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Documenting Pharmacist Intervention: A Technology-Driven Solution to Overcome Challenges

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ABSTRACT

Clinical pharmacist conducts multiple activities governed by the best evidence for disease management and safe medication practices. The ASHP highlighted the importance of documenting and recording clinical pharmacy interventions to prevent adverse drug events and reduce hospital length of stay. Our institution utilizes an in-house electronic documentation system (e-DS) to document clinical interventions. We aim to study the impact of enhancing the e-DS. This study is a retrospective single-center descriptive review post-implementation of in-house e-DS enhancements. Data were collected between September 2017 and December 2019 for documented interventions by clinical pharmacists for admitted patients. Fields for analysis include clinical interventions, expected outcomes of interventions, cycle time for documentation, and drug cost. Outcomes measures include several documented interventions, preventing medication errors/adverse drug events, time-saving and cost avoidance. Descriptive analysis will be performed for categorical variables. The study showed an increased number of documented interventions for preventing medication errors/adverse drug events, time-saving, and cost avoidance, with an average time-saving of 20 minutes per 10 interventions and estimated cost avoidance of 20 000 SAR per month. Study limitations include a lack of interface with EHR and non-feasibility to estimate indirect cost. Investment in documentation system optimization to reduce medication errors/adverse drug events, time-saving and cost avoidance.

INTRODUCTION

Clinical pharmacist conducts multiple activities governed by the best evidence for disease management and safe medication practices with other providers to optimize patient outcomes (Pharmacy, 2014). Their interventions must be documented directly in the patient's medical record or equivalent retrievable documentation system. According to Kim Y. *et al.*, a pharmacist intervention may be defined as an act or action that prevents medication therapy problems and optimize drug therapy for individual patients in cooperation with other healthcare professionals (Kim & Schepers, 2003).

Documentation of clinical activities is an integral part of efficient healthcare delivery, particularly to the clinical pharmacist (Pharmacists, 1996). This documentation can also be used as a metric system to justify clinical pharmacists' productivity and demonstrate their integral role in multidisciplinary healthcare teams.

LITERATURE REVIEW

The ASHP highlights the importance of documenting and recording clinical pharmacist interventions (Pharmacists, 1996). Interventions by clinical pharmacists in a hospital setting prevent adverse drug events, reduce hospital length of stay and mortality rate, and provide a significant economic benefit to healthcare systems (Gallagher *et al.*, 2014; Kim & Schepers, 2003; Samp *et al.*, 2014). Documentation is a vital key performance indicator to demonstrate the impact of clinical pharmacy services. It is also important to improve communication among healthcare providers to optimize medication management plan for a patient (Hamblin *et al.*, 2012). As Catania *et al.* mentions, these data can be used to cost-justify the need for additional clinical pharmacists in a practice setting (Catania & Catania, 1988; Kim & Schepers, 2003). Over the years, hospitals have faced challenges in simplifying, optimizing, and promoting clinical interventions documentation and interpretation.

In the past, clinical pharmacists used to document limited interventions as handwritten notes to physicians or pharmacist progress notes, usually filed with the patient's medical chart. Over the years, many enhancements have been introduced to improve documentation and information utilization (Claus *et al.*, 2012). This has been established since replacing the manual with computerized databases and electronic health records (Kim & Schepers, 2003). Another important aspect of implementing electronic documentation is reducing the variation and lack of standardization of pharmacist intervention documentation to improve patient care. Al-Jedai A. *et al.* highlighted a big variation in the consistency of hospital pharmacists' documentation and data collection between 50% to 72% in various countries (Al-Jedai & Nurgat, 2012).

Kim Y. *et al.* reported limited evidence in the literature regarding the types of pharmacy intervention documentation collection systems and the quality, quantity, and utilization of the collected information (Kim & Schepers, 2003).

