

Original Research

Forgetting Something: Reducing Prescription Abandonment With Automated Pharmacy Kiosks for Discharged Patients in the Emergency Department

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Introduction

Emergency department (ED) revisits are common, with 4.5% of patients revisiting four or more times per year, accounting for 21% to 28% of all ED visits, and 7.5% revisiting within 72 hours. These revisits are linked to increased hospital readmissions, particularly within 30 days. However, with community pharmacies closing or reducing hours, Automated Pharmacy Systems (APS) or kiosks can address these issues by providing accessible, extended-hour services.

Methods

The study analyzed prescription abandonment rates between kiosk and non-kiosk users in an off-site ED and campus ED over six weeks. Data on kiosk use, patient demographics, ED revisits within 3 days, ED revisits within 30 days, and disposition to discharge time was collected.

Results

The study reviewed 120 patients, with 60 kiosk users obtaining all their prescriptions, while 30% of Non-Kiosk users abandoned theirs. Kiosk implementation reduced ED revisits within three days but increased average discharge times by about 10 minutes.

Conclusion

Pharmacy Kiosks significantly reduced prescription abandonment rates and decreased ED revisits within three days. Future studies are needed to explore different APS systems, workflows, and patient experiences.

INTRODUCTION

At least 4.5% revisit the emergency room (ED) four or more times per year and account for 21% to 28% of all ED visit.¹ Another study found 7.5% of patient ED revisits were within 72 hours.² ED revisits are strongly associated with increased hospital readmissions, particularly within 30 days. Hospital readmissions can compromise patient care by increasing the risk of complications, emotional distress, and unfavorable health outcomes.³ They also impose financial burdens, as Medicare's Hospital Readmissions Reduction Program.⁴ may reduce hospital reimbursements by up to 3% for excessive 30-day readmissions.⁵ Since medication non-adherence contributes to nearly half of all treatment failures and elevates the likelihood of readmission, strate-

gies like bedside dispensing and tele-pharmacy can play a critical role in minimizing preventable returns. One study on the Meds to Beds program found that parents reported the program significantly improved the transition home by boosting their confidence and understanding of medications, while also reducing stress related to obtaining medications for home use.⁶ Many community pharmacies are closing or decreasing hours due to an overburdened workforce, shrinking reimbursement rates for prescription drugs, and limited opportunities to bill insurers for services beyond dispensing medications.⁷ Automated Pharmacy Systems (APS) or Kiosks can provide a solution by being accessible while extending hours to increase access to those patients.

According to Chancy et al., the barriers to adherence among these patients included: 32% who forgot, 18% who cited cost concerns, 11% who faced transportation issues, 4% who refused, 16% who gave other reasons, and 19% who could not be reached.⁸ Assessing pharmacy hours and access to pharmacies was a limitation of the study. The relationship between access to pharmacy and medication adherence is significant.⁹⁻¹³ Clinical consultations led by pharmacists have demonstrated effectiveness in enhancing patients' adherence to their prescribed medication regimens.⁹ The CDC leverages the CPSTF recommendation to promote tailored, pharmacy-based interventions aimed at preventing cardiovascular disease. Highlighting the cost-saving nature of these interventions not only strengthens their impact but also presents a compelling opportunity to engage hospitals through financial incentives.¹⁰ Effective interventions include medication education, treatment optimization, and helping with access.¹¹ Causes for ED revisits were recurrence of the same complaint was the highest among patient-related factors (80.5%), inadequate management and no improvement of symptoms in 71.3%.¹³ Patient related factors included recurrence of same complaints, medication adherence, no improvement of symptoms, and complication of a disease.

