Application Program Interface Implementation for the Intercommunication of Prescription Information

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According to the World Health Organization (WHO) (2019), the yearly global financial burden for medication errors is approximately US$ 42 billion. In the United States, medication errors are a primary cause of mortality (Rodziewicz et al., 2023). For example, a patient presented to an emergency room (ER) in North Carolina with complaints of severe vomiting and mental confusion. The symptoms were atypical for this patient, considering their disease history. The physicians admitted the patient to the intensive care unit for diagnosis. After a few days, providers transferred the patient to a higher acuity facility for further workup. After receiving a faxed discharge summary from the initial hospitalization, primary care providers noted that the patient's presenting symptoms were also adverse reactions to a recently prescribed medication, ixekizumab. Neither hospital knew the medicines the patient was taking. The primary care providers immediately contacted the second hospital to inform them of the patient's medicine list. This scenario demonstrates the necessity for accurate medication reporting between primary care clinics and other healthcare facilities. Software technology could assist healthcare providers with decision-making that improves patient outcomes.

A pilot study utilized a type of API, a social knowledge network system, to demonstrate the effects of increasing "meaningful use" versus "limited use" of the EHR's MedRec (Rangachari et al., 2019, p.23). Limited use of an EHR MedRec includes only the software's functions. Meaningful use (MU) meets Health Information Technology for Economic and Clinical Health Act (HITECH) requirements to complete a MedRec for care transitions. Centers for Medicare and Medicaid Services (CMS) requirements for MU include the use of a CMS-approved EHR, accomplishing CMS-defined goals such as continuing quality improvement (QI) initiatives, and reporting measurements of QI or other set goals (Anumula & Sanelli, 2012). The MedRec process includes listing all medications a person takes, separately listing medicines that will be ordered, and comparing the lists (Rangachari et al., 2019). Then, using critical thinking and decision-making skills to determine the comparison results for continued medications, the current list is

disseminated to the patient and healthcare provider for transition. The reduction of medicine errors and improved MedRec lists help determine the efficiency of MU. Rangachari et al. (2019) report that increased usage of "'External Rx History Import'" (p.28) improves the reconciliation of medications for current and new prescriptions. It also decreases the number of undocumented drugs. Without API technology and a lack of EHR MedRec use, the project site's pharmacy software does not meet MU requirements to decrease the risk of medication discrepancies effectively.

The project site is a non-profit 501 3 c facility providing free primary healthcare, pharmaceutical, and limited dental services to 226 patients in three North Carolina counties (Clinic Director, personal communication, January 4, 2024). The facility's mission is to provide primary care services for underserved populations regardless of citizenship or legally protected class. Anyone aged 18-64 may apply for services and receive care if they meet eligibility requirements for county residency, lack of insurance, and an income of less than 300% above the federal poverty line. Volunteer medical providers and one paid provider complete an average of 70-80 monthly primary care visits. Orthopedics, dental, and women's health provide 30-35 monthly encounters. The pharmacy dispenses over 400 prescribed medications per month. Through private donations, grants, extensive fundraising, and volunteer services, the clinic can increase every dollar donated to $8.00 worth of medical services provided. The project site also utilizes other charity sources to cover expenses outside the facility, such as specialty consults and diagnostic services. Most of the supplies for clinic use are donated. The EHR is provided free of charge through The North Carolina Association of Free and Charitable Clinics.

Literature Review

A literature search was completed to find information regarding implementing API to allow different types of software to communicate and become interoperable within a primary care setting for MedRec use. The literature search yielded 106 articles, but only five pertained to the DNP project. The articles selected contribute to the study but do not provide information to suggest the best solution for

this DNP project. There is a research and literature gap because there is little information about API software implementation specific to primary care settings for medication reconciliation. The levels of evidence in the most relevant studies are level V and level VI.

Each study is distinct in its research purpose but contains elements related to the proposed DNP project. The reviewed articles all agree that the lack of interoperability of systems for EHRs is a barrier that influences MedRec (Cresswell et al., 2019; Redmond et al., 2020; Sutton et al., 2020; Tamblyn et al., 2019). Inaccuracy of a medication list leads to an increase in the potential for medication-related errors. The literature promotes using protocols and systems to communicate between healthcare networks, EHRs, pharmacists, and healthcare providers to reduce mistakes and efficiently resolve discrepancies. Four articles directly relate to some API implementation and endorse its use. One piece pertains to communication between pharmacists and general practitioners to resolve medication discrepancies and errors via telephone or email and is considered adequate (Onatibia-Astibia et al., 2022). However, predicting that the error resolution frequency decreases with an API system is reasonable.

