IMPACT OF A PHARMACY-LED MEDICATION HISTORY PROGRAM IN THE EMERGENCY CENTER OF A LARGE, ACADEMIC HOSPITAL

By:

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Key Words: Transitions of Care, Medication Reconciliation, Medication Safety, Medication Errors, Patient Safety, Medication History

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IMPACT OF A PHARMACY-LED MEDICATION HISTORY PROGRAM IN THE EMERGENCY CENTER OF A LARGE, ACADEMIC HOSPITAL. Adibe C, Varghese S, Patel KR, Erowele G, Fernandez J, Birtcher KK. Harris Health System, Houston, TX.

PURPOSE: To evaluate the medication-related errors identified in medication histories completed by pharmacist extenders and pharmacists, compared to medication histories completed by emergency center providers, for patients admitted through the emergency center of a large, academic hospital.

METHODS: This 10-week pilot study used pharmacist extenders to complete medication histories on patients admitted from the emergency center. Pharmacist extenders were provided with standardized training to complete the histories and document within the patient's electronic medical record (EMR). Emergency center providers completed medication histories for patients prior to admission and served as the control group. Pharmacist extenders and pharmacists served as the intervention group and completed medication histories for the same patients, but after the patient's status changed to admission status. The primary objective is to quantify the number of medication discrepancies captured on medication histories completed by pharmacist extenders and pharmacists compared to medication histories completed by emergency center providers. The secondary objectives include identifying types of errors and discrepancies captured by pharmacy students and pharmacists, cost impact on the institution, average time to complete a medication history by a pharmacy student, the number of errors by therapeutic class, and the types of errors by therapeutic class.

RESULTS: Pharmacist extenders captured 328 discrepancies ($P<0.001$, 95% CI: 2.41-3.36) on 113 medication histories. The majority of discrepancies captured were discontinued/not taking medication. The majority of discrepancies by therapeutic class were associated with analgesic medications.

CONCLUSION: Pharmacy involvement within the medication reconciliation process demonstrated positive outcomes.

Key Words: Transitions of Care, Medication Reconciliation, Medication Safety, Medication Errors, Patient Safety, Medication History

Introduction

Medication errors harm as many as 1.5 million patients each year costing over $3.5 billion.[1] Based on a national surveillance in the U.S., an estimated 4 emergency department (ED) visits for adverse drug events occurred per 1000 individuals annually in 2013 and 2014 and 27.3% of these ED visits resulted in hospitalization.[2] Improving the quality of patient care has become the overarching goal within healthcare over the past couple of decades. The passage of the Patient Protection and Affordable Care Act in 2010 has led to prioritization of quality patient care due to programs targeting patient and medication safety during transitions in care between inpatient and outpatient settings. Health systems and hospitals began receiving rewards or consequences for the quality of care provided to their patients. Safety guards were also implemented into healthcare standards of organizations such as the Joint Commission (TJC) and Det Norske Veritas Global (DNV-GL).

Transitions in care pose problems such as gaps in communication between interdisciplinary teams that can compromise patient safety. Medication reconciliation is a safety intervention used during transitions of care to create the most accurate list possible of all medications a patient is taking. The Institute for Healthcare Improvement defines medication reconciliation as a complex process that involves comparing the list against the provider's admission, transfer, and/or discharge orders, with the goal of providing correct medications to the patient. One of TJC national patient safety goals is centered on improving the safety of using medications. It also incorporated medication review into its *Provision of Care, Treatments, & Services* accreditation requirement.[3] The DNV-GL recently updated its standards to include medication review under its *Patient-Center Care* accreditation requirement.[4]

Adverse drug events (ADEs) can be defined as any harm experienced by the patient as a result of exposure to a medication. Medication errors are included under this term and are defined as errors, either of commission or omission, which begins when a clinician prescribes a medication and ends with medication administration. ADEs can be preventable or non-preventable. Non-preventable ADEs, also known as adverse drug reactions, occur when medications are prescribed and administered appropriately. Preventable ADEs are medication errors that reach the patient and cause any degree of harm.[5] This category is a target for quality improvement because healthcare professionals can mitigate these incidents. Preventable medication errors affect more than 7 million patients each year and cost almost $21 billion annually in direct medical costs across all care settings.[6] The "Medications at Transitions and Clinical Handoffs" (MATCH) study found medication errors on admission in more than one-third of their study patients; 85% of these errors were from medication histories with almost half being omission of information[7].