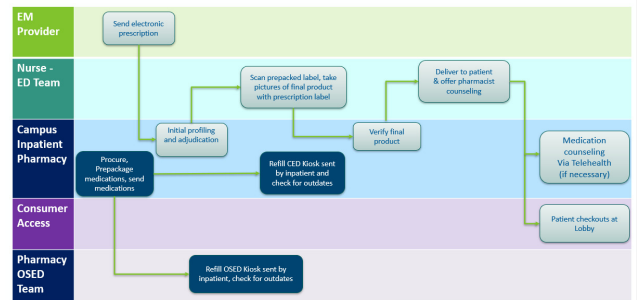
The data strongly supports the hypothesis that improving prescription fulfillment, especially through Kiosk models and meds-to-beds programs, can reduce ED revisits. The Kiosks can be patient or nonpatient facing and can be located in physician offices, medical office buildings, hospitals, or as listed by regulatory bodies where medication access can be increased for patients. Medications are prepackaged as part of a formulary, prescriptions are verified by a pharmacist remotely, and pharmacists are available for retail counseling. The stakeholder or consumer would arrive at the device to retrieve their medication, pay, sign for the prescription, and have the right to counseling. The purpose of this analysis is to compare the prescription abandonment rate (PAR) between Kiosk and Non-Kiosk (NK) users in an off-site emergency department (OSED) and a campus ED (CED) that would increase medication access and compliance.

METHODS

The analysis took place in a 24-Bed OSED and a 20-Bed CED of an eighty-bed hospital in Central Florida. The OSED sees over 25,000 patients and sends over 37,000 prescriptions annually. The CED sees over 27,000 patients and sends over 32,000 prescriptions annually. 40% of the patient population at the OSED is Medicaid/Self-Pay and for the CED the Medicaid/Self-Pay population is roughly 15% while having similar acuity levels. The study is a retrospective quality improvement project and chart review conducted between February 12th, 2025 to March 26th, 2025 for the OSED and April 9th, 2025 to May 21st, 2025 for the CED. Time ranges were selected for the first six weeks the Kiosks were implemented at either site.

Both EDs launched their 24/7 self-pay meds to beds program by utilizing pharmacy Kiosks to see if it would have an

Figure 1. Kiosk Workflow



impact on prescription abandonment. The cashless nonpatient facing workflow is shown in [Figure 1](#), formulary, and write-off/comp protocols shown in [Table 1](#). For the pilot, the teams elected to use a self-pay model to prevent delays in discharge. The workflow included pharmacy, nursing, physicians, and patient financial services (PFS). Adherent 360 was the APS used. The APS is composed of a Kiosk dispensing device that interacts with the APS application. Inventory management, pharmacist work, dispensing, financials, and compliance are all done through the application separate of the EHR. Through the interaction of the application, the Kiosk releases prepackaged formulary medication as a medication delivery device. The APS's workflow is described further in later sections. Kiosk use, age, gender, ED visit history within 90 days, prescription sent after local pharmacy hours, and payor were the baseline items collected. The primary endpoint was the PAR between Kiosk and Non-Kiosk (NK) Users. Secondary endpoints included ED revisits within 3 days, ED revisits within 30 days, discharge disposition to discharge turnaround times, and self-pay prescription capture rates.

FORMULARY & INVENTORY

The formulary was decided using historical prescribing trends at both locations. The emergency medicine physician teams approved and standardized medications, quantities, and interchanges. The medications were loaded if the approved quantity was commercially available or prepackaged with the approved quantity in a 30 – 60 dram bottle that can fit in the APS. Prices were based on a blended 340B and wholesaler acquisition cost (WAC) pricing plus \$5. See [Table 1](#) for the complete formulary. The APS can hold 700 - 800 units of product and was affiliated with the campus' outpatient pharmacy in compliance with statutes.¹⁴ The inpatient and OSED pharmacy team was responsible for prepackaging, refilling, and outdating the Kiosk.

WORKFLOW & STAFFING

At discharge, nurses and providers would request if the patient would like to participate in the ED meds to beds program. If the patient opted in, the provider utilized the approved Kiosk order sentences in the EHR. The inpatient pharmacist covering would verify the prescription and no-