To judge the efficiency of a new computer decision support system (DSS) before implementation nationally in Scotland, researchers conducted a qualitative study through pilot implementations, demonstrations, discussions, and interviews with key stakeholders (Cresswell et al., 2019). One of the four primary themes discovered was the significance of ease of use and interoperability of software. However, the DSS needed to communicate with two major EHR systems in Scotland. This DSS system was not strictly related to just the EHR MedRec. However, this API barrier presented stakeholders with concerns about the need for interoperability, creating work redundancy and wasting time.

A study in Ireland to determine impediments and catalysts for MedRec showed five areas for consideration (Redmond et al., 2020). Areas addressed were ease of use and complexity of completing a MedRec, interdisciplinary team approach and potential for lack of communication, motivation of stakeholders to encompass innovations, patient knowledge of the drug regimen, and multiples or

duplication of medication. One barrier included a lack of "information and communication technology" (ICT) guidance (Redmond et al., 2020, Results section). ICT issues were a primary and continual cause of grievance for study participants. Issues most reported concerned facilities that were paper and computer-based for EHRs and interoperability of systems. The suggested solution is linking prescription databases.

Sutton et al. (2020) discuss the lack of software communication and the problem with the transportability of clinical decision support systems (CDSS) information. There are concerns that the CDSS is not designed for interoperability or cannot communicate well with other systems, preventing patient information from flowing to other systems. A cloud-based system is a practical solution, but one must still have an API to allow interoperability. Cloud-based systems are approved by the Health Insurance Portability and Accountability Act (HIPAA), providing they meet government security requirements. The interoperability of software is a barrier to more than just MedRec completion.

One clustered randomized trial wished to establish whether using an electronic medication reconciliation process from government insurers to coordinate at-home medications with hospital-ordered prescriptions is beneficial (Tamblyn et al., 2019). This study's goal was to show a significant improvement in adverse drug events (ADE) 30 days after hospitalization. Although there was no substantial improvement in the ADEs, there was a significant decrease in medication discrepancies.

The project site does not utilize the EHR medication list, and the site's pharmacy software does not communicate with the EHR. Thus, pharmacy software does not translate medications to the EHR list. The pharmacy-generated list is utilized for MedRec purposes. Non-project site pharmacy prescriptions are manually added to the pharmacy medication list when reported. The pharmacy does not add over-the-counter supplements because of the cost of each prescription entered in the software. There is a significant risk of medication discrepancies without accurately translating the patient's medications.

Current literature and research suggest that API can help improve the MedRec process and reduce medication discrepancies.

Purpose Statement

The DNP project aims to create a bridge between the site's pharmacy software and EHRs linked via government-compliant systems such as the NC HealthConnex. NC HealthConnex is an electronic network for healthcare exchange among healthcare providers (North Carolina Department of Information Technology, 2023) that allows the pharmacy software to communicate with the EHR so that the medication lists are accurate to eliminate potential or actual medication errors. This DNP study aims to evaluate the API effectiveness and improve the medication accuracy of the medication lists for the project site. The research will add to the current knowledge regarding the effectiveness of API use.

Methods

The DNP project utilizes a theoretical framework and a Systems Theory. The framework serves as a guide for the research process and for the study to encompass variations between the clinic pharmacy and other clinic healthcare providers with the same goal of creating an accurate medication list (Luft et al., 2022). The theory allows facilitation for multiple independent facilities to create one system, such as numerous primary care clinics, hospitals, imaging centers, and pharmacies, to make a healthcare system (Plsek, P., 2001). The API implementation will link the clinic system to allow other parts of the healthcare system to exchange information better.

PDSA cycles were implemented at every sample audit to ensure consistency of methods and rules for the inclusion and exclusion criteria for pre- and post-implementation samples and medication auditing. Pre-implantation sample inclusion criteria consisted of charts that must be of active patients at the time of data collection; medication lists must contain at least three medications to audit, and either a consult visit or an ER visit as of January 2023 but before September 1, 2023, with a home medication list. Some consult notes were disqualified as samples because the medication list was omitted from the

progress note. An online random number generator assigned chart order to all active patients. The first 40 samples that met the criteria were accepted for the project. The team felt that 40 samples, or about 15 percent of the patient population, well-represented overall MedRec encounters. The most recent visit date for multiple ER or consult notes was selected. The post-implementation samples had to meet the same criteria as the pre-implementation charts. The only difference between the samples is that all the pre-implementation charts had different patients, and the post-implementation samples contained some repeated patients but with varying visit dates. Also, post-API samples consult and ER visit dates occurred after 11/1/23.

Medication exclusion criteria for audit were antibiotics, as-needed medications, over-the-counter medications, one-time medications, short-term medications like a prednisone taper, and vaccinations. Medication errors were counted for differences in dosage and frequency, missing dosage or frequency, or omitted medications from either list. Inclusion for correct medication included the right patient, drug, dose, route, and time. Other medication criteria included that they are prescribed, changed, or discontinued before the consultation or ER visit date for audit inclusion.

