists and pharmacy technicians
- Develop mechanism for providing feedback to individual practitioners regarding their scorecard performance

Monitoring & Evaluation

Access to Data
- Optimize and standardize the utilization of EPIC as it relates to medication reconciliation
- Establish a mechanism for staff involved in medication reconciliation to provide ongoing feedback on the process
- Establish unit-specific Medication Reconciliation dashboards with accurate and accessible data

Reporting
- Design and implement individual practitioner performance related scorecards

Process Design

Mitigation strategies
- Conduct a current state/gap analysis on medication reconciliation across the organization
- Align current practices for Medication Reconciliation on admission to evidence based practices
- Customize Medication Reconciliation process for different settings (i.e. patient type and population)
- Explore alerts in EPIC to complete medication reconciliation before a physician prescribes medication
- Monitor, understand and mitigate medication reconciliation delays

Effectiveness & Efficiency
- Establish a process for handling patient's home medication & blister package, specifically as it pertains to EMS
- Establish mechanism of prioritizing BPMH in ED for pharmacy technicians
- Develop a pharmacist medical directive for over the counter medication

Human resources
- Increase capacity of pharmacy technicians in ED to cover all shifts

Technology
- Raise awareness on demarcation in Epic of MR completion and by whom
- Implement process for scanning medication lists into Epic

Communication
- Develop mechanism to improve communication between physicians and pharmacy within the first 24 hours
- Improve communication with patients and families regarding medication reconciliation

Education & Training

Staff
- Explore first draft of a manuscript
- Provide education and training to front-line staff regarding medication reconciliation process
- Provide education for physicians on use of patient medication list in Connecting Ontario
- Incorporate Medication Reconciliation process workflows in the Connecting Ontario iLearn

Patients & Family Education
- Engage the patient and family in medication reconciliation process at admission
- Include a patient partner in the Medication Reconciliation Committee/design of medication reconciliation mitigation strategies
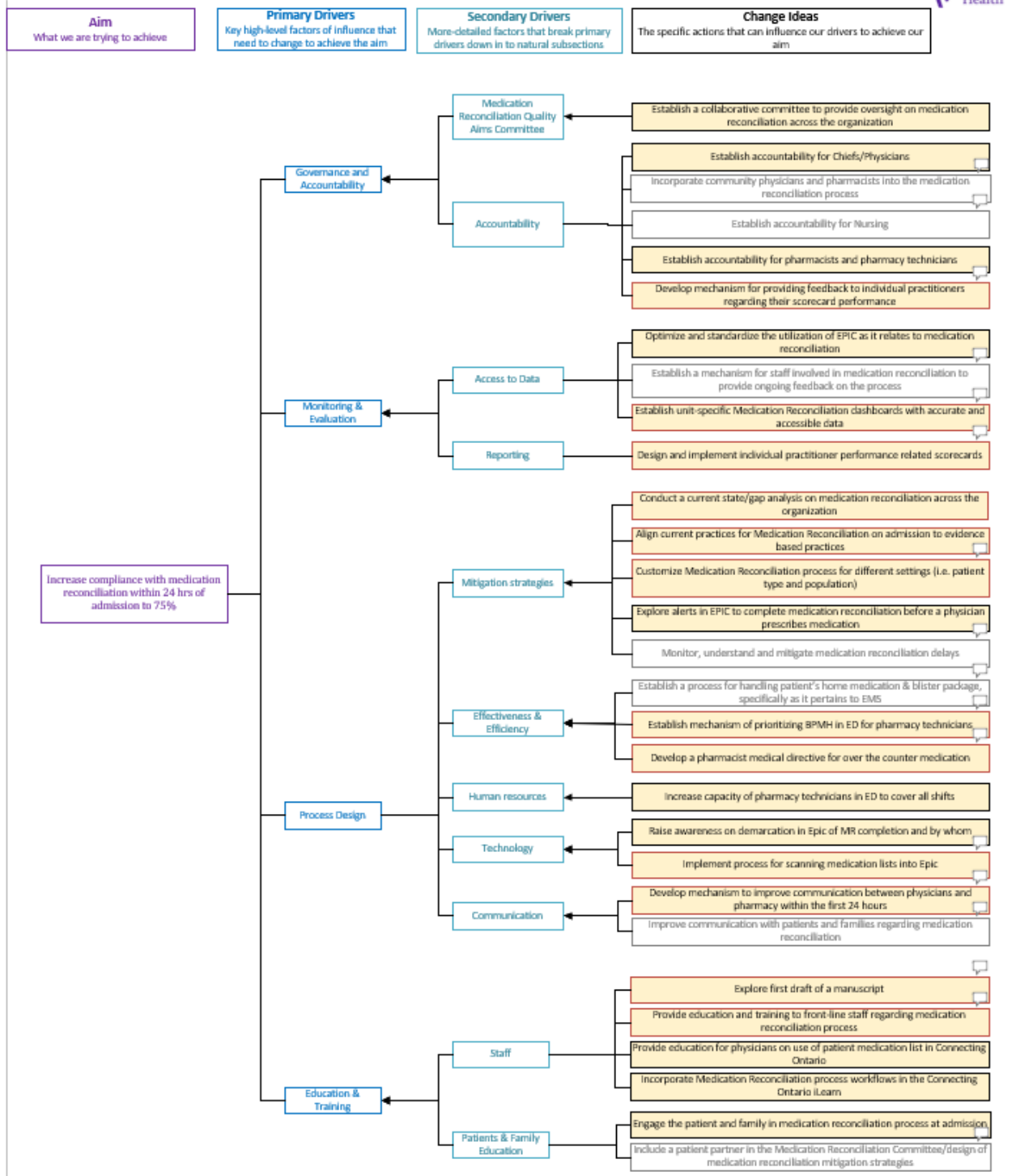
Figure 2: Medication Reconciliation Quality Aim Change Ideas Diagram

A variety of mechanisms for training were used throughout the journey. When tools geared towards physician workflow were modified, education sessions took place in physician department meetings, and the information was imbedded in the learning home dashboard of the EMR. In more targeted areas such as labour and delivery, a less passive approach was utilized in delivering education with the pharmacist and clinical informatics analysts providing one on one training to physicians directly on the unit to raise awareness about the required workflows to complete reconciliations. Training continued until a critical mass of physicians were trained. Formal E-Learning is available to all users to raise awareness of BPMH.