Pharmacists are trained to be experts in the field of medication therapy management and are equipped with more drug knowledge than any other healthcare professional. Pharmacist extenders, also called pharmacy extenders, are personnel who complete duties that are delegated and overseen by a pharmacist that allows the pharmacist to broaden his or her scope of responsibilities. Some examples of pharmacist extenders are pharmacy students who have the capacity to act as pharmacists, exercise clinical judgment, and conduct themselves in a professional manner. Student pharmacists have demonstrated significant impacts on the reduction of medication discrepancies under the auspices of a pharmacist in several studies. During a three-month period in one study, student pharmacists reviewed 1,045 home medications and discovered 290 discrepancies (27.8%; $p=0.02$).[8] In another study, student pharmacists involvement in the medication reconciliation process led to reduction of readmission in the tertiary care ED, improved patient satisfaction and more confidence in patients' medication use.[9] Another example of pharmacist extenders are pharmacy technicians who have a fundamental understanding of medication use and are proficient in communication skills and problem-solving.[4] In a study in an urban academic medical center by Sen and colleagues, pharmacy technicians were used to obtain medication histories. During the study's three-month period, 1748 discrepancies on preadmission

medication lists were identified.[10] In another study, medication histories conducted by pharmacy technicians were accurate 88% of the time compared with 57% of those conducted by nurses ($p < 0.0001$).[11] Overall, pharmacist extenders are qualified individuals to carry out the task of obtaining accurate medication histories.

Medication reconciliation is an integral part of the transitions of care process, can help bridge the gaps of communication, and can mitigate medication misadventures. During transitions, healthcare professionals collaborate in an organized, multidisciplinary program to improve medication safety as the patient moves between different levels of care or patient care settings. Documenting the best possible medication history is the cornerstone of the medication reconciliation process and can significantly decrease medication errors and adverse drug events (ADEs). Obtaining a medication history is the first step of medication reconciliation. It is necessary to obtain a comprehensive and accurate medication history for several reasons. First, providers rely on medication histories to properly evaluate and assess patients because they provide insight into potential medical issues and facilitate treatment decisions.[11] Secondly, medication histories help identify critical medications such as antimicrobials, anticoagulants, anticonvulsants, and pain medications as well as nonprescription medications that are often overlooked. Lastly, while collecting medication histories, it is an appropriate time to also assess for allergies. Often times, intolerance and side effects are documented as allergies, which can unfortunately disqualify a patient for a certain medication. Allergies, side effects and intolerances are respectively distinct and independent terms with different meanings.

Pharmacists and pharmacist extenders have demonstrated their value in medication history process and are uniquely positioned to coordinate the medication reconciliation process. However, at Harris Health System, pharmacy personnel are not formally involved in the process. The purpose of this study is to evaluate the medication-related errors identified in medication histories completed by pharmacist extenders and pharmacists, compared to medication histories completed by emergency center providers, for patients admitted through the emergency center at Ben Taub Hospital, a large, academic hospital within the health system. Emergency center providers include physicians, resident physicians, and mid-level practitioners.