Table 1. Formulary & Self-Pay Protocol

Kiosk Formulary Medication
acetaminophen (Tylenol) 160 MG/5ML sol Qty: 118 [#]
acetaminophen (Tylenol) 500 mg tab Qty: 100 [#]
Albuterol Sulfate (2.5 MG/3ML) 0.083% Inhalation Nebulization Solution Qty: 75
Albuterol Sulfate HFA 108 (90 Base) MCG/ACT Inhalation Aerosol Solution Qty: 8.5
aluminum & magnesium -simethicone (Mylanta) 200-200-20 MG/5ML oral suspension Qty: 355 [#]
amlODIPine Besylate 5 MG Oral Tablet Qty: 30
Amoxicillin 400 MG/5ML Oral Suspension Reconstituted Qty: 100 [^]
Amoxicillin 500 MG Oral Capsule Qty: 14
Amoxicillin 875 MG Oral Tablet Qty: 20
Amoxicillin-Pot Clavulanate 875-125 MG Oral Tablet Qty: 14
Azithromycin 250 MG Oral Tablet Qty: 6
bacitracin 500 UNIT/GM ointment Qty: 30 [#]
Benzocaine-Menthol 15mg/3.6mg Loz Qty: 16 [#]
Benzonatate 200 MG Oral Capsule Qty: 20
Cefuroxime Axetil 500 MG Oral Tablet Qty: 14
Cephalexin 250 MG/5ML Oral Suspension Reconstituted Qty: 100 [^]
Cephalexin 500 MG Oral Capsule Qty: 14
Cephalexin 500 MG Oral Capsule Qty: 28
cetirizine (Zyrtec) 10 MG tablet Qty: 30 [#]
Chlorhexidine Gluconate 0.12 % Mouth/Throat Solution Qty: 473
Ciprofloxacin HCl 500 MG Oral Tablet Qty: 14
Clindamycin HCl 300 MG Oral Capsule Qty: 21
Cyclobenzaprine HCl 5 MG Oral Tablet Qty: 30
Diclofenac 1% Topical Gel Qty: 100 [#]
Diclofenac Sodium 50 MG Oral Tablet Delayed Release Qty: 30
Dicyclomine HCl 20 MG Oral Tablet Qty: 20
diphenhydramine (Benadryl) 25 MG tablet Qty: 24 [#]
Docusate 100 mg Caps Qty: 100 [#]
Doxycycline Hyclate 100 MG Oral Tablet Qty: 14
Erythromycin 5 MG/GM Ophthalmic Ointment Qty: 3.5
famotidine 20 mg tab Qty: 25 [#]
Fluconazole 150 MG Oral Tablet Qty: 1
Fluticasone Propionate 50 MCG/ACT Nasal Suspension Qty: 16
Gabapentin 100 MG Oral Capsule Qty: 100
guaifenesin (Mucinex) 600 MG 12 hr tablet Qty: 20 [#]
hydrochlorothiazide 12.5 MG Oral Tablet Qty: 30
hydroxyzine HCl 25 MG Oral Tablet Qty: 30
ibuprofen 100 MG/5ML suspension Qty: 118 [#]
Ibuprofen 800 MG Oral Tablet Qty: 30
Ketorolac Tromethamine 10 MG Oral Tablet Qty: 12
Lidocaine 4% Patch Qty: 5 [#]
Lidocaine Viscous HCl 2 % Mouth/Throat Solution Qty: 100
Lisinopril 10 MG Oral Tablet Qty: 30
Meclizine 25 mg chew tab Qty: 100 [#]
Meloxicam 7.5 MG Oral Tablet Qty: 15