Many pharmacy intervention reporting systems, from

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paper to electronic, are used in pharmacy practice settings. Although hospital administrative personnel admit that current systems demand equipment or software costs, the support was minimal. As a result, pharmacies tend to self-enhance their systems or use commercially available systems that meet their needs (Kim & Schepers, 2003).

At our institution, clinical pharmacists have utilized a secured in-house electronic Documentation System (e-DS) since 2010 to capture the clinical pharmacist intervention documentation. The initial version of the e-DS had many challenges and limitations. This study aims to enhance and measure the improvement of e-DS clinical pharmacist intervention documentation.

MATERIALS AND METHOD

This retrospective single-center descriptive study of clinical pharmacists documented interventions post e-DS enhancements. Data were collected between September 2017 and Dec 2019 for auditing and evaluation purposes. The enchantments were implemented in 3 phases; September 2017, January 2018, and September 2018, respectively. In order to evaluate the impact of our enhancements, data was collected from September 2017 to 2018. All the end-users were surveyed through multiple formats, and feedback for program feature enhancement testing was deliberated. Additional data was collected for another 12 months to measure users' experiences (January to December 2019). Some of the Outcomes we looked into were several documented interventions, preventing medication errors/adverse drug events, time-saving and cost avoidance. The data was collected from secondary and tertiary sources (Annette Clarkson, 2008; Australia, 2018; Pharmacists, 1996; Pharmacy, 2014; project, 2016). Data to be collected on the secured in-house e-DS for analysis include clinical interventions, types of interventions, cycle time for documentation, and intravenous (IV) to oral (PO) conversion drug cost avoidance. Outcomes analyzed from the e-DS generated reports that include several documented interventions, prevented medication errors/adverse drug events, time-saving, and cost avoidance (Annette Clarkson, 2008; Australia, 2018; Gin, 2013; Guidance, 2013; Hospitals, 2008; Pharmacists, 1996; Pharmacy, 2014; project, 2016) Descriptive analysis is performed for categorical variables on Microsoft Excel 2016. A time-saving Calculator for estimating the cycle time. This study was approved by the Institutional Review Board (IRB) of King Faisal Specialist Hospital and Research Center.

The pharmacy automation and informatics team supports the in-house e-DS enhancements through a series of efforts to optimize clinical pharmacist documentation. Some enhancements included: standardizing the intervention classification and field categories per recent literature in international evidence see appendix 1(Australia, 2018). improving layout usability and enabling remote accessibility from smart devices. The latter was established through hospital-secured access to ensure information confidentiality. A downtime contingency plan was designed and reflected in the department's policy to avoid data loss and ensure its integrity.

RESULTS

Investment in enhancing clinical pharmacist documentation system optimized interventions documentation that was reflected through an increased number of documented interventions for preventing medication errors/adverse drug events, time-saving and cost avoidance by 56% with a monthly average of 4,600 interventions. The average time saving is 20 minutes per 10 interventions. The estimated cost avoidance from converting IV to PO formulations is approximate ~ 27 000 SAR per month. The number of prevented medication errors/adverse drug events interventions accounted for 34,847 (50%), while the top type of interventions per the expected outcomes was related to enhancing therapeutic effect 49,050 (71%) of total interventions. The level of significance of the documented interventions (7% minor, 66% moderate versus 27% severe) is illustrated in figure 1. The top categories of document intervention per the DOCUMENT standardized categorization were Monitoring 52% followed by Drug Selection 18% then Undertreated 10% categories refer to figure 2.