Methods

Study Rationale

Harris Health System is a community-owned healthcare system that serves the underinsured residents of Harris County, one of the nation's largest counties. It is comprised of two acute care hospitals: Ben Taub Hospital, a 444-bed hospital located within the Texas Medical Center, the world's largest medical center, and Lyndon B. Johnson Hospital, a 207 bed hospital located further north in Houston. Harris Health System also contains Quentin Mease Community Hospital, a rehabilitation hospital, and numerous outpatient and specialty clinics. Ben Taub Hospital, specifically, contains a level I trauma center and had almost 90,000 emergency center visits last year. Of these visits, over 12,000 resulted in admissions, which comprise about 60% of the hospital's total admissions. Due to this proportion, targeting emergency center admissions would have the most impact on patient safety.

At the health system, the task of obtaining medication histories is generally a shared responsibility between nurses and providers. Nursing staff is required, at minimum, to obtain the drug name for each medication. In the emergency centers, the medication review process, at minimum, should include a review of or screening for medications applicable to the medical relevance of the setting by the provider. Emergency center nurses are not formally involved in the medication reconciliation process.

Study Design

A prospective, pilot study was conducted over a 10-week period from October 2017 to December 2017. During this time, the impact of a pharmacy student-led medication history program within a large, academic hospital was evaluated. Several stakeholders including pharmacy operations, pharmacy quality, pharmacy informatics, and the emergency medicine team were engaged to ensure that this project was coordinated and efficient. The purpose of this study was to evaluate the medication-related errors identified in medication histories completed by pharmacy extenders under supervision of pharmacists, compared to medication histories completed by emergency center providers, for patients admitted through Ben Taub's emergency center. It was hypothesized that pharmacy (pharmacy students and pharmacists) would identify and prevent medication-related errors by providing a more complete and thorough medication history compared to emergency center providers who are currently responsible for this task. The assumption was that the medication histories completed by providers are completely accurate and thorough since these are the designated healthcare professionals for this task in the emergency department. Providers typically complete the medication histories for patients who are likely to be admitted.

Pharmacist Extenders

Pharmacy students completing Introductory Pharmacy Practice Experiences (IPPE) and Advanced Pharmacy Practice Experiences (APPE) rotations were utilized as the pharmacist extenders in this study. They were provided with standardized 6-hour training by a pharmacist (PGY2 pharmacy administration resident) that consisted of direct instruction and modeling, and was conducted during the first workweek. Pharmacy students were also provided with a medication history checklist, interview and data collection forms (Figure 1), as well as a specialized patient list in the electronic health record (EHR) that identified the target patients. Pharmacy students were expected to dedicate one full 8-hour day per workweek during their rotation block. Pharmacy students were instructed to document each medication history on a data collection sheet during the patient interview. Following the interview, pharmacy students transferred the information to the home medication list in the patient's electronic medical record (EMR). The data collection sheet also contained summative information of the types of discrepancies observed and the time to complete the medication history interview.

Target Patients & Study Groups

The target patient population was any adult patient ≥ 18 years of age admitted from Ben Taub emergency center. Patients were excluded if they were unconscious, critically ill, in isolation, or in the psychiatric emergency department. For the purpose of this study, the pharmacist extenders focused on the lower acuity emergency center units. Emergency center providers completed medication histories for patients prior to admission and served as the control group. Pharmacist extenders served as the intervention group and completed medication histories for the same patients, but after the patient's status changed to admission status. A pharmacist supervised the extenders at all times and the PGY2 pharmacy administration resident remotely verified the medication histories completed by the extenders on the EHR.

Endpoints

The primary endpoint of this study was to quantify the medication discrepancies captured in medication

histories completed by pharmacist extenders under supervision of pharmacists compared to medication histories completed by emergency center providers. The secondary endpoints included identifying types of errors and discrepancies captured by pharmacist extenders, the cost impact on the institution, the average time to complete a medication history by a pharmacy student, the captured errors by therapeutic class, and the types of errors by therapeutic class. The specific types of discrepancies evaluated for were: discontinued/not taking medication, incorrect/missing medication, incorrect/missing dose, incorrect/missing route, incorrect/missing frequency, incorrect/missing allergy, incorrect/missing formulation, and duplication. Inferential and descriptive statistics will be used to assess the differences between the control group and intervention group.

