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Kelly J. Hiteshew

Thaddeus Franz

Kristen Lamberjack

Aleda M.H. Chen

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## Don't Leave Without Them: Dispensing asthma medications to pediatric patients upon discharge is associated with decreased hospital readmissions

Kelly J. Hiteshew, Pharm.D.<sup>1</sup>; Thaddeus Franz, Pharm.D.<sup>1</sup>; Kristen Lamberjack, Pharm.D.<sup>2</sup>; and Aleda M.H. Chen, Pharm.D., M.S., Ph.D.<sup>1</sup>  
<sup>1</sup>Cedarville University, School of Pharmacy and <sup>2</sup>Nationwide Children's Hospital, Outpatient Pharmacy

**Key Words:** asthma, readmission, exacerbation, pediatric, pharmacy, discharge

### Abstract

**Purpose:** Asthma exacerbations are a leading cause of hospital and emergency department admissions at pediatric institutions. The objective of this study was to determine if patients who obtain discharge medications from a pediatric institution's outpatient pharmacy after an admission for asthma have a lower thirty-day readmission rate than those who do not obtain discharge medications from the outpatient pharmacy. **Methods:** This multi-phase retrospective study included an initial chart review, an intervention period, and a second chart review of the intervention period. The chart reviews included patients ages two years and older with a discharge diagnosis of asthma or wheezing. During the intervention phase, pharmacists promoted use of the outpatient pharmacy by patients admitted for these conditions using multiple methods. In each chart review, the patients readmitted for asthma or wheezing within thirty days were classified as either outpatient pharmacy users (OPP users) or non-OPP users. Differences in readmission rates between OPP users and non-OPP users, as well as differences in overall OPP utilization, were analyzed before and during the intervention phase using a Chi-square test. **Results:** The initial chart review found no significant difference in thirty day readmission rates between OPP users and non-OPP users (6.2% and 7.5%, respectively;  $\chi^2 = 1.15$ ;  $p = 0.274$ ). The number of OPP users increased significantly from the first chart review to the second (11.8% and 45.9%, respectively;  $\chi^2 = 929.04$ ,  $p < 0.001$ ). The second chart review revealed that OPP users had a significantly lower readmission rate than non-OPP users during the intervention phase (2.3% and 10.9%, respectively;  $\chi^2 = 52.5$ ;  $p < 0.001$ ). **Conclusion:** Obtaining discharge medications from the OPP was associated with a lower thirty-day readmission rate in children with asthma. Promoting use of the OPP for transitional care should continue to be part of future efforts to decrease hospital readmissions.

### Background

In recent years, researchers have identified the need for health care providers and public health officials to improve clinical outcomes in pediatric asthma by addressing gaps in access to care, seizing opportunities for improvements in the health care system, and examining asthma-related hospitalizations.<sup>1-3</sup> Inpatient (IP) hospitalizations are one potential result of an exacerbation of asthma, which is a chronic inflammatory condition of the airways. Exacerbations also may lead to missed days of school and work for the child and parent, impaired daily functions and quality of life, emergency department (ED) visits, or death.<sup>1,4-6</sup> According to the National Health Interview Survey, the prevalence of asthma in children less than 18 years old has increased from 8.7% to 9.6% from 2001 to 2009, and is significantly higher than in adults.<sup>3</sup> The goal of treating asthma is to prevent morbidity, which is measured by exacerbations and progressive deterioration of lung function, and mortality.<sup>7</sup> Children who are ethnic minorities, under age five, from low-

income households, inner-city residents, or who are exposed to tobacco smoke or air pollution have a higher risk of experiencing morbidity and mortality from asthma.<sup>1,4,7</sup> Other known risk factors for morbidity and mortality from asthma include individuals with an increased frequency and severity of past asthma exacerbations, multiple ED visits or IP hospitalizations for asthma in the past year, or any history of intubation or intensive care unit (ICU) admission for asthma.<sup>7,8</sup>

The National Heart, Lung, and Blood Institute (NHLBI) and the National Asthma Education and Prevention Program (NAEPP) Expert Panel Report 3 clinical guidelines released in 2007 emphasize the importance of preventative anti-inflammatory treatment. Yet, asthma exacerbations continue to be a leading cause of pediatric hospitalizations.<sup>3,4,7</sup> In 2007, there were 41.4 hospitalizations and 132.7 ED visits for asthma per 10,000 children under age five.<sup>9</sup> The Healthy People 2020 goal is to significantly reduce these numbers to 18.1 hospitalizations and 95.5 ED visits per 10,000 children.