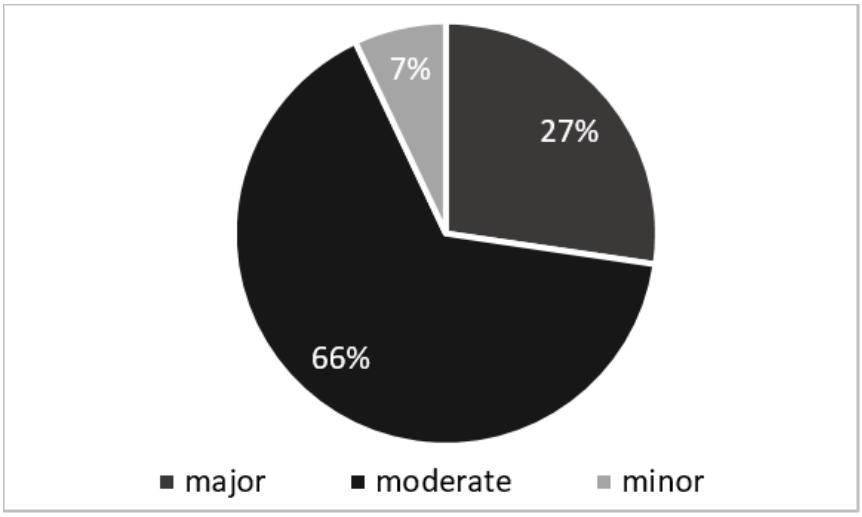


Figure 1: Illustrating the Level of Significance of the Documented Interventions.

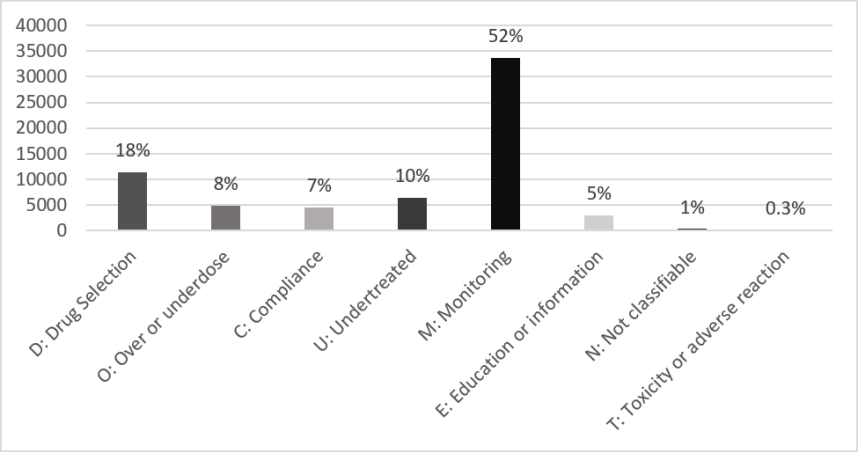


Figure 2: Illustrate the type of document intervention per the DOCUMENT MRP standardized categorization.

DISCUSSION

Documenting clinical pharmacist interventions is essential to quantify the impact on patients' outcomes and justify the workload and the value of the provided clinical pharmacy services. Haslett *et al.* stated that documented pharmacist interventions had prevented 27% of potentially serious adverse drug events in a tertiary-care medical center/teaching hospital (Al-Jedai & Nurgat, 2012; Kim & Schepers, 2003). Also, hospital pharmacy directors acknowledge that documenting clinical pharmacist interventions is useful in demonstrating individual and organizational competency (Kim & Schepers, 2003). In the same survey, almost 40% of the pharmacy directors commented that the most common opinion was pharmacist time challenge or unfriendliness of available comprehensive documentation systems. The survey universally affirmed that those systems are vital to a clinical pharmacist's responsibility. Those systems supported the communications of clinical pharmacists' actions with other healthcare providers and reflected clinical pharmacy services' importance. While many pharmacies continued to document their interventions manually, others invested in computerized options. The latter provided the advantages of providing more comprehensive information and user-friendliness compared to the manual.

Furthermore, the report highlighted that the available systems were challenged with providing real cost savings or clinical outcome information. The main reason for the administrative reluctance to invest in obtaining software, equipment, and maintenance is the cost which may reach $5000. Accordingly, there have not been enough solutions to overcome all the problems. However, a step forward has been taken to utilize personal digital assistants (PDA) for clinical pharmacist intervention documentation systems (Kim & Schepers, 2003).