Statistical & Financial Analysis

A paired samples t-test was used to analyze the statistical significance of the primary endpoint, any differences between our study groups. This test was selected with the assumption that the population mean is zero. The control group captures what the system is considering to be standard of care. Descriptive statistics will be used to analyze the secondary objectives. The cost impact will be an estimate of potential annual cost avoidance associated with the intervention of a pharmacy-led medication history program at the health system. The cost avoidance was determined using the Veterans Affairs (VA) model by Lee and colleagues in which they calculated the product of the probability of harm for the intervention, the average cost of a medication error, and the quantity of errors observed.[12,13] The VA health system is very similar to Harris Health System. Both institutions are non-profit government entities, serve a relatively closed population, manage a closed formulary, and contain several outpatient clinics. The VA model was rationalized by the input of both an experienced physician and pharmacist. The probability of harm was estimated on a probability scale of 0-1.0. If the error was concluded to not have any harm without pharmacy intervention, then a score of 0 was assigned. If the error was neither likely nor unlikely to cause harm without pharmacy intervention, then a score of 0.5 was assigned. If the error was concluded to cause harm without pharmacy intervention, then a score of 1.0 was assigned. A number was assigned to each of the discrepancies captured based on this scale and clinical judgment.

Results

At the completion of the 10-week pilot, the extenders completed 113 medication histories and missed opportunities on 36 patients. This was accomplished over an 8-week data collection period with about 168 dedicated hours. Two of the ten weeks were used to train the pharmacist extenders. Medication discrepancies were identified in 109 of 113 (96.5%) patients.

For the primary outcome, the pharmacist extenders captured 328 discrepancies when completing medication histories on patients for whom providers had already completed medication histories. This outcome is statistically significant compared to the control group ($P<0.001$, 95% CI: 2.41-3.36). Pharmacist extenders captured an average of 3.26 discrepancies on medication histories for admitted patients. The average time for a pharmacy student to complete a medication history interview was 13.69 minutes. The majority of discrepancies captured were discontinued/not taking medication (n=181) and incorrect/missing medication (n=132) (Table 1, Figure 2). The majority of discrepancies by therapeutic class were associated with analgesic medications (n=75) followed by hypertension medications (n=38) (Table 2, Figure 3). Based on the results of this study, the cost avoidance during the 8-week data collection period was estimated to be $365,310 (Table 3). The potential annual cost avoidance associated with a 52-week pharmacy-led medication history program is $2,374,515 (Table 4).

Discussion

Harris Health System can benefit from a streamlined, comprehensive medication history program involving pharmacy personnel focusing on transitions in care. As stated earlier, about 60% of Ben Taub's admissions are from emergency center visits. This transition in care is an opportunity to make the biggest impact on medication review and patient care outcomes. Harris Health System functions as a patient-centered medical home and has the advantage of providing quality and coordinated care to patients whom have established long-term relationships with providers. Most of the health system's patient population is the underserved and underinsured community of Harris County. These patients have a high probability of not adhering to treatment regimens or keeping up with their disease management, thus these patients have the most need for a transition of care program. Pharmacists and pharmacist extenders are integral to patient and medication safety especially within the confines of the emergency center. These individuals can minimize medication errors and adverse drug events, reduce readmission rates, provide medication education, answer general medication questions, improve HCAPHS scores[8], and serve as a resource to the healthcare team. Published literature generally supports the involvement of pharmacy personnel due to their extensive drug knowledge and expertise.[7-13] Pharmacy involvement within the medication reconciliation process demonstrated positive and significant outcomes in our study. This comprehensive medication history program, at minimum, should include pharmacist supervision of a pharmacist extender.