metFORMIN HCl 500 MG Oral Tablet Qty: 60
Methocarbamol 500 MG Oral Tablet Qty: 40
Methocarbamol 750 MG Oral Tablet Qty: 40
methyIPREDNISolone 4 MG Oral Tablet Therapy Pack Qty: 21
Metoclopramide HCl 10 MG Oral Tablet Qty: 40
metroNIDAZOLE 0.75 % Vaginal Gel Qty: 70
metroNIDAZOLE 500 MG Oral Tablet Qty: 14
Mupirocin 2 % External Ointment Qty: 22
Naproxen 500 MG Oral Tablet Qty: 20
Nebulizer Machine Qty: 1 [#]
Nitrofurantoin Monohyd Macro 100 MG Oral Capsule Qty: 14
Ofloxacin 0.3 % Ophthalmic Solution Qty: 5
Ondansetron 4 MG Oral Tablet Disintegrating Qty: 15
Orphenadrine Citrate ER 100 MG Oral Tablet Extended Release 12 Hour Qty: 14
Oxymetazoline 0.05% Nasal Spray 30 mL Qty: 1 [#]
Pantoprazole Sodium 40 MG Oral Tablet Delayed Release Qty: 30
Penicillin V Potassium 500 MG Oral Tablet Qty: 28
phenazopyridine (Pyridium) 99 MG tablet Qty: 12 [#]
polyethylene glycol (miraLAX) Qty: 119
Polymyxin B-Trimethoprim 10000-0.1 UNIT/ML-% Ophthalmic Solution Qty: 10
prednisoLONE Sodium Phosphate 15 MG/5ML Oral Solution Qty: 50
predniSONE 20 MG Oral Tablet Qty: 5
predniSONE 50 MG Oral Tablet Qty: 5
Prochlorperazine Maleate 5 MG Oral Tablet Qty: 20
Pseudoeph-Bromphen-DM 30-2-10 MG/5ML Oral Syrup Qty: 60
Sucalfate 1 GM Oral Tablet Qty: 30
Sulfamethoxazole-Trimethoprim 800-160 MG Oral Tablet Qty: 14
Tamsulosin HCl 0.4 MG Oral Capsule Qty: 14
valACYclovir HCl 1 GM Oral Tablet Qty: 21
Write-Off/Comp Protocol
If patient can't afford medication that meets any of the criteria below:
1. Provider or nurse leader wishes the patient to go home with medications due to risks of adherence or compliance 2. Patient being discharged when their retail pharmacy is closed and patient opted to use Kiosk 3. Any downtime during collections or if the patient only had cash

Appendix:

Over the counter item, stored outside of kiosk

^ Set up as a premeasured kit with sterile water for reconstitution

tify the nurse in the EHR that the medication is ready for release. Then, the nurse would retrieve the medication from the Kiosk workstation, scan the prepackaged label, take photos of the bottle with prescription label for the pharmacist to verify remotely, and compile medications into prescription bag with the receipt. Once the pharmacist completed the second verification, they notified the nurse and PFS that the patient was ready for checkout. The nurse would deliver the medication with their discharge paperwork and escort the patient to checkout. PFS would collect the signature, payment, and check the patient out. If counseling was required, the nurse, provider, or PFS would contact pharmacy via phone and the pharmacist would speak to the patient.

Patients that received a prescription were included in the analysis. Due to regulations, the APS did not release any controlled substances. To collect the primary endpoint, a medication history technician followed up with the NK patient's community pharmacy to confirm if their prescriptions were picked up. Patients were not included in the analysis if the technician was unable to reach the users' outpatient pharmacy for NK patients. Secondary endpoints were retrieved through retrospective chart review. The required sample size was calculated to be 120 patients, with a margin of error of 7% and a 95% confidence interval. Chi-Square statistical tests were used for the primary endpoint of prescription abandonment.

Table 2. Results

Baseline Demographics	Kiosk	No Kiosk (NK)	Total
N	60	60	120
Age (Yr)	41.3	40.7	41.0
Female (%)	63.3%	58.3%	60.8%
Moderate To High Acuity [#]	93.3%	91.7%	92.5%
Previous ED Visit within 90 days	31.7%	21.7%	26.7%
Script Sent To Pharmacy After Hours ^{\$}	38.3%	26.7%	32.5%
Insurer: Commercial	48.3%	55.0%	51.7%
Insurer: Medicare or Medicaid	25.0%	25.0%	25.0%
Insurer: Other/Self Pay	26.7%	20.0%	23.3%
Results	Kiosk (60)	No Kiosk (NK) (60)	
Patients with Abandoned Prescriptions (%)**	0	30	
ED Revisits 3 days (%)	1.67	5	
ED Revisit 30 Days (%)	15	15	
Average of Discharge Dispo to Discharge (min)	31.5	21.1	

Appendix

[#] Health-system standardized acuity levels from not urgent, low, moderate, and high acuity^{\$} Utilized patient's preferred pharmacy's available hours^{**} Chi-Square Test was used for primary endpoint through excel analysis tool pak