Over the past years, our institution has used various methods to document clinical pharmacy interventions, starting with manual documentation on a paper-based form in 2008. The form includes clinical pharmacists, patient information, and drug-related problems (Al-Jedai & Nurgat, 2012). This manual method had many challenges: loss of documentation, time & paper consumption, inaccessibility, lack of data security and integrity, and difficulty in collecting and interpreting data timely. Accordingly, to overcome these challenges, an in-house build of an electronic documentation system (e-DS) for capturing clinical interventions was implemented in 2012. The e-DS captured interventions performed by clinical pharmacists; however, there were unresolved shortcomings associated with the system. For example, no user interface on the hospital server, which limited the clinical pharmacist's access remotely, an unfriendly data entry layout that resulted in long documentation time, and a lack of data standardization to obtain meaningful information and timely report. Accordingly, an attempt to improve the e-DS was completed by releasing a new enhanced system version. The enhancement project was implemented over 3 phases; September 2017, January 2018, and September 2018. To evaluate the impact of those enhancements, data was collected from September 2017 to 2018. Each phase included a cycle of (implementing modification according to end-user feedback, education for the clinical pharmacists about the new features, and a testing period). Further data were collected for additional 12 months to evaluate sustainability (January to December 2019).

Implemented Enhancements on the e-DS Updated Version

Standardization

Upon searching for the most comprehensive, standardized, and the closest to meet our clinical pharmacists' needs, we selected DOCUMENT MRP and recommendation classification codes provided by Guidelines for Pharmacists Performing Clinical Interventions by the Pharmaceutical Society of Australia (Australia, 2018). The selected categorization was further customized to meet the unfulfilled needs, see Table 1. Customizations were added to capture some of the clinical pharmacist's productivity data (for example, drug shortage issues, reviewing of Non-Formulary Medication or Off-label medication use requests). Another customization was deleting some categories. For example, medication

education provided to a patient is documented directly on the patient's EHR. Also, the conversion from IV to PO category was removed to EHR as part of the enhancement to minimize entry duplication and improve communication with other healthcare providers. The latter was part of another plan to establish clinical pharmacist standardized notes for certain services on EHR. This standardization helped minimize the Drug Related Problem from 20 major categories and 107 subcategories to 8 categories and 37 subcategories in the updated version (Australia, 2018).

Usability

The initial e-DS version layout took a long time for clinical pharmacists to document their interventions timely. Human factor engineering was considered while implementing the layout enhancements. This included: automated popups for the user and the dates, the option to manually change the intervention date where available to allow retrospective data entry, and an in-build calendar for date selection used to prevent non-standardized date format. Also, a dropdown list for the inpatient units was added to limit discrepancies in the unit's name to be extracted accurately in the report for workload purposes. The most impactful enhancements were allowing multiple interventions to be documented per patient daily on the same page instead of multiple pages for each intervention, see figure 3. Additionally, activating the Tab button to move quickly between fields and the automatic fill option using the first letter/category code to minimize typing time. Furthermore, intervention categories and subcategories were popping up in separate windows by double clicking instead of a long dropdown list to select from. For accurate referencing of comments, the free text box for it per patient was moved to be next to each medication intervention. These enhancements resulted in an almost 45% reduction in the time needed for documentation, see Figure 3.

Accessibility & Security

Accessibility was a major challenge for clinical pharmacists to document their interventions timely. Users needed to access the e-DS from his/her personal desktop computer using their authorized access (Pharmacy, 2014). The targeted enhancement was to upload the electronic documentation system to a secure web page within the institution network (hospital server). This maintained patient confidential information and provided users with remote access to e-DS from the inpatient unit's workstation computers, computers on wheels (COW), tablets, or mobile devices.