The findings in this study demonstrated that pharmacist extenders captured 328 discrepancies on 113 patient's medication histories during an 8-week data collection period over approximately 168 hours. The pharmacist extenders discovered that 4 of the 113 (3.5%) patients had accurate medication histories and thus no changes were made. Pharmacist extenders were unable to capture all emergency center patients and only focused on patients admitted from certain emergency center units (i.e. no high acuity patients). The capture rate was less than 1% of emergency center admissions during the study period. An emergency center Spanish translator was on-site for language barriers with Spanish-speaking patients. For patients who spoke a language other than English and Spanish, pharmacist extenders were informed to use the system's translation phone line. Based on the Pareto principle, a quality improvement philosophy, the discontinued/not taking medication category falls in the top 20% of discrepancies and is considered to be of vital importance and focus (Figure 4). Pharmacist extenders missed 36 opportunities for several reasons including the patient resting, the patient away for a procedure, or the patient transferred to the floor. Pharmacist extenders had already invested time into reviewing these patients' EMR prior to finding out they were unavailable. The majority of discrepancies were amongst analgesics followed by anti-hypertensive medications. The "other" category included the following medication categories: antihistamine, laxative, herbal, anticonvulsant, antiemetic, bronchodilator, antispasmodic, topical, eye drops, anti-dementia, birth control/hormone, thyroid hormone replacement, anti-glaucoma and sedative.

The cost impact was calculated using the VA model by Lee and colleagues and estimated that the institution would avoid $2,374,515 annually. The average of the assigned probability of harm for each discrepancy based on the therapeutic medication class was calculated to be 0.81 (Table 5). This is indicative of a higher possibility of harm occurring without pharmacist intervention.[12,13] The average cost per error calculated by Lee and colleagues, was $1,375. When the average cost of error is multiplied by the number of discrepancies captured during the study period and the average probability of harm, we get an estimated cost avoidance of $365,310 during the study period. When this value is extrapolated to reflect 52 weeks for a year, we retrieve the estimated cost avoidance of $2,374,515.

Our study had several limitations with resource availability and allocation for the health system being a major challenge partly because we are a non-profit county institution. The most feasible and cost-

effective options when piloting the medication history program were explored. Pharmacist extenders were utilized as the intervention group while they were completing a hospital administration APPE rotation or an institutional IPPE rotation. This allowed for the pharmacist extenders to gain experiential education credit during the study period. Recurring training was required at the start of each new rotation block. Depending on the level of comfort for each student, on-the-job training and reinforcement was provided when deemed necessary. Since portable electronic resources were not available during the study period, pharmacist extenders were instructed to document each medication history on a data collection sheet during the patient interview. This information was then transferred to the EMR after the interview. This transfer time was not time-effective and could have been circumvented with the use of dedicated laptops or a powered computer cart (i.e. workstation on wheels).

Another resource limitation was the lack of a dedicated on-site pharmacist, such as a transitions of care pharmacist. The emergency medicine clinical pharmacist provided supervision throughout the study period and the PGY1 pharmacy resident provided training and supervision for three weeks during the study. However, these pharmacists did not oversee verification of the medication histories completed by pharmacist extenders. Pharmacist extenders were only allowed to complete medication histories while a pharmacist was on-site to supervise which was Monday through Friday from 8:30am-5:00pm. The PGY2 pharmacy resident was responsible for remote verification of the medication histories via the EHR. The PGY2 pharmacy resident was unable to verify all medication histories within 24 hours due to barriers associated with being off-site. Since it is typical for a large urban emergency center to be more demanding outside of business hours (i.e. evenings and weekends),[14] this study is not a true representation of pharmacy's potential impact in the medication reconciliation process.