Clinical Transformation Enabled through Information and Technology

Medication reconciliation rates were monitored through the Medication Safety Committee since the 2017 EMR implementation and, in late 2018, it became evident that the low compliance rates were not an artefact of transitioning to a new system. Medication reconciliation at admission was added to the hospital's QIP in 2019.

Early efforts post EMR implementation were focused on addressing lack of resources to complete medication histories and modifying the EMR tools to suit the hybrid process, however the Quality AIM group identified drivers of persistent low compliance in the areas of governance and accountability, education and training, process design and monitoring and evaluation. The root causes that still required to be addressed included the lack of ability to prioritize reconciliation within the first 24 hours of admission, lack of congruence between the provider workflows and documentation requirements in the EMR, inadequately optimized functioning to full scope of practice for the pharmacists and lack of visibility to all users (physicians, pharmacy personnel and leadership) to actual compliance and progress.

Concerns arose from providers about the lack of clarity and standardized expectations for use of the reconciliation tools in the EMR and this prompted an extensive review of the tools in the EMR. Medication reconciliation workflows are extensively integrated throughout the EMR, and many users were making inputs and changes to documentation that impacted the capture of medication reconciliation. A significant amount of effort was required to understand what actions impacted reconciliation documentation and compliance capture.

Electronic Tools and Dashboards

With limited resources to support documentation of patients' BPMH, electronic tools and dashboards were developed to assist interdisciplinary team members to identify and prioritize patients who would benefit most from completion of medication reconciliation closer to admission and, ideally before the patient was admitted to hospital (proactively).

Tools were modified to reflect workflows including:

- EMR features were updated in the Admission Navigator to allow for more intuitive workflow navigation as below.

- Clinician's patient lists were optimized to facilitate BPMH and medication reconciliation completion being identified as a priority in their daily clinical workflow, as demonstrated in the screen capture below.

Pharmacy Patient List

- The addition of "Med Doc Reviewed?" column for nurses and "BPMH completed" column for pharmacist in "Patient List" created visibility to support the identification of incomplete BPMH and prompt for timely completion of BPMH.

- The built-in feature of a direct link on these icons allows users to open the EMR directly to the section where user can document BPMH.

Prescriber Patient List

- The "adm med rec status" column in prescriber's patient list enhances visibility for those with incomplete admission medication reconciliation.

- Prescribers can double click on the icon and be directed to complete "Reconcile Home Medication" section.

- In the Women and Child program, nurses are primarily responsible for completion of BPMH and many patients do not typically take medications, however the system still required acknowledgement of medications being reviewed to communicate there were no medications to reconcile. In this area, the dashboard below was created to flag nurses to indicate whether the BPMH documentation was completed.

These tools allowed improved visibility and created efficiency by directly linking the user to the appropriate EMR section to complete reconciliation.

Best Practice Alerts (BPA)

Best practice alerts (BPA) are a decision support tool in the EMR that provides suggestions to the user based on a specific criteria or rule in the system. BPAs were developed to flag prescribers when the BPMH has been documented by pharmacy personnel, but medication reconciliation remains outstanding. Two versions of the BPA were developed to flag providers and give direction about the tasks that needed to be completed to ensure that all the patient's medications were documented and reconciled. The BPA allows providers to directly access the modules of the EMR through a hyperlink to where those tasks need to be completed. The following screen capture demonstrates these BPAs.

If admission med rec is incomplete:

High Priority (1)

⚠ Admission medication reconciliation is incomplete for this patient. Please click on the link below to complete reconciliation:

↱ Click here to complete admission med rec

Dismiss

If admission med rec is incomplete and PTA meds have not been reviewed:

High Priority (1)

⚠ Admission medication reconciliation is incomplete for this patient. Please click on the link below to review home medications, mark the Med List Status as "Provider complete", and then complete admission medication reconciliation:

↱ Click here to complete admission med rec

Dismiss

Given that a few years had passed since the implementation of the EMR, the organization started to see patients returning to hospital who had a previously documented medication list in the EMR. Prescribers assumed the BPMH was documented on the current encounter and proceeded with reconciliation of medications from an outdated medication list. As a follow up to several of these incidents documented in the hospital's electronic incident reporting system, another BPA was developed to ensure prescribers were reconciling medications from the current encounter to ensure patient safety. This BPA provided users with a hyperlink to education about how to update and document a current BPMH so they could proceed with reconciliation and ensure patients were being ordered the appropriate medications in hospital. A conscience effort was made to not make a hard stop within workflows so that care can be provided to patients that do not have a medication history in emergent situations such as a John Doe coming to the emergency department with no family present.   Consideration can be given to a structured data field with commonly occurring reasons for delaying the medication reconciliation process but experience with some of our other clinical decision support tools suggests that providers typically choose the most convenient field that may not be reflective of the true reason so it was a fine balance between gathering useful data and not having enough choices. The choice was made to not gather information in this case.
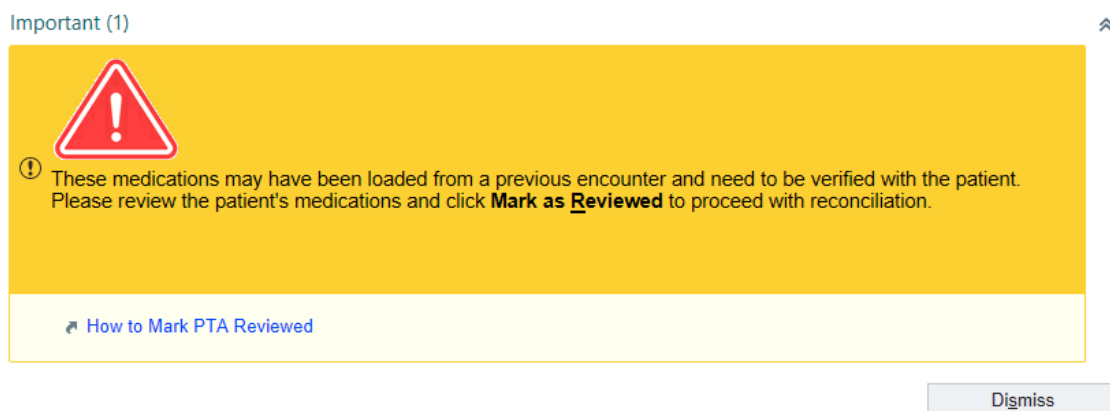
There are third party clinical decision support databases used to support physicians and pharmacists to identify drug/drug or drug/allergy interaction risks so there has been no BPA developed for these types of risks.