Table 1: Customized DOCUMENT Medication-Related Problem (MRP) and recommendation categorization codes

D: Drug Selection
D1 Duplication
D2 Drug interaction
D3 Inappropriate drug
D4 Inappropriate dosage form/ route
D5 Contraindications apparent
D6 No indication apparent
D7 Drug shortage issue
D8 TPN initiation
D9 TPN follow up
O: Over or underdose
O1 Prescribed dose too high
O2 Prescribed dose too low
O3 Incorrect or unclear dosing
O4 Incorrect/Inappropriate renal dosing
C: Compliance
C1 Need: to hold/ resume or renewal reminder
C2 Difficulty reaching physician/ nurse
C3 Non-compliance with policy/ guidelines/ protocol
C4 Need to review of policy/ guidelines/ protocol
C5 Need to review chemotherapy protocol
C6 Review Non-Formulary Medication Request
C7 Review of Off-label medication use request
U: Undertreated
U1 Condition undertreated
U2 Condition untreated

U3 Preventative therapy required
U4 need for therapeutic alternative
M: Monitoring
M1 TDM/laboratory/microbiology monitoring
M2 Non-laboratory monitoring
M3 Allergy/demographics missing
M4 Chart Review
E: Education or information
E1 Patient requests pharmacy related information
E2 Physician requests pharmacy related information
E3 Nurse requests pharmacy related information
E4 Pharmacist requests pharmacy related information
E6 Inservice/competency conducted
N: Not classifiable
NO
T: Toxicity or adverse reaction
T1 Toxicity, allergic reaction or adverse effect present

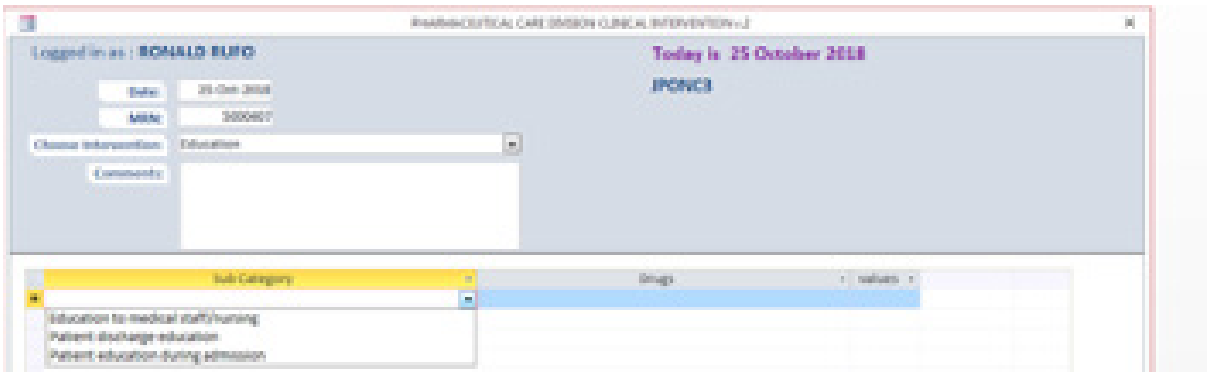
Table 2: Customized DOCUMENT MRP and recommendation categorization codes per intervention expected outcome

ADR/Medication error prevented
D: Drug Selection
D2 Drug interaction
D3 Inappropriate drug
D4 Inappropriate dosage form/ route
D5 Contraindications apparent
O: Over or underdose
O1 Prescribed dose too high
O2 Prescribed dose too low
O3 Incorrect or unclear dosing
O4 Incorrect/Inappropriate renal dosing
U: Undertreated
U1 Condition undertreated
U2 Condition untreated
U3 Preventative therapy required
M: Monitoring
M3 Allergy/demographics missing
T: Toxicity or adverse reaction
T1 Toxicity, allergic reaction or adverse effect present
ADR/Medication error prevented/ Enhanced Therapeutic Effect
M: Monitoring
M1 TDM/laboratory/microbiology monitoring
M2 Non-laboratory monitoring
Cost Saving/ ADR or Med Error prevented
D: Drug Selection
D1 Duplication
D6 No indication apparent
Cost Saving/ ADR or Med Error prevented/ Enhance Therapeutic Effect