In order to sustain this program and expand it into a streamlined comprehensive transitions of care program, the pharmacy department would need additional resources. Utilizing pharmacist extenders on a continuous cycle throughout the school year would be a very cost-efficient option, though the use of pharmacist extenders has its challenges. Another would be to allocate full time equivalents (FTEs) for dedicated pharmacy technicians +/- pharmacist extenders, at least one dedicated on-site pharmacist, and a dedicated pharmacist supervisor for the program. To sustain the program, PGY1 and PGY2 residents can manage the initiative as program coordinators, an experience that would further enhance the residents' acumen in managerial roles.

Conclusion

Medication reconciliation is an integral part of the transitions of care process and can help bridge the gaps of communication between interdisciplinary healthcare teams. Obtaining an accurate medication history can significantly decrease medication errors and facilitate providers in making decisions about a patient's care. Pharmacy involvement in the medication review process can help optimize reconciliation and avoid costs associated with medication errors. Our pilot study demonstrated positive and significant outcomes when pharmacy was involved in the medication reconciliation process and identified a need for a comprehensive medication history program targeting transitions in care. Streamlining the medication history process would improve medication safety and the quality of care the institution provides.

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Table 1: Medication Discrepancies

Type of Error/Discrepancy captured	Total
Discontinued/not taking med	181
Incorrect/missing med	132
Incorrect/missing frequency	6
Incorrect/missing dose	5
Duplication	4
Grand Total	328

Table 2: Number of Errors by Therapeutic Class

Number of Errors By Therapeutic Class	Total
Analgesic	75
Antihypertensive	38
Supplement	35
Antimicrobial	27
Cardiovascular	20
Antipsychotic	21
Antidiabetic	16
Anticoagulant	13
Antacid	12
Other	78

Table 3: Cost Impact Analysis During Study Period

Cost Factor	Total
Medication errors/discrepancies captured	328
Average Cost per Error	$1,375
Average Probability of Harm	0.81
Cost Avoidance During Study Period[a]	$365,310

[a]Cost Avoidance Calculations:
# of medication errors multiplied by the average cost per error multiplied by the average probability of harm = Total cost avoidance during study period

Average Cost per Error: $1,375 as determined by Am J Health-Syst Pharm. 2007; 64:63-8

Average Probability of Harm: Determined by Lee and Colleagues model. See table 5 for the probability of harm for each therapeutic class

Table 4: Projected Annual Cost Impact Analysis

Cost Factor	Total
Average medication errors/discrepancies captured per week *(based on 8-week pilot study)*	41
Average Cost per Error	$1,375
Average Probability of Harm *(based pilot study)*	0.81
Projected Cost Avoidance Per Year [a] ***(based on 52 weeks of coverage)***	$2,374,515

[a]Cost Avoidance Calculations:
Average # of medication errors multiplied by the average cost per error multiplied by the average probability of harm = Total cost avoidance during study period

Average # of medication errors/ discrepancies captured per week: 328 discrepancies from 8-week data collection period during pilot study divided by 8 weeks

Average Cost per Error: $1,375 as determined by Am J Health-Syst Pharm. 2007; 64:63-8

Average Probability of Harm: Determined by Lee and Colleagues model. See table 5 for the probability of harm for each therapeutic class

Table 5: Probability of Harm Calculations based on therapeutic classes

Probability of Harm Calculations			
Therapeutic Medication Class	**Number of errors**	**Assigned Probability of Harm (POH) for Class**	**Product of number of errors in class multiplied by POH**
Analgesic	75	0.5	37.5
Anti-hypertensive	38	1	38
Supplement	35	0.5	17.5
Antimicrobial	27	1	27
Antipsychotic	21	1	21
Cardiovascular	20	1	20
Antidiabetic	16	1	16
Anticoagulant	13	1	13
Antacid	12	1	12
Antihistamine	11	1	11
Laxative	10	1	10
Herbal	8	0.5	4
Anticonvulsant	8	1	8
Antiemetic	6	1	6
Bronchodilator	5	1	5
Antispasmodic	7	1	7
Topical	4	0.5	2
Eye Drops	3	0.5	1.5
Female Hormone	3	0.67	2.01
Anti-dementia	2	1	2
Thyroid hormone replacement	2	1	2
Anti-glaucoma	1	1	1
Sedative	1	1	1
		Average Probability of Harm = 0.81	