Education

Education was another instrumental component to the journey of medication reconciliation compliance success, powered using technology. Education developed for pharmacy staff and physicians focused on two components:
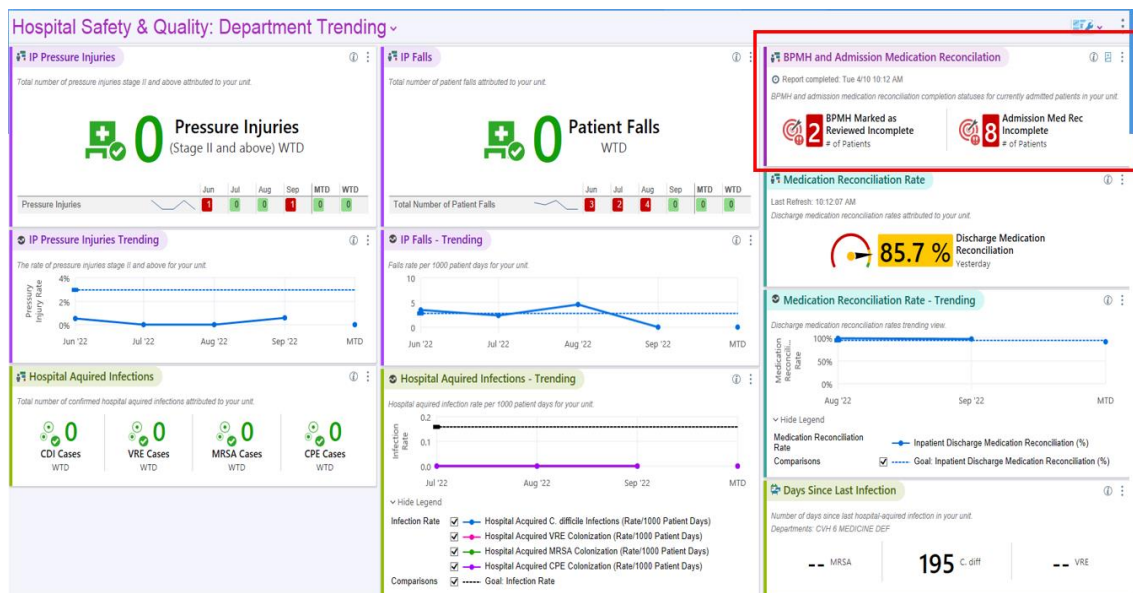
1) EMR medication reconciliation workflows

2) how to use the electronic tools that were built in EMR

The education was provided in the form of eLearning with video recordings as well as virtual demonstrations to targeted groups of prescribers, pharmacy staff and nurses. Detailed tip sheets were made available to users in the EMR Learning Home Dashboard for ease of access.

Electronic Quality Dashboards

In 2020, as part of the quality aim zero harm journey, the organization introduced electronic quality boards in patient care units and medication reconciliation compliance rates were published for review by nurses, prescribers and pharmacists at quality and safety huddles. The displayed metrics initially reflected compliance after a patient was discharged from hospital. The patient care units found it challenging to use the retroactive data to drive improvement in compliance since the patients were already discharged. In 2021, a change idea was established to develop dashboards reflecting the BPMH and medication reconciliation completion status for all patients currently admitted in the patient care unit. The real-time metric provided users with a current view of how many outstanding medication reconciliations there were on the unit and if BPMH's were documented. A cross check against physicians' patient lists allowed providers to identify outstanding reconciliation for their assigned patients.

Review of Compliance Metrics

The numerator for compliance measurement is the cases that achieved medication reconciliation of all documented prior-to-admission medications within 24 hours of admission over the denominator which is defined as the total admissions except newborns, NICU cases and length of stays less than 24 hours. Compliance is captured after a patient's admission is

completed and assigned to the second unit of admission since the first unit is typically either the emergency department or the operating suite.

The real-time dashboards created visibility that called into question the integrity of the compliance metric the organization had been reporting. This prompted an exhaustive review of the definition, inclusions and exclusions of the medication reconciliation compliance metrics. As the metrics were "corrected", gaps in workflows contributing to lower compliance were unveiled as were gaps in data capture, as was the case in the Women and Child program where completion of BPMH by nurses was not being captured. As a result of metric logic updates and correction, information on medication reconciliation compliance is now visible to allow the team to develop targeted improvement plans for specific clinical areas through departmental engagement after identifying gaps and challenges.

Scope of Practice Optimization

The pharmacy department has optimized their team's scope of practice through the certification of pharmacy technicians to gather best possible medication histories and pharmacists to adapt medication orders for medications that patients were taking prior to admission. In instances when prescribers bypass reconciliation of non-urgent but crucial medications, pharmacists can assist to complete the reconciliation and improve the overall medication reconciliation workflow efficiency and compliance. The EMR has been leveraged to facilitate documentation of these interventions, capturing of workload and ongoing monitoring of compliance to support optimization of resources and sustainability of these practices.

Improving Adherence to the Standard of Care

Compliance (process quality measures):

- Overall medication reconciliation at admission has improved:
    - 2019 – 33.8%; 2020 – 54.1%; 2021 – 58.9%; 2022 YTD – 69.68%
- Medication reconciliation within 24 hours of admission has improved from 37.7% in 2019 to achieve the target at 70.3% in 2022
- The charts below demonstrate overall compliance trends and compliance within 24 hours of admission.