U: Undertreated
U4 need for therapeutic alternative
Cost Saving/ Enhance Therapeutic Effect
D: Drug Selection
D7 Drug shortage issue
Enhance Therapeutic Effect
D: Drug Selection
D8 TPN initiation
D9 TPN follow up
C: Compliance
C1 Need: to hold/ resume or renewal reminder
C3 Non-compliance with policy/ guidelines/ protocol
C4 Need to review of policy/ guidelines/ protocol
C5 Need to review chemotherapy protocol
C6 Review form A
C7 Review form B
M: Monitoring
M4 Chart Review
E: Education or information
E1 Patient requests pharmacy related information
E2 Physician requests pharmacy related information
E3 Nurse requests pharmacy related information
E4 Pharmacist requests pharmacy related information
E6 Inservice/competency conducted

Reports from the updated e-DS version became easily and timely retrieved with meaningful information: the number of interventions per period/inpatient units or pharmacist, top categories of interventions, top intervened medications, and cost avoidance per medication. These reports were utilized for workload/ productivity purposes. Also, it can be shared with Pharmacy and Therapeutic (P&T) or drug utilization committees, quality improvement committees, pharmacy management, and hospital management to support the positive impact of the clinical pharmacists to optimize patients' outcomes and to prevent harm (Kim & Schepers, 2003). Other meaningful fields reported in the literature were not added to the updated e-DS version; for example, the level of intervention significance and acceptance response rate, considering the allotted documentation time versus the number of priority fields to be completed. Our study findings showed a gradual improvement in documented interventions after each enhancement, especially with the testing, education, and immediate feedback from the end users. Additionally, there is a direct correlation between the number of documented interventions, the number of clinical pharmacists on duty, and the inpatient census for that period. Regardless, documented interventions were easily doubled over the sustainability period.

Before:



After:

