Leveraging Pharmacy-Centric Workflows within the Electronic Health Record as a Cornerstone to Robust Transitions of Care Services

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Transitions of care is an area at high risk for medication errors. Omissions, duplications, wrong medication initiation or inappropriate discontinuation are just a few of the possible complications that can arise during hospital admission and discharge processes.[1] Recent research shows that such medication-related problems are exceedingly common – nearly 50% of medication reconciliations were found to contain errors in a study of elderly patients taking five or more medications prior to admission.[1] Additional studies on medication reconciliation have resulted in similar findings.[2,3] The consequences of such errors can be significant, both in terms of patient risk and cost to the healthcare system.[2-5] Up to 12% of permanent disabilities and deaths have been attributed to adverse drug events, with the cost of these errors as a whole estimated at 3.8 million dollars per hospital per year.[2,3] As such, it is important to ensure the integrity of processes surrounding medication reconciliation.

In this article we describe a suite of services implemented at Aurora Health Care that are intended to streamline workflows and safeguard against medication errors during transitions of care. These services include medication histories, medication reconciliation order pending, medication reconciliation review, and bedside delivery of discharge medications (Figure 1). We will detail both the electronic health record (EHR) workflows used to support these services, and strategies that made these services successful.

> **Editors Note:** *This article was invited to discuss innovative workflows and technologies within healthcare institutions to promote patient care*
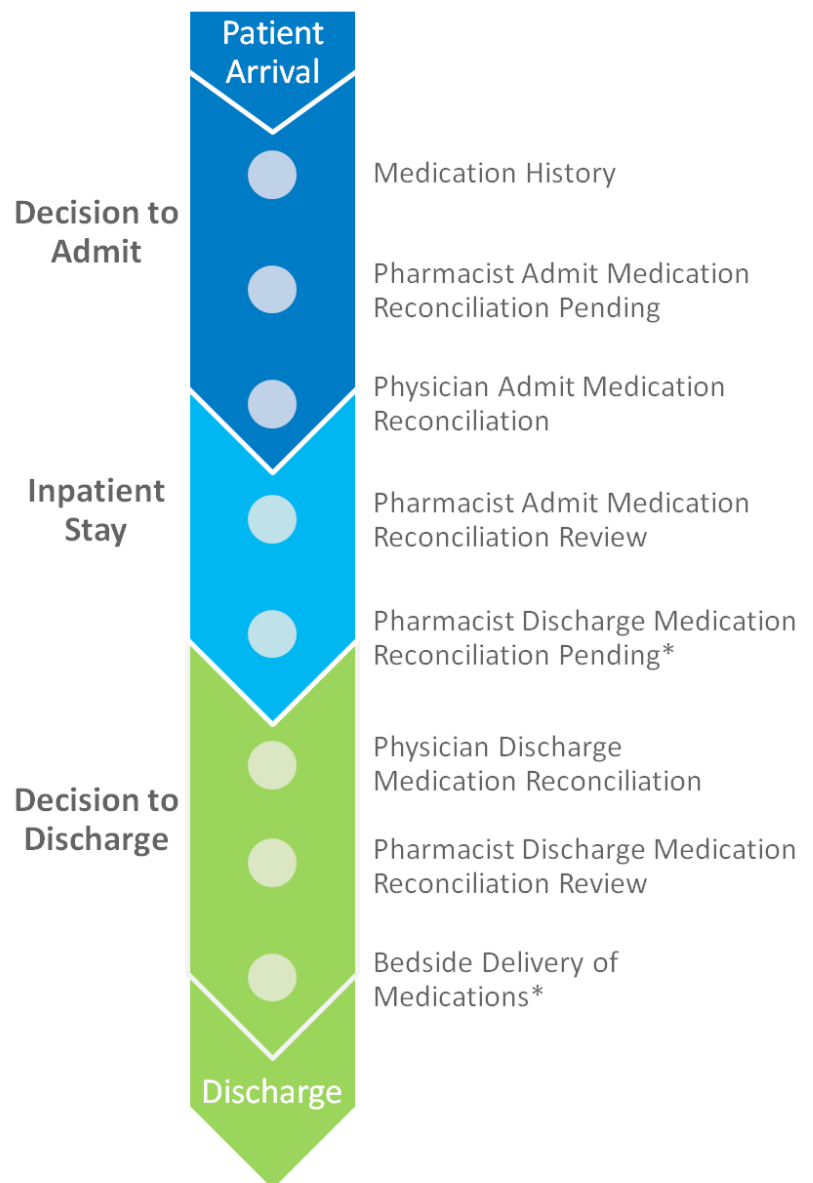
FIGURE 1. Transitions of Care Workflow