Overall Medication Reconciliation Over time - QIP def'n

Medication reconciliation Percent < 24 hours - QIP def'n
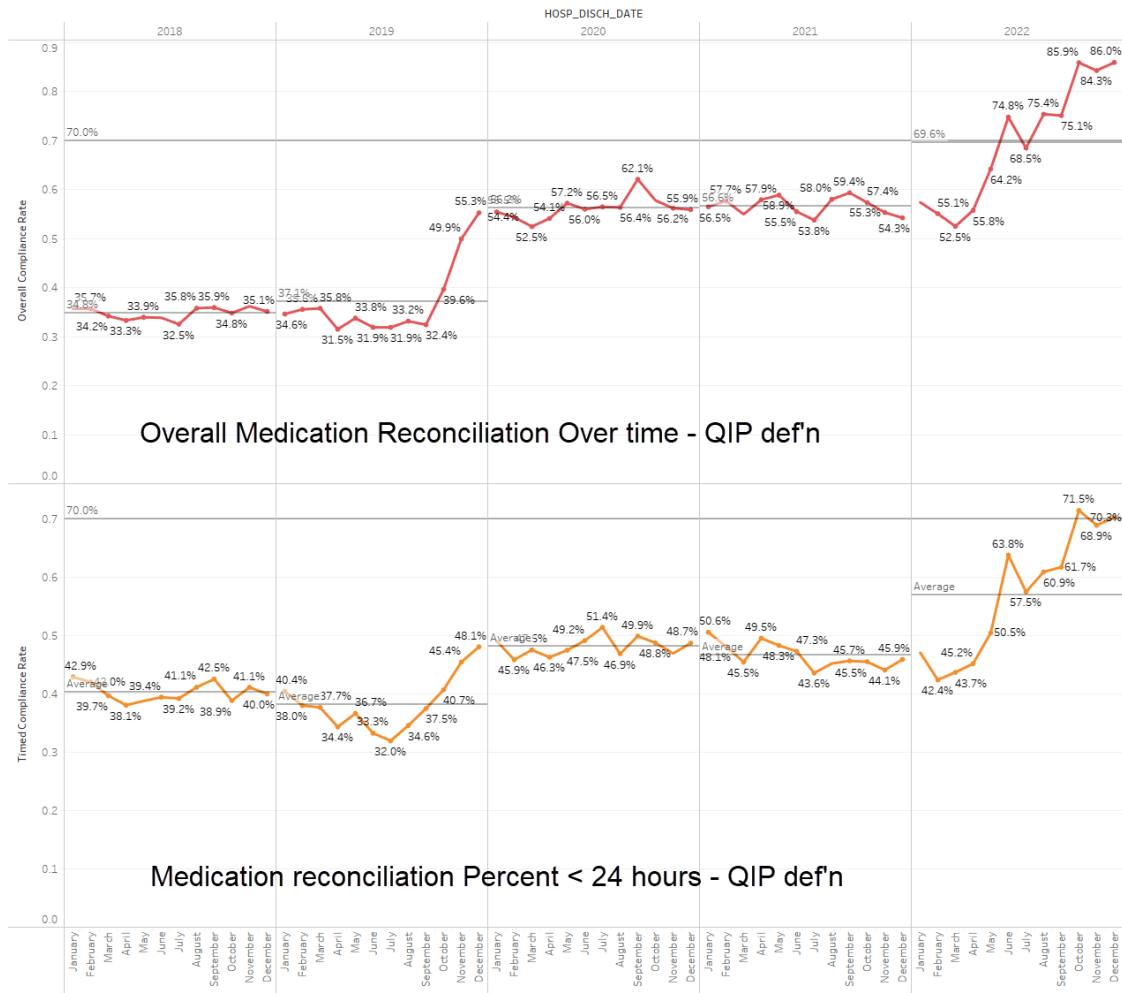
- BPMH completion is at 95% indicating a potential to further improve medication reconciliation compliance
- 32% of patients have a BPMH documented in the EMR proactively so we can assume most of these patients likely have their medication reconciliation completed AT the time of admission.

Improving Patient Outcomes

Order Clarifications (outcome measures):

In the context of medication reconciliation, a potential adverse drug event would be defined as suboptimized therapy (incorrect strength or frequency, medication not ordered when indicated or medication ordered when not indicated). At Mackenzie Health, clinical pharmacists document an order clarification iVent (intervention) in the EMR to communicate that a clinical intervention was submitted for review by the patient's most responsible physician (MRP).

These iVents collectively represent clinical interventions that would lead to the prevention of a potential adverse event when actioned. The implementation of a policy and workflows that enable pharmacists to adapt medication orders in the EMR, has led to a decrease in the number of order clarification iVents. Since June 2021, we have seen a 32% improvement in medication reconciliation compliance and 26.7% improvement in compliance within 24 hours.   During this time, we have also seen a concurrent 41% reduction in the number of order clarification iVents documented by clinical pharmacists. Given that these interventions are intended to prevent unintended reconciliation discrepancies which are potential adverse events, this signals that potential adverse events are being addressed closer to the time of admission to hospital and thereby minimizing the likelihood of risk associated with these potential adverse events. In the figure below, slope of the iVent rate is downwards and significant in the intervention period (R-square = 0.65, P<0.0001)