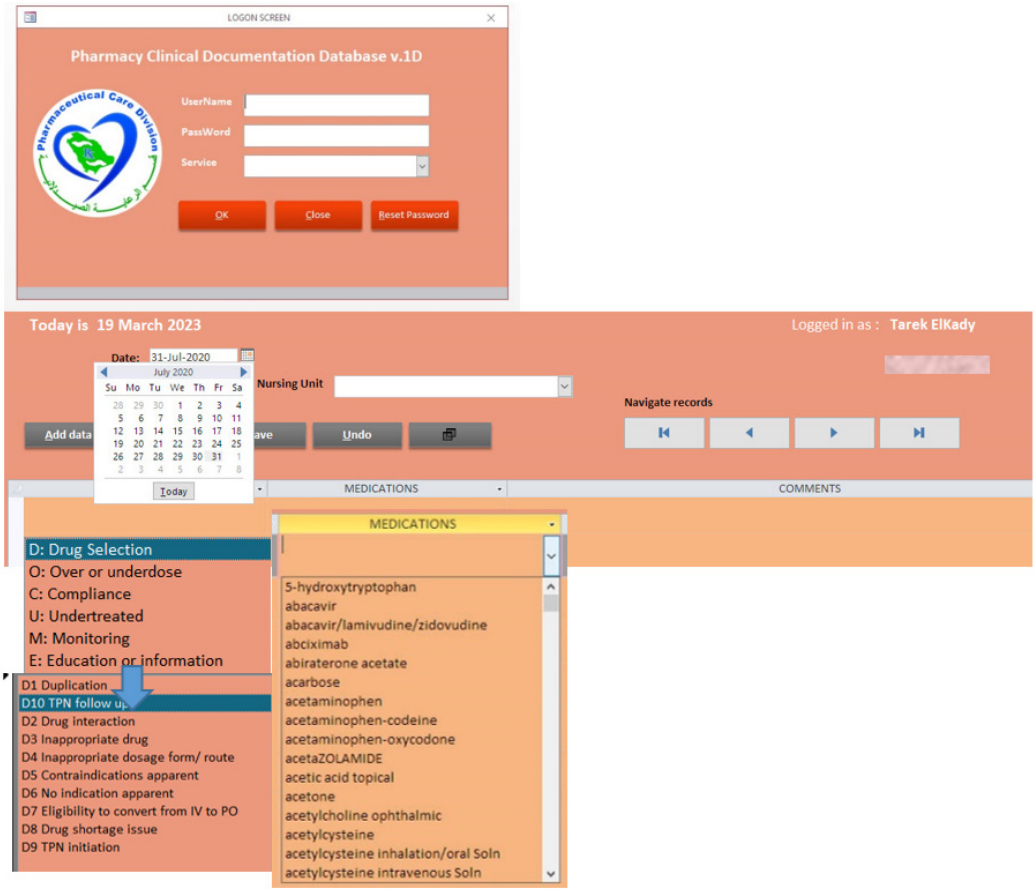


Figure 3: Usability and accessibility enhancements on the eDS layout

Our analysis reflected the successful documentation of the well-established therapeutic drug monitoring service, as it was ranked the top among reported categories with 52% of all documented interventions. The lowest reported category was toxicity or adverse reaction (0.3%). This is explained by the parallel hospital safety reporting system that requires staff to use for such incidents. This duplication can be modified in the future. Supporting the successful selection of the customized standardized categorization, we noticed that an insignificant percentage (1%) of interventions were not classifiable. See Table 3.

Table 3: Number of documented interventions per DOCUMENT (MRP) and recommendation categorization codes for the studied period

DOCUMENT MRP and recommendation categorization	Number of interventions (%)
D: Drug Selection	11,389 (18%)
O: Over or underdose	4,857 (8%)
C: Compliance	4,591 (7%)
U: Undertreated	6,471 (10%)
M: Monitoring	33,692 (52%)
E: Education or information	3,024 (5%)
N: Not classifiable	327 (1%)
T: Toxicity or adverse reaction	174 (0.3%)
Total	**64,525**

To identify the impact of the expected outcome, we replicated published studies with similar intervention categories and significance levels (Campbell, 2011). Accordingly, the top reported types of interventions per expected outcomes were invested in enhancing therapeutic effect and (adverse Drug Reaction (ADR)/ medication error prevention with 49% and 26%, respectively, as shown in Table 4. Our study demonstrated that the majority of clinical pharmacist interventions were impactful per the level of significance. These results

Table 4: Number of documented interventions per intervention expected outcome for the studied period

Intervention expected outcome	Number of interventions
Enhance Therapeutic Effect	33,887
ADR/Medication error prevented	17,692
ADR/Medication error prevented/ Enhanced Therapeutic Effect	13,657
Cost Saving/ ADR or Med Error prevented	2,308
Cost Saving/ ADR or Med Error prevented/ Enhance Therapeutic Effect	1,190
Cost Saving/ Enhance Therapeutic Effect	316
Cost Saving	127
Total	**69,177**

support the huge value of the clinical pharmacist in medication management.

As the hospital administration highly appreciates the cost-saving initiatives, focused efforts were directed to establish the intravenous (IV) to oral (PO) conversion service. It describes converting intravenous therapy to an alternative oral formulation as clinically applicable (Craig & Andes, 1995; Cyriac & James, 2014). Based on Craig and Andes's review, the mean duration of IV therapy before converting ranged from 2 to 8 days (Craig & Andes, 1995; Paladino *et al.*, 1991). Accordingly, this study utilized 8-days of therapy to demonstrate the cost saving. Our service launched with ten medications, primarily antimicrobials, that have impactful cost savings. Later, the list was expanded to seventeen medications once the service was stabilized, see appendix VI. Over the sustainability period, we identified that the top five cost-saving medications were responsible for 93%, listed in order: levetiracetam, omeprazole, voriconazole, fluconazole, and acetaminophen; see Table 5.