RESULTS

The OSED had 2,999 ED visits where 4,500 prescriptions were provided and a Kiosk prescription capture rate of 10%. The CED had 2,797 ED visits where 3,689 prescriptions were sent and a Kiosk prescription capture rate of 15%. After randomization, 30 OSED Kiosk patients, 30 CED Kiosk patients, 57 OSED NK patients, and 30 CED NK patients were reviewed to make a total of 147 patients. 27 patients in the OSED NK group did not meet criteria due to outpatient pharmacy follow up on prescription abandonment. 120 patients were included in the analysis. The baseline demographics and results are shown in [Table 2](#). 60 Kiosk patients obtained all their prescriptions while 30% of NK patients (18/60) abandoned their prescriptions ($P < 0.05$). One Kiosk patient and three NK patients revisited the ED within 3 days. Both groups experienced 9 ED revisits within 30 days. The average disposition to discharge time was 31.5 minutes to 21.1 minutes for the Kiosk and NK patients respectively. Both arms had similar patient populations except for an increased history of ED revisits within 90 days (38.5% VS 26.7%), after hour pharmacy prescriptions (38.3% VS 26.7%), and Self-Pay patients (26.7% VS 20%) in the Kiosk arm.

DISCUSSION

Implementation of pharmacy Kiosks in OSEDs and CEDs has significantly reduced prescription abandonment. The study also found a 3.3% reduction in ED revisits within 3 days. Of the 33% of the NK patients that abandoned their prescription, the prescription was sent during their

pharmacy's after hours. This was recently highlighted in Chancy, et al's study.⁵ With the addition of Kiosk to the ED team's workflow, the patient's average disposition to discharge time was roughly 10 minutes longer to their stay (31.5 minutes VS 21.1). On average, during the study, 77% of the prescriptions sent from the OSED and CED were available formulary items in the Kiosks. The write-off/comp protocol was used for 29% of total OSED Kiosk patients versus 24% of total CED Kiosk patients. In this protocol, the prescription fee was waived or covered by the health-system if one of the following: Provider or nurse leader wishes the patient to go home with medications due to risks of adherence or compliance, Patient being discharged when their retail pharmacy is closed and patient opted to use Kiosk, any downtime during collections or if the patient only had cash. With having the goal of increasing medications access to patients, we believed protocol use was appropriate during this study.

The ED physician, nursing, and PFS staffing models between the OSED and CED did not change but included the Kiosk workflows. Traditionally, for pharmacy, the campus inpatient pharmacy team provided oversight of the OSED. The campus inpatient pharmacy team verified orders, and the mobile OSED pharmacy team visited the OSED twice a week for automated dispensing cabinet replenishment. For Kiosk implementation, the campus pharmacy team was responsible for prepacking and served as the central inventory for both the OSED Kiosk and the CED Kiosk. For this, the pharmacy team earned 0.5 pharmacy technician full time equivalent (FTEs) for each Kiosk for prepackaging and Kiosk inventory. The pharmacy team used 0.2 pharmacy technician FTE for a capture rate of 10% and up to 0.5 FTE

for a capture rate of 30% for labor expense and productivity. The campus pharmacy team would send the prepacked formulary medication to the OSED for the mobile OSED pharmacy team to replenish the Kiosk.

The campus pharmacy team replenished their own Kiosk in the emergency department. Like the ED physicians, nursing, and PFS, the work for Kiosk prescription verification for the pharmacist was absorbed in the workflow. Prescription verification was accomplished and prioritized by the ED pharmacist and central pharmacy when ED shift was flexed. The average prescription turnaround time for the pharmacist was 6 minutes (4.1 for initial drug utilization review and 1.9 minutes for photo quality assurance verification). An increase in pharmacist interventions took place because the pharmacist had access to the patient's EHR. Therapy recommendations, antimicrobial dosing, drug-drug or allergy interactions, and therapeutic interchanges were the most common inpatient pharmacist interventions on outpatient prescriptions. For compliance, statutes for APS use in different states may vary. A Risk-Based Analysis was conducted that assessed possible regulatory violations and medication safety events.

LESSONS LEARNED, OPPORTUNITIES, AND LIMITATIONS

Due to the Kiosk's ability to operate 24/7 without any physical pharmacist presence, it required a significant amount of collaboration with pharmacy, nurses, providers, and PFS. The APS was separate and did not interface with the inpatient EHR. Therefore, nursing, pharmacy, and PFS were trained on the new system four weeks prior to go-live. [Figure 2](#) shows the lessons learned and the action items to improve the process moving forward. Provider workflows, Kiosk scripting to patients, payment conversations, and workflow communication were the processes that required improvement after go-live.