*Optional Processes

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Transitions of Care Process From the Pharmacy Perspective

Technician-Driven Medication History

The first of the pharmacy-managed transitions of care activities is the admission medication history. The process begins with the decision to admit a patient to an inpatient unit. Direct hospital admissions and admissions from the emergency department both generate a real-time message within the EHR which is sent to pharmacy technicians notifying them of a medication history to be completed. The technician uses a custom-built navigator (i.e. a series of interconnected pages which guides the user through a workflow) within the EHR to direct them through the process of documenting prior-to-admission medications. Information obtained from the patient or caregiver, as well as the patient's pharmacy, is used to compile an accurate medication history. Once finished, the technician documents the medication history as complete within the navigator, which allows other members of the health care team to see that it has been done.

Pharmacist Admission Medication Reconciliation Order Pending

With the medication history completed, the pharmacist is then able to "pend" admission medication reconciliation orders for patients admitted from the ED. This order pending service allows a centralized group of pharmacists to enter (but not sign) complete medication orders prior to medication reconciliation by the provider. Medication issues related to formulary substitution, renal dose adjustment, and drug interactions are just a few examples of the problems that can be preempted through this pending process. Once the pharmacist has pended these medications, the provider may choose to accept or reject the actions of the pharmacist on a medication-by-medication basis.

The admission medication pending process begins when the technician marks a medication history as complete. This action generates an automated message to the pharmacist assigned to the pending orders workflow, notifying the pharmacist that an admission medication reconciliation pending is available to be completed. The pharmacist then opens the patient's profile and begins the process by launching a specially-designed workflow navigator within the EHR that contains all of the information and activities needed for pending orders (Figure 2). Within the navigator, the pharmacist reviews the prior-to-admission medication list, begins selecting an action for each medication as appropriate (e.g. resuming, holding, or replacing medications), and pends the actions for the provider to review and sign at a later time. The next step in the workflow allows the pharmacist to leave a brief note, viewable by the provider, which outlines pertinent information regarding the medications that were pended. Finally, a formal note in the patient's medical record is automatically generated by the navigator for the pharmacist which includes

FIGURE 3. Example of Pended Meds

Reconcile Prior to Admission Medications ←→

ⓘ This is where you determine which Prior to Admission medications will be ordered as Inpatient medications.

Sort by [Reviewed ▾]   Order Unselected | Don't Order Unselected | ⚠ Next

Orders Needing Review

🖰 **albuterol inhaler 2 puff**   [Continue as inpatient] [Don't continue as inpatient] [Replace] [Remove permanently from med list]
2 puff EVERY 4 HOURS PRN, Inhalation, Asthma Symptoms, Starting Today at 0939
Shake well before use.
This order was created from albuterol (VENTOLIN) 108 (90 BASE) MCG/ACT inhaler

🖉 **cyanocobalamin injection 1,000 mcg** [Continue as inpatient] [Don't continue as inpatient] [Replace] [Remove permanently from med list]
1,000 mcg EVERY 30 DAYS, Intramuscular, First dose on Wed 9/21/16 at 0900

🖰 **hydroCORTisone (CORTIZONE) 1 % cream** [Continue as inpatient] [Don't continue as inpatient] [Replace] [Remove permanently from med list]
2 TIMES DAILY, Topical, First Dose Today at 1145
For external use only.
This order was created from triamcinolone (ARIS

Pended Reconciliation

⚠ There are reconciliation changes pended by Rahim Merchant, RPH on
Mon Dec 12, 2016 1:18 PM. Would you like to apply these changes?
Any pended changes can be reviewed and changed before signing.