Table 5: IV to PO Conversion Medication List

Medication	IV Dose	Equivalent Oral Dose	IV to Oral Conversion Ratio	Frequency
Acetaminophen	650 mg	650 mg	1:1	Continue same
Ciprofloxacin	200 mg	250 mg	1:1.25	Continue same
	400 mg	500 mg		
		750mg		
Clindamycin	300mg	300mg	NA	Continue same
	600 mg	450 or 600 mg		
Cyclosporine*	25 mg	30mg to 45mg	1:1.2 to 1.8	Continue same
Dexamethasone	1-10mg	1-10mg	1:1	Continue same
Doxycycline	100 mg	100 mg	1:1	Continue same
Fluconazole	200 mg	200 mg	1:1	Continue same
	400 mg	400 mg		
	800 mg	800 mg		
Folic Acid	1mg	1mg	1:1	Continue same
Levetiracetam	250 mg	250 mg	1:1	Continue same
Levothyroxine	50 mcg	100 mcg	1:2	Continue same
Levofloxacin	500mg	500mg	1:1	Continue same
	750mg	750mg		
Linezolid	600 mg	600 mg	1:1	Continue same
Metronidazole	250 mg	250 mg	1:1	Continue same
	500 mg	500 mg		
	500 mg	500 mg		
Mycophenolate mofetil*	500mg	500mg	1:1	Continue same
Omeprazole	40 mg	40 mg	1:1	Continue same
Rifampin	600 mg	600 mg	1:1	Continue same

Tacrolimus*	1mg	3mg or 4mg	1:3 to 4	Twice daily
Thiamine	50-100mg	50-100mg	1:1	Continue same
TMP/SMZ	5-20 ml	1 SS tab =5ml IV	1:1	Continue same
	5ml IV= 400mg SMX + 80mg TMP	1 DS tab=10ml IV		
		2DS tabs=20ml IV		
Voriconazole	200 mg q12h	200 mg q12h	1:1	Continue same
Valproic Acid	250 mg Q8H	250 mg Q8H	1:1	IV valproate sodium given at same total daily dose/same frequency as oral products. However, daily doses >250 mg should be divided.

Although clindamycin IV to PO conversion shows negative direct cost-saving, the indirect cost of hospitalization, sterile medication preparation by pharmacy, administration by nurse, and associated risk of line infection outweigh that value.

The main challenge with the updated e-DS version was that it was not integrated with EHR. This prevented accessibility by other healthcare providers to the clinical pharmacist interventions that support the medication management plan. In addition, this limit the generation of clinical outcome data (e.g., length of hospital stay, readmission, and mortality rate). Furthermore, the hospital-invested billing system cannot capture the monetary value of the clinical pharmacist services.

Table 6: IV to PO Conversion Cost Avoidance (SAR) during the sustainability period, ranked from highest to lowest.

Drug Name	**8-days Cost Saving (SAR)**
Levetiracetam	131,828
Omeprazole	92,624
Voriconazole	83,920
Fluconazole	10,288
Acetaminophen	9,152
Valproic acid	6,120
Ciprofloxacin	5,344
Acyclovir	3,348
Doxycycline	2,840
levothyroxine	2,366
Levofloxacin	1,896
Rifampin	1,472
Metronidazole	432
TMP/SMZ	233.36
Dexamethasone	157.6
Linezolid	80
Clindamycin	-28,184
Total	**323917**

CONCLUSION

Technology investments to improve the clinical pharmacist's intervention documentation helped enhance the process and provide meaningful data to show the value of the clinical pharmacist in providing direct patient care. Many technological enhancements were implemented, including standardized intervention categorization, enhanced database usability and accessibility, and building reports. This is positively reflected in the number of documented interventions, preventing medication errors/adverse drug events, time-saving and cost avoidance.

The next step is to propose integrating the clinical pharmacist intervention documentation on the EHR to allow visibility to other healthcare providers, translate interventions into clinical outcomes, and plan for the clinical pharmacist services' billing system.

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