Historically, physicians would use their own prescription favorites in the EHR and sent the prescriptions to the patient's preferred pharmacy. Now at discharge, they needed to request if the patient wanted to participate in meds to beds, confirm if the prescription is on formulary, then utilize the Kiosk prescription sentences in the EHR. During go-live, a pharmacist would review possible ED discharged patients and partner with the provider on possible Kiosk use. Also, data was provided to physician leadership for targeted education and follow up.

Scripting and payment conversations served as a challenge for each of the team members because meds to beds processes were owned by the campus retail pharmacy teams. The nursing teams were asked upon patient arrival to bring awareness to the Kiosk meds to beds program. Patient flyers and resources were provided to support the teams. When scripting took place, it led to difficult conversations for nursing, providers, and PFS because the program was self-pay and patients wanted to utilize their insurance. As a result, patients would opt-out of the meds to beds program and led to team member dissatisfaction. After receiving feedback from the stakeholders on this concern, the teams elected to utilize insurance since the APS was able to incorporate real time adjudication that

wouldn't cause discharge delays. See [Figure 2](#) for complete action plans on scripting and payment collections.

Due to the lack of EHR interface, remote verification, and multiple stakeholders in the workflow, communication was an area of opportunity. The pharmacy team communicated to nurses through the EHR and to PFS through the health-system's approved chat system. The pharmacist communicated to the nurse when the medication was ready for retrieval and delivery. Lastly, the pharmacist messaged PFS when the patient was ready to be checked out. There were instances where team members were pulled into patient care and troubleshooting. This caused delays because the messages were going unread and required escalation. As an area of opportunity, the APS is developing a centralized communication tool and tracking system to overcome this barrier.

The project and analysis had limitations. A larger sample size would have increased reliability and validity to the results. Another limitation was the assessment of the reason for the ED revisits or the reason for prescription abandonment. Statutes or legislature may vary by state on Kiosk formularies and practices which can pose as a challenge. Lastly, the study's self-pay model for the meds-to-beds program posed as a barrier, as patients were unfamiliar with this model and preferred to use their insurance, leading to dissatisfaction and opt-outs. These limitations highlight areas for improvement in future implementations of pharmacy Kiosks and similar interventions.

CONCLUSION

This is the first analysis to introduce a 24/7 ED Meds to Beds program with automated Kiosks. The project was able to demonstrate a collaborative workflow between physicians, nursing, pharmacy, and PFS so patients can retrieve their discharge medications in the ED. The study found that the Kiosks significantly reduced prescription abandonment rates and slightly decreased ED revisits within three days. Future studies are warranted for different APS systems, workflows, adjudication processes, and patient experience.

CONFLICTS OF INTEREST

None

IRB APPROVAL

Obtained at local institution

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None

Figure 2. Lessons Learned & Areas of Opportunity

Lessons Learned	Barrier	Action Plan
Nurse scripting on arrival	Nurses involved in difficult money or payment discussions with patients.	PFS to initiate scripting during patient registration.
Updating (consistently) pharmacy preferences in EHR	- Kiosk pharmacy manually selected in EHR. - If admitted or follow up visits w/ PCP pharmacy preference not updated, script sent to Kiosk.	- Kiosk is set as the preferred encounter pharmacy with the patient's pharmacy second. - EHR optimization of pharmacy preferences on initial or future visits. - Targeted education to departments and clinics in updating pharmacy preferences.
Providers initiating prescriptions to Kiosk	- Confirming Kiosk formulary and prescription routing to Kiosk. - Scripting for meds to beds.	- Entering Kiosk verbiage in order sentences visibly. - Signage and handouts prepared for providers. - Targeted provider education.
Communication Workflow	Multiple communication points and steps for initial verification, releasing, final verification, checkout, and trouble shooting.	APS developing tracking systems and streamlined communications.
Payment Collection	- Patients unfamiliar with self-pay model because meds were historically "covered". - Patients wanted to use cash.	- Kiosk to include adjudication. - PFS developed process to accept cash.

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