[Manage this unsigned work] [Delete this unsigned work] [Close]

🖰 **lisinopril (ZESTRIL) tablet 10 mg** ...emove permanently from med list
10 mg DAILY, Oral, First Dose Today at 1145
This order was created from benazepril (LOTENS

🖰 **montelukast (SINGULAIR) tablet 10 mg** ...emove permanently from med list
10 mg NIGHTLY, Oral, First Dose Today at 2100
This order was created from montelukast (SINGU

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all pended actions. The order pending process is completed once the pharmacist signs the note.

Provider Admission Medication Reconciliation

Once the pharmacist has pended the orders, the provider will see an alert in their admission workflow notifying them that pharmacist medication reconciliation pending is complete. The brief note left by the pharmacists during their pending process is shown within this alert to aid in communication. When the provider begins medication reconciliation, he or she will see actions for each medication pre-populated as the pharmacist had previously pended them (Figure 3). The provider can choose to accept all actions, modify certain medications, or remove all actions and start over. Once the provider has completed the medication reconciliation and signed all orders, pharmacist medication reconciliation review can begin.

Pharmacist Admission Medication Reconciliation Review

The process of medication reconciliation review occurs within the first 24 hours of admission, and involves a pharmacist assessment of all orders signed by the provider during medication reconciliation. Patients needing review are identified during daily patient monitoring through the use of specific icons displayed on pharmacists' patient lists (Figure 4). These icons indicate the status of a patient's

medication reconciliation review, with a red exclamation point representing an incomplete review, and a green checkmark representing a completed review. Once a patient with an incomplete review is identified, the pharmacist uses a customized medication reconciliation navigator to compare prior-to-admission medications with signed medication orders (Figure 2). Many medication-related problems are frequently preempted through the pending process, however, those which remain are addressed during review or noted for follow up in a pharmacist intervention tool within the EHR. These notations display in several pharmacist daily workflows, to ensure that they are able to be attended to at some point during the patient's inpatient stay. Once the medication reconciliation review is complete, the pharmacist documents it as such. This causes the patient list icon to change from a red exclamation point into a green checkmark, indicating to

other pharmacists that the review has been completed.

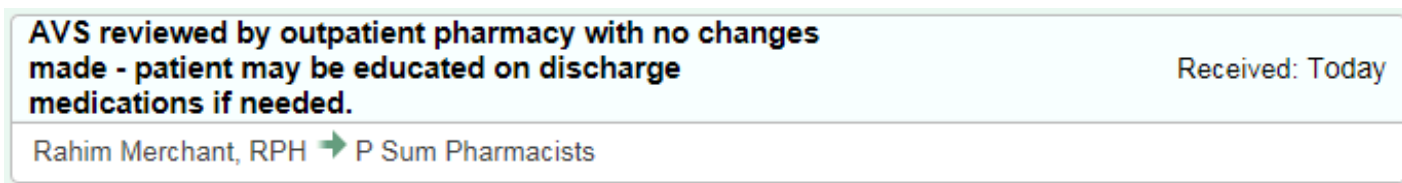### Discharge Medication Reconciliation Order Pending

While pending of medication orders on admission is done for many of the patients at Aurora, pending of medications on discharge is done by consult only. As such, workflow for this service differs slightly from pending of admission orders. The process typically begins several days prior to the expected date of discharge. Providers must enter a consult for pharmacy to pend medications prior to discharge medication reconciliation. This action automatically generates several indicators to pharmacy that a patient requires pending of medications for discharge, including an icon within the pharmacist's patient list, as well as a banner within the pharmacist's monitoring tool. The pharmacist utilizes a customized workflow navigator to

FIGURE 4. Example Patient List

Patient Name/Age/Sex	Room/Bed	Admission Date	RPh Admit Med Rec	RPh D/C Med Rec
Willow, M (66 year old M)	T10110/A	11/1/16	✓	⛔
Willow, M (30 year old F)	T10101/A	11/1/16	✓	✓

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FIGURE 5. Example Message

AVS reviewed by outpatient pharmacy with no changes made - patient may be educated on discharge medications if needed.