Reduction in Rate of Pharmacy Intervention with Increased Medication Reconciliation Completion
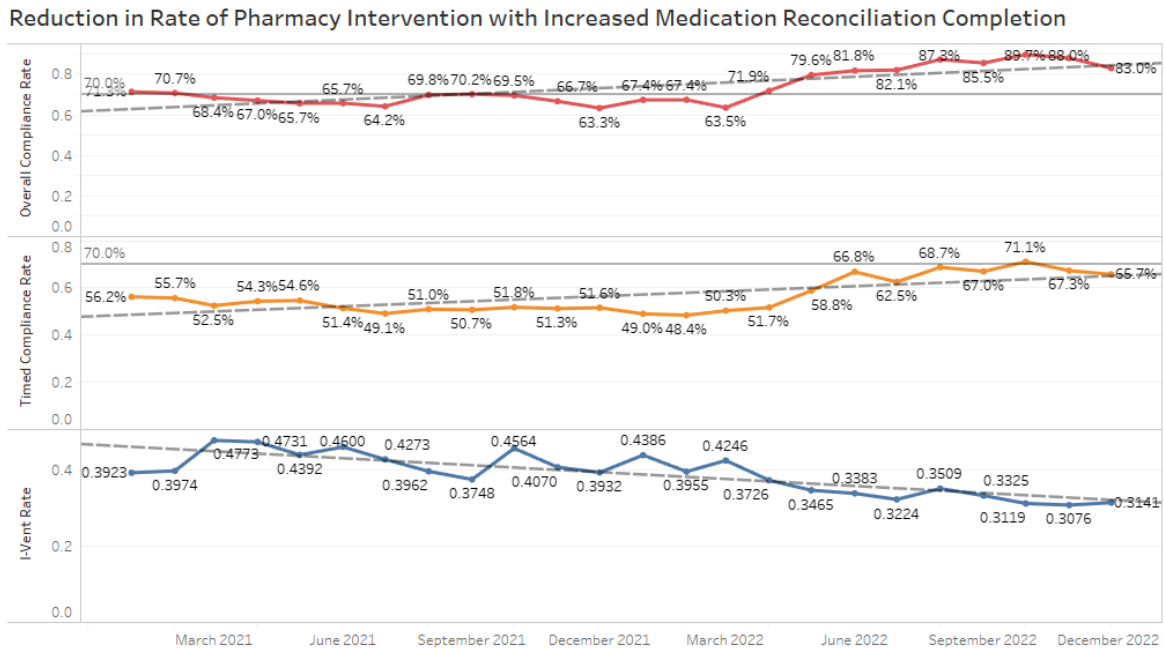
Reduction in Adverse Drug Events (outcome measures):

As previously mentioned, the Canadian Institute of Health Information (CIHI) requires the mandatory coding of adverse drug events as part of its Hospital Harm Initiative. The adverse drug events have diagnosis clusters such as the development of allergic reactions, bleeds from anticoagulants or other adverse effects. A review of the coding of adverse drug events in 100,000 charts since 2018 was undertaken as a far better representation of the occurrence of adverse events than the voluntarily reported medication incidents discussed previously.

As the compliance with medication reconciliation at admission increased, there was a trend downwards in the adverse drug event rate as shown in the figure below during the period of intervention (R- squared 0.142, P-value 0.07).

Reduction in Adverse Drug Event rate with increased Medication Reconciliation Completion
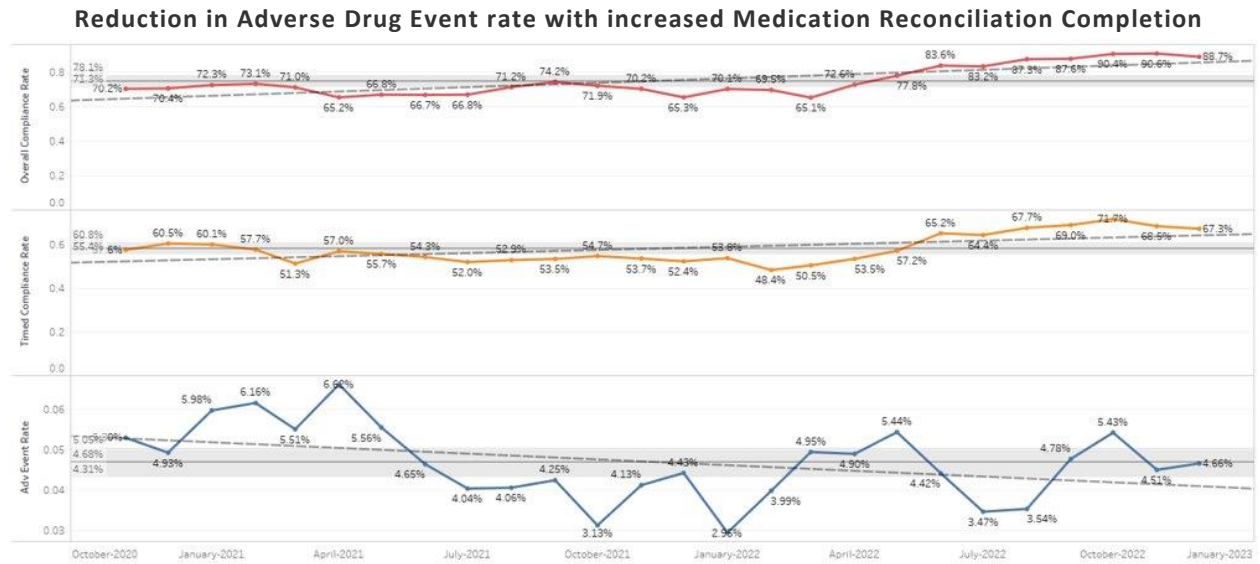
Clinical decision medication alerts in the EMR support pharmacists and physicians in identifying potential risks in medication prescribing. One of the most dangerous adverse drug events (ADE) is QT prolongation which can occur in patients who experience a drug-drug interaction with certain medications. The prolongation of the cardiac rhythm can lead to dangerous arrhythmias and cardiac arrest. A review of the frequency of QT prolongation alert firing was compared in the groups who had medication reconciliation completed before and after 24 hours of admission. This data demonstrates that the drug-drug interaction alert fired and was actioned (discontinued or removed) more frequently in the group who had reconciliation completed within 24 hours of admission, indicating that the providers were able to avoid prescribing medications that could potentially lead to QT prolongation earlier for more patients.