The guidelines recommend continued treatment with several prescription medications after an exacerbation,<sup>7</sup> but children diagnosed with asthma may have increased barriers to health care, including unmet prescription needs.<sup>1,10-13</sup> Kogan and

**Corresponding Author:** Kelly J. Hiteshew, Pharm.D.  
Cedarville University, School of Pharmacy, Assistant Professor of Pharmacy Practice, 251 N. Main St., Cedarville, OH 45314  
Office: 937-766-7771; Cell Phone: 513-571-2580  
E-mail: [kellyhiteshew@cedarville.edu](mailto:kellyhiteshew@cedarville.edu)

colleagues (2010) found that children in fair or poor health or with special health care needs due to a chronic condition (including use of prescription medications) were more likely to be underinsured and experience barriers to appropriate health care.<sup>10</sup> Prescription access for asthmatics is crucial, because poor adherence to therapy has been found to be a prevalent cause of uncontrolled asthma.<sup>14-18</sup> Delays in obtaining medication could lead to non-adherence, uncontrolled asthma, and readmissions.<sup>13,16</sup>

Pharmacists can play a pivotal role in the prevention of morbidity and mortality due to asthma.<sup>19</sup> Education and management of asthmatics by pharmacists has been shown to improve inhaler technique and medication adherence, leading to better asthma control and reduced ED and IP admissions.<sup>20-24</sup> Yet, these efforts are not effective unless the patient has immediate access to prescription medications. As discussed, high-risk asthmatic children, such as those recently admitted for an exacerbation, may encounter several barriers to obtaining prescription medications. An outpatient pharmacy on the hospital campus may be able to eliminate some of these barriers by dispensing discharge medications to patients before they leave the campus, resulting in better initial medication adherence and therefore a lower rate of readmission within thirty days, which is equivalent to the usual supply of medication dispensed. Therefore, the primary objective of this study was to determine if patients who obtain first-fill medications from a pediatric institution's outpatient pharmacy after an ED or IP admission for asthma have a lower thirty-day readmission rate than patients who do not obtain discharge medications from the outpatient pharmacy. The secondary objectives of this study were to examine the relationship between selected patient characteristics (age, insurance, and type of readmission) and OPP utilization for patients readmitted within 30 days.

## Methods

This multiphase, interventional study was conducted at a free-standing, tertiary pediatric institution with an on-campus outpatient pharmacy. The institution has more than 350 inpatient beds and treated over 19,000 inpatients and 76,000 emergency department patients in 2010. The study included three components: a pre-intervention retrospective chart review, an intervention, and a second retrospective chart review. The timeline (see Figure 1) details several important stages of the study. The hospital Institutional Review Board (IRB) gave the pre-intervention phase of the study expedited approval. The intervention and second chart review were considered quality improvement and were exempt from IRB review.

### *Pre-Intervention Retrospective Chart Review*

The purpose of the initial chart review was to determine if patients who obtained discharge medications from the outpatient pharmacy (OPP) had a lower rate of thirty-day readmissions than those who did not obtain discharge medications from the OPP. Using the institution's electronic medical record (EMR), patients ages two and older admitted to the hospital or ED with a principal ICD-9 diagnosis of asthma or wheezing from October 2008 through June 2010 were identified. Each patient's chart was analyzed for thirty-day readmission encounters, which were defined as an IP or ED readmission within thirty-days of a prior IP or ED admission. The OPP records of patients with thirty-day readmission encounters were examined to determine whether or not each readmitted patient had used the OPP to fill his or her asthma medications within one day of discharge. Readmitted patients then were classified into two groups: OPP users or non-OPP users. Finally, the rates of thirty-day readmission were calculated for each group and compared.