Received: Today

Rahim Merchant, RPH ➜ P Sum Pharmacists

review medications for discharge, perform medication pending on those medications, and leave brief notes to the provider regarding the pended actions. Pharmacists periodically review the pended actions, and revise them throughout the patient's stay, to ensure that the pended discharge medication reconciliation orders are clinically appropriate for the patient as their condition changes. If the consult for discharge medication reconciliation was entered on the day that the patient is expected to be discharged, the pharmacist is also notified via a real-time message within the EHR. The pharmacist will then pend discharge medications as appropriate for the patient's discharge that day.

Provider Discharge Medication Reconciliation

Once the provider has made the decision to discharge the patient, he or she may begin the discharge medication reconciliation process. If the pharmacist has pended medications for discharge, the provider will be alerted that the pharmacist has pended medications and will see the brief notes left by the pharmacists, as well as the pended actions during reconciliation, similar to the admission medication reconciliation process. The provider may then choose to accept all actions, modify certain medications, or remove all actions and start over. The provider discharge medication reconciliation is complete once the provider has signed all medications for discharge.

Pharmacist Discharge Medication Reconciliation Review

After the provider has completed the discharge medication reconciliation process, the pharmacist is notified to complete a medication reconciliation review by both a patient list icon and a real-time notification message within the EHR. Note that while discharge medication reconciliation

order pending is optional and completed only by consult, discharge medication reconciliation review is intended to be completed for nearly all patients. Similar to the admission medication reconciliation review, the pharmacist checks for problems such as medication interactions and dosing errors, as well as problems specific to discharge, such as unclear medication instructions. After collaborating with the provider to resolve any medication-related problems, the pharmacist documents the review as complete.

Bedside Delivery of Discharge Medications

After the medication reconciliation is reviewed by the pharmacist, the nurse is notified within their discharge navigator that the discharge medication list can be given to the patient. In addition, the nurse will also send any paper prescriptions to the outpatient pharmacy if the patient elected to utilize the discharge medication delivery program provided by the facility's outpatient pharmacy. The outpatient pharmacy is automatically notified within the EHR of a patient requiring discharge prescription delivery when both of the following conditions are met: 1) the patient has elected to use the bedside medication delivery program based on discrete documentation and 2) the discharge medication reconciliation review by the inpatient pharmacist is complete. At this point, the outpatient pharmacy will begin to prepare and deliver the medications to the patient's room. Inpatient pharmacists are kept informed of the status of the prescriptions at all times through real-time notification messages generated by outpatient pharmacy actions (Figure 5). Inpatient pharmacists have the ability to see that a prescription requires additional insurance authorization before being delivered, that changes were made to the originally prescribed medications, and that

a prescription has been delivered. This allows the inpatient pharmacist to inform nursing of any delays in prescription delivery and to better coordinate the timing of medication education. The integration of this information between inpatient and outpatient pharmacists also ensures that workflows yield an accurate discharge medication list, convenient discharge prescription delivery, and efficient and seamless medication counseling.

At a high level, the pharmacy-managed transitions of care services implemented by Aurora ensure safer medication therapy during the error-prone admission and discharge processes. Key benefits of these services are assuring the integrity of patient medication lists (inpatient and outpatient), assessing for and intervening on inappropriate medication orders, and providing medication education when needed. In addition, efficiencies result from medication order pending during medication ordering and verification, as potential medication-related issues are preemptively resolved by the pharmacist. Efficiencies in process were also realized by integrating the various transitions of care activities into the EHR in an intuitive manner that limited the need to manually find information, and worked seamlessly into existing pharmacist workflows. Finally, bedside delivery of medications has benefitted patients by potentially increasing the rate of prescription pick-up.

Strategies for a Successful Implementation

The implementation of these services throughout the organization was not an easy feat, nor completed in a single iteration. Instead, a structured process of planning, piloting, and collecting data was utilized in order to achieve our end goal. There were also several factors that worked together to facilitate the implementation

and success of these initiatives at Aurora Health Care.

Integrated Health System

The first of these factors is the organization's approach to functioning as an integrated health system, despite the challenges of the diverse practice settings that exist across all 16 hospitals, 150+ clinics, and 70+ retail pharmacy sites. Aurora Health Care operates on one formulary, has one pharmacy and therapeutics committee, and uses a single EHR instance among all hospitals and clinics. In addition, each discipline has a systemized structure – especially so within pharmacy. The pharmacy department is headed by a cabinet comprised of senior leadership with representation of inpatient services, ambulatory, and outpatient areas, to encompass the entire continuum of patient care. This practice-based representation is mirrored in other decision-making bodies throughout the pharmacy department, such as the system pharmacist practice council and system technician practice council. Structuring the department in this manner has allowed for effective and rapid implementations, as input is gained from all sites and final workflows are standardized throughout the system.