QT Prolongation Alert Comparison by Time to Medication Reconciliation

ALT_NAME	Over 24 Hours (Alerts Per CSN)		Under 24 Hours (Alerts Per CSN)	
ONDANSETRON / QT PROLONGING AGENTS	1.75	1.47	1.89	1.58
HYDROXYCHLOROQUINE / QT PROLONGING AG.	2.00	1.00	1.00	2.00
HYDROXYZINE / QT PROLONGING AGENTS			1.00	1.50
DOMPERIDONE / QT PROLONGING AGENTS	1.40	1.11	1.25	1.00
AZITHROMYCIN / QT PROLONGING AGENTS	1.00	1.00	1.00	1.07
ZIPRASIDONE / SELECTED QT PROLONGING AG.			1.00	
TRAZODONE (>= 100 MG) / QT PROLONGING A.	1.00			
QUETIAPINE / QT PROLONGING AGENTS	1.00		1.00	
QUETIAPINE / MODERATE CYP3A4 INHIBITORS.	1.00		1.00	1.00
PROPOFOL / QT PROLONGING AGENTS	1.00	1.00	1.00	1.00
MOXIFLOXACIN / QT PROLONGING AGENTS			1.00	
METHADONE FOR MAT / SELECTED ANTIPSYCH.			1.00	
LEVOMEPROMAZINE / QT PROLONGING AGEN.	1.00			
HYDROXYCHLOROQUINE / POSSIBLE QT PROLO.			1.00	
HALOPERIDOL / QT PROLONGING AGENTS			1.00	
FLUCONAZOLE / QT PROLONGING AGENTS	1.00		1.00	1.00
DONEPEZIL / QT PROLONGING AGENTS	1.00		1.00	
DOMPERIDONE / POSSIBLE QT PROLONGING A.			1.00	
DISOPYRAMIDE / QT PROLONGING AGENTS			1.00	
CITALOPRAM / QT PROLONGING AGENTS	1.00		1.00	
AMIODARONE / QT PROLONGING AGENTS	1.00	1.00	1.00	1.00

Improvement in Delay to Medication Administration

Certain classes of drugs need to be administered on time because a drop in drug levels can cause patient harm. Epilepsy drugs are one such class. Delay or missing doses can result in subtherapeutic serum levels and this can lead to an unexpected seizure. In Ontario once a patient has a seizure, they lose their license to drive for one year. Thus, treatment given on time is imperative when the patient is admitted to hospital. We analyzed all patients with epilepsy class of drugs with respect to whether medication reconciliation met the target of under 24 hours or not. In patients from December 2020 to December 2022 who met this target the average time to administration of the first dose after admission was 15.9 hours earlier than if medication reconciliation was done greater than 24 hours.

Length of Stay (outcome measures):

This analysis shows the difference in total length of stay between patients who had medication reconciliation completed within 24 hours versus those patients who did not (i.e. completed greater than 24 hours). The length of stay difference held true through the years and recently has converged as the percentage of patients completed in under 24 hours has increased to over 70%. The calculations were done based on QIP definitions of excluding cases that were staying 24 hours or less as well as newborns and patients in NICU. Excluding the 24-hour cases, the difference between the two populations exaggerated. There were other initiatives in the hospital at both sites aimed at the length of stay, but we expect them to affect both groups equally. There was no difference in the delta between the two hospitals. Looking at Medicine and Surgery only, the difference between less than 24 hours and greater than 24 hours is a median 1.94 days in Med Surg cases = 46.6 hours (95% CI: 1.30-2.58 days; P <0.001). An analysis of the difference in length of stay for typical Medicine-Surgery cases (as defined typical excludes discharge less than 24 hours or greater than 21 days as well as excluding deaths,

separations and transfers) decreased this difference to 0.93 days (95% CI: 0.61 to 1.25 days; P <0.001). We looked at the 90th percentile length of stay case (long stay cases atypical cases) in Medicine and Surgery only and the difference was even greater at 5.7 days but the P- value was 0.22 or not significant (95% CI: –1.9 - 13.3 days). This relationship held true whether we examined Medicine and Surgery cases alone or including other departments such as Mental Health, Emergency department and the Women and Child program. The exclusions in the QIP project were those cases less than 24 hours, newborns and NICU cases. Graphs show all patients except for the exclusions.

In summary, we have been able demonstrate that the cohort of patients who have medication reconciliation completed within 24 hours of admission have a median **reduction of 1.94 days length of stay in Med Surg cases since January 1, 2019** than patients whose medications were reconciled more than 24 hours after admission.

	LOS Difference < 24h vs > 24 h	95% CI	P value
Med Surg cases	1.94	1.30-2.58	<0.001
Typical cases – Med Surg	0.93	0.61-1.25	<0.001
Long stay – acute Med Surg	5.7	-1.9-13.3-	NS