HARRISHEALTH SYSTEM

Figure 1: Interview Sheet: 2-page document

Patient Initials:		Allergies:		Date:
DOB:	Ht/Wt:	Reason for Visit:		Start Time:
MRN:		Language:	Interpreter Contacted? Y N	End Time:
Outside Pharmacies: *Did you call any? Y N*				Bed Number:

Prescription Medications				
Medication Name	**Strength**	**Sig (Dose, Route, Frequency)**	**Last Taken**	**Indication**

Herbals and Over-the-Counter Medications				
Medication name	**Strength**	**Sig (Dose, Route, Frequency)**	**Last Taken**	**Indication**

HARRISHEALTH SYSTEM

Discrepancies/Errors										
Medication Name	Discontinued/ Not Taking	Incorrect/ Missing med	Incorrect/ Missing dose	Incorrect/ Missing frequency	Incorrect/ Missing route	Incorrect/ Missing Formulation	Incorrect/ Missing Allergy	Duplication	Missing Indication	Other:

Total number of home medications on Prior-to-Admission List: _____

Total number of home medications reported: _____

Total minutes for interview: _____

Comments

Completed By (PharmD Candidate): _____

Checked By (RPh): _____

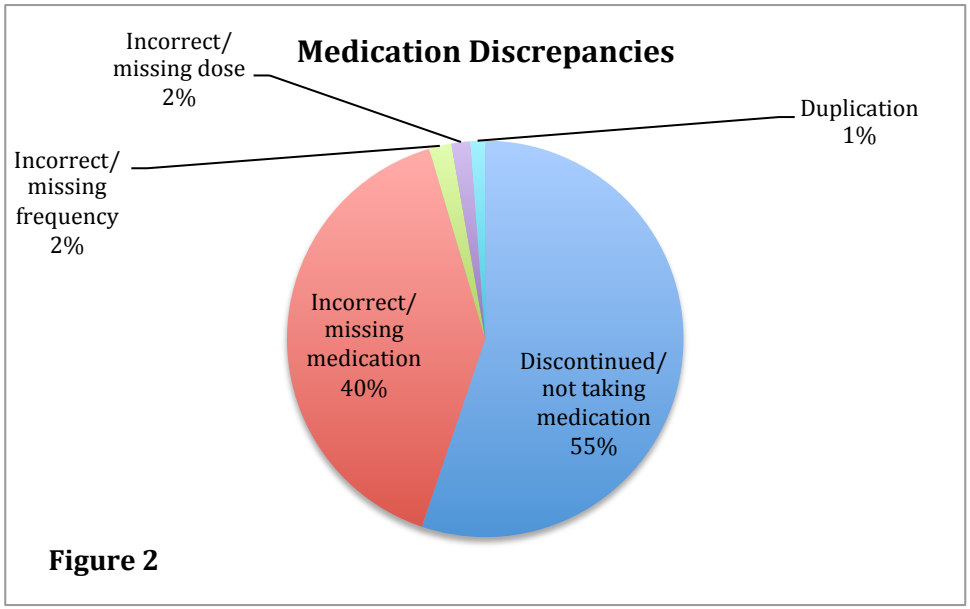

Figure 2

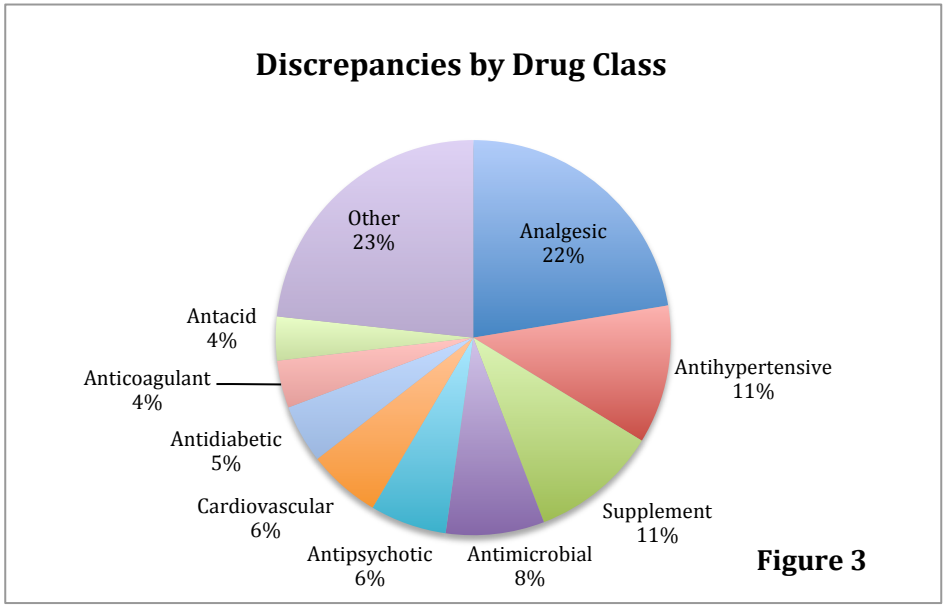

Figure 3

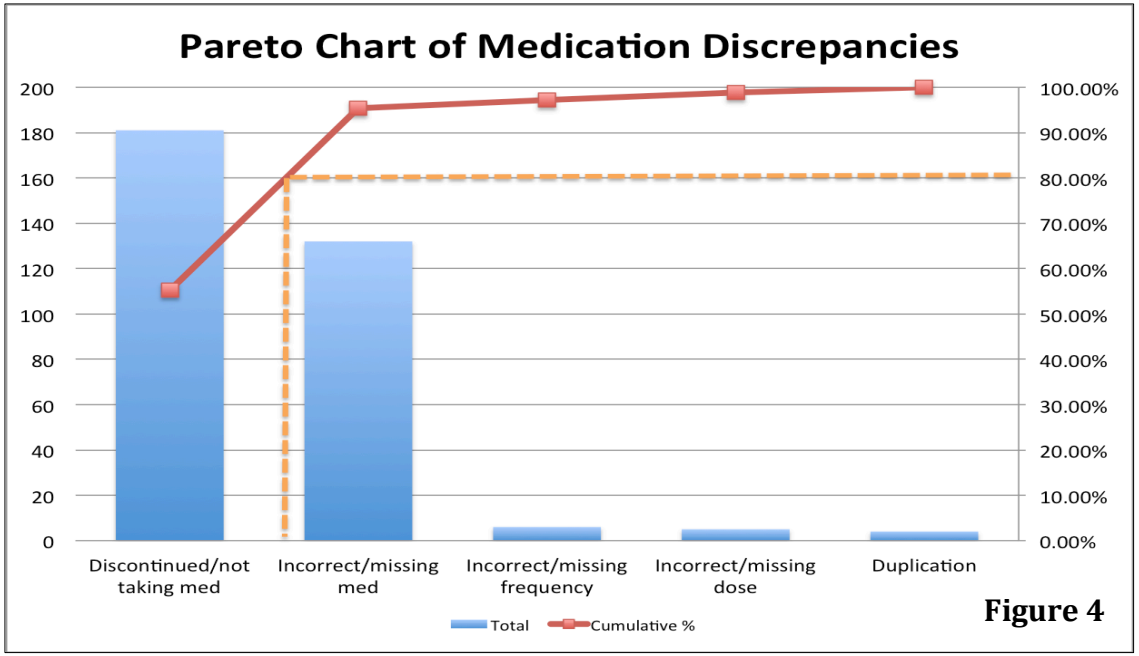

Figure 4