System Level Multidisciplinary Collaboration

Aurora applied this unified, systems approach for its transitions of care initiatives by chartering a system-level medication reconciliation steering committee co-lead by nursing, pharmacy, and provider champions. This council is comprised of front line providers and leaders from case management, compliance, pharmacy, nursing, medicine, clinical informatics, and IT (information technology) with representation of inpatient and outpatient care areas. Inviting all stakeholders to the table allowed for informed, efficient decision-making, buy-in from all disciplines, and fostered the development of a solution that managed transitions of care from all angles. While higher level decisions were made with this group, the committee also broke out into process, practice area, and discipline-specific workgroups comprised of end-users. These workgroups had ownership of workflows by defining the detailed processes, documentation, and tools that would ultimately bring these initiatives to life.

Integration of Clinical Informatics and IT

Even with the diligent work put into implementing these initiatives, to truly be successful, they required regular use and incorporation into end-user workflow. One manner in which this was achieved was through the creativity of the clinical informatics and IT teams to leverage EHR functionality in innovative ways. The solutions that were developed – the various navigators and automated messaging, for example – were not pre-built within the EHR, and only came to fruition by incorporating informatics representatives from the very onset of this initiative. By doing so, clinical informatics and IT were able to collaborate with clinicians to help shape the narrative of transitions of care. Thus, they were able to avoid the back-and-forth dialogue that often results when clinicians have developed an idea, only to later find out that the technology is unable to support it.

End User Buy-In

As a result of the aforementioned multi-disciplinary collaboration, the tools that were developed were designed to integrate the transitions of care initiatives into existing workflows in an efficient manner that had minimal impact in full time equivalents (FTEs). Ultimately, in order for the end user to incorporate these solutions into their day-to-day activities, these workflows needed to provide them some type of value. This was accomplished by using the EHR as a foundation for all of these interrelated activities, and also providing transparency to all clinicians throughout the various stages of the process. For example, instead of expending effort to contact pharmacy to determine if discharge medication reconciliation review had been completed, nurses are automatically alerted from within their discharge navigator. By reducing the need for unnecessary disruptions in workflow, these tools have become indispensable components of daily operations.

Conclusions

We have discussed various ways in which Aurora Health Care has been able to leverage pharmacy within transitions of care – an area where the profession can be highly impactful. Aurora has been able to implement these solutions by working as an integrated organization, and driving initiatives through a system-level steering committee that is centered upon multidisciplinary collaboration. End-users were given ownership of workflows and worked closely with informatics and IT to ensure a seamless process from start-to-finish. As transitions of care remains a high priority within healthcare, these processes will continue to evolve to meet the challenges that are faced in closing gaps of care for patients. ●

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References

1. Rodriguez Vargas B, Delgado Silveira E, Iglesias Peinado I, Bermejo Vicedo T. Prevalence and risk factors for medication reconciliation errors during hospital admission in elderly patients. *Int J Clin Pharm.* 2016;38(5):1164-1171.
2. Vira T, Colquhoun M, Etchells E. Reconcilable differences: correcting medication errors at hospital admission and discharge. *Qual Saf Health Care.* 2006;15(2):122.
3. Varkey P, Cunningham J, O'Meara J, Bonacci R, Desai N, Sheeler R. Multidisciplinary approach to inpatient medication reconciliation in an academic setting. *Am J Health Syst Pharm.* 2007;64(8):850-854.
4. da Silva BA, Krishnamurthy M. The alarming reality of medication error: A patient case and review of Pennsylvania and national data. *J Community Hosp Intern Med Perspect.* 2016;6(4):31758.
5. Anderegg SV, Wilkinson ST, Couldry RJ, Grauer DW, Howser E. Effects of a hospital-wide pharmacy practice model change on readmission and return to emergency department rates. *Am J Health Syst Pharm.* 2014;71(17):1469-1479.