Table 1: Length of Stay (LOS) difference

Under 24 vs Over 24 Hour Med Rec LOS and Volume
QIP definition, Med-Surg Departments, All Cases
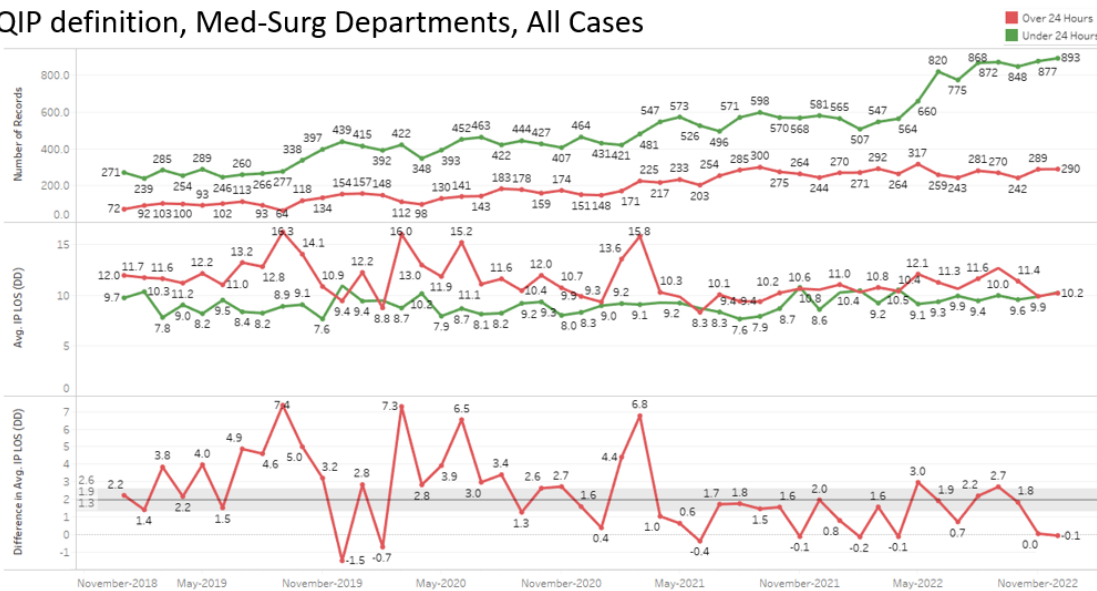
Under 24 vs Over 24 Hour Med Rec LOS and Volume
QIP definition, Med-Surg Departments, Typical Cases
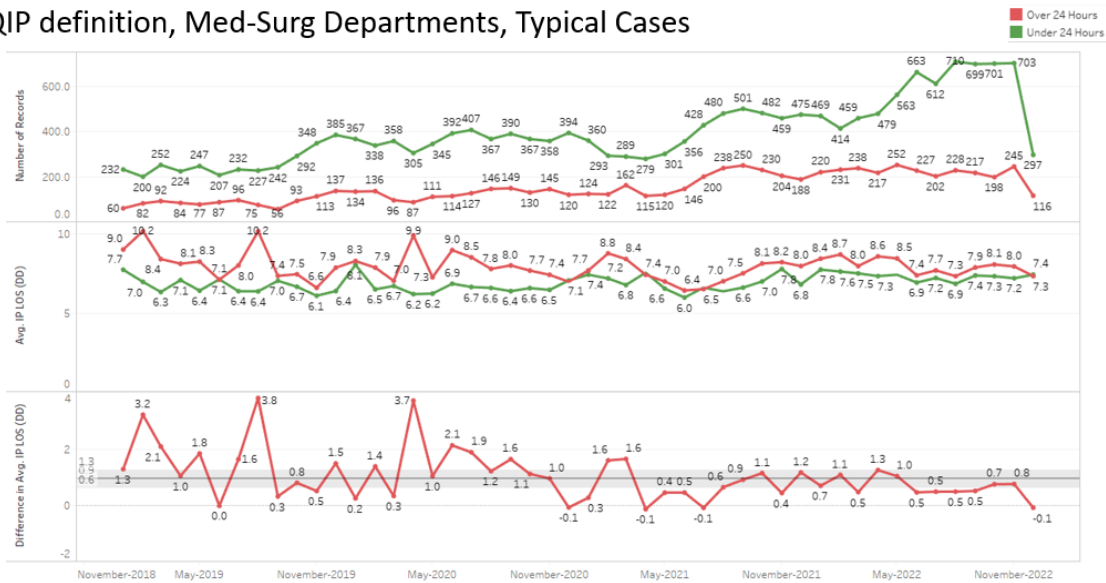
The Effect of Adverse Drug Events on the Length of Stay

From the coded data set the most common adverse drug reaction is anticoagulant adverse drug reaction. This for example would be bleeding or drop in hemoglobin, thrombosis. In patients where medication reconciliation is done within target of under 24 hours, vs over 24 hours the average difference in length of stay is 4.2 days later in delayed medication reconciliation. Clinically, this makes sense as subtherapeutic INR or elevated INR takes 3 to 5 days to correct prior to discharge.

Accountability and Driving Resilient Care Redesign

Electronic medication reconciliation compliance metrics can be broken down to different time variables and drilled down to the specific site and patient care area. Reporting for the QIP looks at the overall compliance at an organization level and this dashboard will also be used for ongoing monitoring and process improvement at the Medication Safety Committee.

The dashboard in the screen capture below also shows the proactive BPMH rate to enable better utilization and effectiveness of the BPMH pharmacy technician resources. In a Canadian environment without physician scribes, limited pharmacy resources and overloaded emergency departments, not every patient presenting in the Emergency department will be able to have a BPMH documented before admission and predicting who will be admitted is a challenge to directing those resources. This indicator has been useful to demonstrate the usefulness and efficiency of BPMH resources and will be more valuable in the future to monitor usefulness of artificial intelligence tools leveraged to predict likelihood of admission.

Medication Reconciliation Dashboard ⌄

Med Rec Metrics

These metrics populate daily

84.3 % Admission Med Rec MTD

72.2 % Admission Med Rec - 24 Hours MTD

96.3 % Discharge Med Rec MTD

- Inpatient Admission Medication Reconciliation (%)
- Inpatient Admission Medication Reconciliation (%) - 24 Hours
- Inpatient Discharge Medication Reconciliation (%)
- BPMH Completion Rate (%) - Overall
- BPMH Completion Rate (%) - 24 Hours
- Prospective BPMH Rate (%)

	Q1 '21	Q2 '21	Q3 '21	Q4 '21	Q1 '22	Q2 '22	Q3 '22	Q4 '22	YTD	QTD	MTD
	56.3%	57.4%	57.1%	55.6%	54.9%	65.1%	73.1%	85.4%	85.1%	85.1%	84.3%
	47.9%	48.4%	44.8%	45.2%	44.4%	53.3%	60.1%	73.2%	70.5%	70.5%	72.2%
	80.4%	74.1%	85.9%	90.3%	94.4%	96.3%	95.1%	94.5%	95.2%	95.2%	96.3%
	80.7%	82.3%	84.5%	84.3%	84.3%	85.8%	86.8%	92.9%	92.9%	92.9%	94.3%
	58.5%	58.8%	66.7%	66.9%	68.2%	70.8%	70.3%	77.6%	76.4%	76.4%	78.2%
	22.3%	21.3%	25.4%	23.6%	23.3%	28.3%	26.6%	30.6%	31.6%	31.5%	31.8%

Pharmacy leadership uses a consolidated dashboard, as shown below, of the real-time metrics for each patient care area across the organization to monitor daily workload and realign resources to areas requiring supports.   These dashboards also drive performance improvement by creating visibility when BPMH are charted but the medications have not yet been reconciled.