Intervention

The team comprised the site pharmacist, two MedServe fellows, and a primary investigator (PI). An application for certification from the National Council of Prescription Drug Programs for the site pharmacy was completed so the API could begin working with the pharmacy software. The API was active as of August 22, 2023. The MedServe fellows assisted in reviewing the charts for any ER visit or consultation notes. They printed the pharmacy list for the selected samples to compare with the home medication list. The first 40 charts that met all criteria were chosen for the study.

Post-implementation samples were collected from the transmission order of the fax machine at the project site from November 1, 2023, through January 4, 2024. This period gave enough time for the API to begin transmitting medication information to the site EHR and other healthcare facility EHRs

associated with the patient. Only 26 eligible samples were collected for post-implementation; thus, the first 26 pre-implementation samples were used for comparison. All chart samples were double-checked for criteria certification.

Each nurse employed at the project site completed an anonymous survey to determine the staff's opinion of MedRec at the facility. The survey asked three questions about how comfortable they felt completing a MedRec at the facility regarding safety, proficiency, and whether they liked the current procedure. A choice of five responses, from strongly disagree to strongly agree, was provided, and a numerical value of negative two to positive two was assigned. The neutral option response was assigned a value of zero.

Results

For the medication errors, the proportion of the number of errors was calculated for each pre- and post-implementation sample, and the total percentage of errors for each sample group was calculated to compare if there was an increase or decrease in the number of medication errors for the post-API samples. The percentage proportion for errors was chosen to demonstrate the research data as most would understand it. The pre-implementation group totaled 106 medication errors out of 155 medications audited (68% errors). The post-implementation group totaled 122 errors of 221 medications audited (55%). These figures show a 13% decrease in medication error in the post-API implementation group. The first 155 pre- and post-implementation medications audited were compared to note 88 medication errors (57%), which demonstrates an 11% decrease in error.

Four nurses completed the pre-implementation survey, which has a total value of negative five. Three of the same four nurses completed an identical post-implementation survey, scoring seven, indicating a 12-point increase in their level of confidence. Another statement was added to the post-implementation survey to request written thoughts regarding the success of a new policy for MedRec using the EHR after the API.

Statements included:

"I am positive we will develop a successful policy for medication reconciliation."

"Any decrease in medication error is positive, and an EHR which improves the transfer of prescription medications would be beneficial to any healthcare office/ clinic."

"As long as the staff is trained and has continuing education on how to properly reconcile the medications, I think we will be successful in that area."

Barriers and Limitations

The first barrier noted during the project's implementation phase was the uncertainty of when the API would begin to transmit patient medication data to the EHR. The transmission timing would affect post-implementation samples. Pre-implementation samples were already collected. After contacting the API software team, the site liaison and the PI decided to wait at least six to eight weeks, as patient information would not cross over until patients picked up their medications from the pharmacy. Therefore, if a patient recently picked up all refillable drugs for nine months before API, the EHR would not update until the next refill. However, after five weeks, some medication lists on consult notes and ER lists had the medications printed identical to those on the pharmacy medication list with exact wording, font, and instructions. It was inevitable that the API crossed over to the project site EHR and other facilities. The discovery meant that other providers would have a record of the patient's medication list. Other pre-implementation barriers to the project included rules for excluding medications for auditing and counting medications as errors.

Medications typically ordered as needed (prn) were often written around the clock, for example, an albuterol inhaler with a frequency of every four hours instead of every four hours prn shortness of breath. After discussion with the site liaison, it was determined that the medication should be read as written, and if it did not state prn, then it should be around the clock. The missing reason for using the prn was not counted as an error in this study. Some medication discrepancies are related to the time of

updating the pharmacy list with a new medication order and the consulting physician visit date. For instance, when a patient had a consultation visit before the date that medication changed, discontinued, or began, and there was a discrepancy, audit exclusion applied for that medication. Other auditing rules determined not to count a medication as incorrect included if the dosage was the same regardless of taking more tablets to equal a specific dosage, if the frequency was the same, such as "every day" versus every night at bedtime, and when names of medications were different such as metoprolol succinate reading as metoprolol ER on the comparative list as both medications are extended-release. Each time a new error variation occurred, the samples were reviewed again for audit criteria consistency.

A significant barrier post-implementation was Medicaid expansion, and a large percentage of the patient population group decreased due to Medicaid approval. The decrease in patients lowered the number of referrals and consult visits for sample collection. After discussing this with faculty advisors and the site liaison, the sample collection period was extended. However, the extension yielded 26 post-API samples. Thus, a decision was made to use only the first 26 pre-implementation samples for the comparison study instead of the initial 40.