BPMH and Admission Medication Reconciliation - MRH

Report completed: Wed 22/2 05:16 PM

BPMH and admission medication reconciliation completion statuses for currently admitted patients.

BPMH and admission medication reconciliation completion statuses for currently admitted patients. Note that if medication reconciliation is completed by physician and BPMH is updated after the fact, medication reconciliation will revert to incomplete.

197 / 219 BPMH Marked as Reviewed Ratio

179 / 219 Admission Med Rec Completed Ratio

Department	Ratio BPMH Completed	Ratio Admission Med Rec Completed
MRH A2 CCC REHAB PURPLE	21 / 22	21 / 22
MRH A2 COMPLEX REHAB	11 / 13	11 / 13
MRH C3 MEDICINE AQUA	26 / 31	25 / 31
MRH C4 MEDICINE AQUA	27 / 27	27 / 27
MRH C4 MEDICINE PURPLE	28 / 29	26 / 29
MRH D3 MEDICINE AQUA	26 / 28	25 / 28
MRH D4 SURGERY PURPLE	25 / 27	21 / 27
MRH D5 CRITICAL CARE	21 / 22	15 / 22
MRH EMERGENCY DEPARTMENT	12 / 20	8 / 20
Ratio	197 / 219	179 / 219

BPMH and Admission Medication Reconciliation - CVH

Report completed: Wed 22/2 05:16 PM

BPMH and admission medication reconciliation completion statuses for currently admitted patients.

BPMH and admission medication reconciliation completion statuses for currently admitted patients. Note that if medication reconciliation is completed by physician and BPMH is updated after the fact, medication reconciliation will revert to incomplete.

310 / 321 BPMH Marked as Reviewed Ratio

265 / 321 Admission Med Rec Completed Ratio

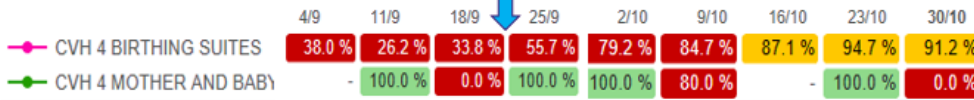| Department	Ratio BPMH Completed	Ratio Admission Med Rec Completed
CVH 2 CRITICAL CARE ABC	21 / 21	20 / 21
CVH 2 CRITICAL CARE RECOVERY UNIT	5 / 5	5 / 5
CVH 4 BIRTHING SUITES	6 / 6	1 / 6
CVH 4 MOTHER AND BABY	13 / 14	9 / 14
CVH 4 PEDIATRICS	0 / 3	0 / 3
CVH 5 MENTAL HEALTH	32 / 32	31 / 32
CVH 5 STROKE DEF	34 / 35	29 / 35
CVH 6 MEDICINE ABC	30 / 33	23 / 33
CVH 6 MEDICINE DEF	35 / 36	35 / 36
CVH 7 MEDICINE ABC	33 / 33	27 / 33
CVH 7 MEDICINE DEF	33 / 33	26 / 33
CVH 8 SURGERY ABC	30 / 30	30 / 30
CVH 8 SURGERY DEF	24 / 25	22 / 25
CVH EMERGENCY DEPARTMENT	14 / 15	7 / 15
Ratio	310 / 321	265 / 321

The quality aim group regularly looks at compliance in specific patient service areas to identify workflow and educational interventions to generate change ideas that target overall improvement. This improvement is overseen at Program Quality Councils and Medication Safety Committee to ensure changes are sustained.

A recent example of a process improvement occurred within the Women and Child program delivery team where the drill-down dashboard identified an opportunity for improvement. Focused interdisciplinary discussions resulted in interventions such as the implementation of a grease board for nurses, additional BPA's supporting this area's unique workflows and the opportunity to change nurses' security access to allow migration of MyChart patient portal inputs into the BPMH documentation in the EMR. A weekly drill down provided the improvement team with the ability to closely monitor the impact of their interventions and support a quick Plan-Do-Study-Act (PDSA) cycle to support improvement.

Medication Reconciliation Dashboard ⌄

Med Rec Metrics

Implemented "Med Doc Reviewed" on Sept 21, 2022

BPMH Completion Rate (%) - Overall

	4/9	11/9	18/9	25/9	2/10	9/10	16/10	23/10	30/10
CVH 4 BIRTHING SUITES	38.0 %	26.2 %	33.8 %	55.7 %	79.2 %	84.7 %	87.1 %	94.7 %	91.2 %
CVH 4 MOTHER AND BABY	-	100.0 %	0.0 %	100.0 %	100.0 %	80.0 %	-	100.0 %	0.0 %

As mentioned previously, the corporate dashboards are monitored through the organization's Quality Improvement Plan and reported through the Hospital Quality Committee to the Quality, Safety, Risk Committee of the Board. The results are also reviewed quarterly at the organization's Medication Safety Committee to identify areas of opportunity. The Quality Aim group attempted to develop a physician medication reconciliation compliance scorecard for each provider, however due to changes in handover of patients from physician to physician and the coverage models, it was very challenging to assign accountability for completion to any one specific provider at a given point in time. Efforts are currently under way to establish an oversight and reporting mechanism through the program Quality Councils and physician departments to identify contributors of low compliance and establish department or program specific improvement plans to further improve compliance rates.

Impact in a Canadian Healthcare System

In the Canadian healthcare environment, patient flow is a pervasive issue with demand far exceeding the system's capacity. The length of stay reduction of 1.94 days implied by the data in this case study, when evaluated with a 67% YTD rate of medication reconciliation within 24 hours of admission, equates to a saving of 16,615 patient days over 3 years. This translates to 45.5 beds over 3 years or about 15 beds per year. Because these beds are always occupied, this does not represent a financial savings to the healthcare system, however in this setting where access to care is at a premium, this information positively contributes to overall efficiency in patient flow.

This case study has also highlighted the importance of creating visibility to actual compliance with quality and safety processes. The use of surrogate measures of medication reconciliation compliance (i.e. completion of a BPMH) do not always translate to compliance with the action that truly impacts patient safety.