In retrospect, more knowledge of the API would benefit the study before implementation, such as the time to begin transmitting data and calculating how long it would take for most of the patient population's medications to transmit to the site's EHR and thus other provider facilities' EHRs. The team recommends establishing at least six months of API implementation before collection for post-implementation samples and a minimum period of 6 months for the post-implementation collection time. Another recommendation is to have a more significant number of samples to compare. The team feels more time would yield a larger sample pool and provide more substantial results.

Post-implementation Findings

Four post-API samples noted that some medications did not cross over from the project site pharmacy to the consulting provider's or ER EHR medication list. Another sample showed that the API

updated the consulting provider MedRec for an olmesartan prescription to replace losartan. However, the consulting provider MedRec still had losartan listed as well. This study cannot determine if the API did not indicate the discontinuation of the losartan or if the other facility did not question the use of both medications and make corrections to the MedRec. Another consulting provider's medication list did not show any updates from the API. The last recorded medication entries were from 2014, yet the API's last medication update was 11/6/23. Consulting providers are sent medical history and a current pharmacy medication list before appointments. A lack of API interoperability may be a reason for concern. Two samples included the same patient but different provider consults within the same healthcare facility complex. Some medications were transferred to one entity but not to the other. Again, it cannot be determined if this is an API-related incident or if the facility complex has various EHRs that may not communicate with the project site's API. These findings demonstrate the significance of MedRec completion at every patient encounter.

Implications for Practice

Implications for the DNP project include meeting standards set forth by the 2009 Health Information Technology for Economic and Clinical Health Act (HITECH). In 1996, HIPAA section Title II required providers to provide a means for EHR transmissions, such as electronic prescribing and data transmissions to other providers, while maintaining HIPAA security (Brook, 2023). HITECH enables users to demonstrate work completed using a quantifiable and qualifiable method via the EHR. Providers must comply with HITECH Act regulations to qualify for federal subsidies to businesses that accept Medicare and Medicaid patients. The project site does not receive these subsidies, and compliance is not mandated. However, completion of the project establishes the MU of the EHR for the project site.

Other implications include meeting aims set forth by The National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP) and the Quadruple Aim. NCCMERP suggests a national benchmark for medicine errors is unreliable as comparing facilities is secondary to vast

differences between an organization's standards, practices, and even med-error perceptions (2020). The NCCMERP advises that organizations hold themselves accountable for benchmarks and provides many resources and guidelines to incorporate into facilities' practice for accountability, standards to reduce medication error, and algorithms for error classification. Sharing medical error information among medical practices is encouraged to continue the study and development of medication error elimination and prevention. Eliminating medication risks and errors meets the criteria for Quadruple Aim. Including the initial IHI Triple Aim goals to enhance patient satisfaction and outcomes, ensure optimal population health, and reduce healthcare costs (Institute for Healthcare Improvement, n.d.); the fourth element promotes the caregiver's well-being to increase job satisfaction (Huntsberry & Wettergreen, 2021). The completion of the project satisfies these criteria.

Implications of this project also affect the stakeholders. The results mean that MedRec policy changes decreased work redundancy and improved job satisfaction for nursing and other healthcare providers. Patients will have improved medication safety, reduced healthcare costs, and improved healthcare outcomes secondary to improved MedRec use and decreased medication discrepancies between EHR lists. The community will benefit from reduced healthcare costs related to less healthcare received due to medication errors and improved confidence in medical providers. The PI and site liaison believe that extended time and a more extensive sample set would indicate a considerable decrease in the medication errors noted in this study.

Ethical Considerations

There are no ethical considerations for this project. Research certification from the Collaborative Institutional Training Initiative program was obtained. The University and Medical Center IRB prescreened the project and did not require an IRB review. The project site's Clinical Director, Medical Director, and pharmacist approved the project. The project site paid the required pharmaceutical credentialing fee to obtain API implementation.

Conclusion

The WHO estimates that medication errors are a significant financial burden globally. The API created a line for prescription transcription from the pharmacy software to the site's EHR and other healthcare facility EHRs associated with the patient. When MedRecs are accurate, there is less risk for discrepancies and errors, resulting in improved patient outcomes and decreased financial costs. The purpose of this DNP project was to evaluate the efficiency of the API. The post-API intervention denotes a 13% decrease in medication errors between the site's pharmacy medication list and the consult or ER visit note's home medication list. As in the scenario of the patient presenting to a hospital with confusion and vomiting, if the hospital EHR had the new medication prescribed listed on it, providers may have been able to diagnose and treat the patient to avoid a second hospitalization.

It is imperative to utilize MedRec at every visit and transition of care. Patients are often unreliable in dictating home medications from memory and do not regularly bring prescriptions with them to appointments. API transfers medications to patient-associated healthcare providers' EHRs and becomes a backup to improve medication list accuracy.

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