### *Intervention*

The intervention was designed to increase the percent of asthma patients utilizing the OPP upon discharge. Outpatient pharmacists performed educational interventions with patients' families and clinical staff to encourage utilization of the OPP. This effort, called *Don't Leave Without Them*, was part of a hospital-wide initiative to decrease asthma admissions and took place from July 2010 to February 2011. Monday through Friday, pediatric inpatients being treated for asthma exacerbations were identified by outpatient pharmacists via a consult order that was sent through the EMR. The pharmacists visited each patient and their family members at least once during their admission to educate the family about the OPP and distribute a promotional card detailing the services offered by the OPP, as well as its location and hours of operation. Questions from the patient/family were common, and often led to informal discussions about medications, but no formal medication or disease state education was performed. Occasionally, the pharmacists were unable to make contact with a patient or family during their admission. If the family chose to use the OPP, the card acted as a reminder to their nurse to ensure prescriptions were sent accordingly. In the ED, flyers promoting the OPP were distributed to patients upon admission by registration staff. These flyers served the same purpose as the cards given to inpatients, but were not complemented by a personal visit from a pharmacist.

Collaboration with nurses, respiratory therapists, medical staff, discharge coordinators, and other hospital staff was essential for the success of this program. Interventions aimed at educating staff about the purpose of *Don't Leave*

*Without Them* were continuous and focused on the units that treated the majority of asthma exacerbations, due to the large number of clinical staff. The outpatient pharmacists were in regular communication with the clinical leaders of these units and worked with them to distribute weekly updates on the program's progress to their clinical staff. Although the program was driven by two outpatient pharmacists, several non-pharmacy clinicians and staff were champions for the program, including discharge coordinators who regularly called the outpatient pharmacists to let them know which patients were going home that day, physicians, nurse leaders, and administrators.

#### *Second Retrospective Chart Review*

Thirty day readmission rates were reassessed to determine the impact of the intervention phase using a retrospective chart review with the same inclusion criteria and methods as the initial chart review, but for the time frame of the intervention phase (July 2010 to February 2011). The thirty-day readmission rates were again calculated for each group and compared to determine if there was a difference in the thirty-day readmission rates between OPP users and non-OPP users.

#### *Statistical Analyses*

All data were analyzed using IBM SPSS v. 20.0 for Windows (Armonk, New York). An *a priori* level of 0.05 was used for statistical significance. Descriptive statistics were used to examine OPP use, thirty-day readmissions (ED and IP), age, and insurance type (private and Medicaid). Differences in readmission rates, type of readmission (ED or IP), age (<4 years, 5-11 years, and  $\geq 12$  years), and insurance status (private or Medicaid) between OPP users and non-OPP users, as well as differences in overall OPP utilization, were analyzed before and during the intervention phase using a Chi-squared or Kruskal-Wallis test as appropriate.

## Results

#### *Pre-Intervention Retrospective Chart Review*

The first phase of the study evaluated 4,903 encounters that met inclusion criteria, occurring from October 2008 to June 2010. Only 578 of these encounters (11.8%) were OPP users (see Table 1). OPP users had a lower thirty day readmission rate than non-OPP users. However, the relationship between OPP-utilization and readmission rate was not statistically significant (6.2% and 7.5%, respectively;  $\chi^2 = 1.15$ ;  $p = 0.274$ ) (Table 2).

#### *Second Retrospective Chart Review*

The number of OPP users during the intervention phase was 45.9%, an increase from 11.8% pre-intervention. The relationship between OPP-utilization and study phase was

statistically significant (Table 1;  $\chi^2 = 929.04$ ;  $p < 0.001$ ). A total of 1,824 encounters were analyzed using a retrospective chart review at the end of the intervention, revealing 127 thirty-day readmissions (Table 1). Overall, thirty-day readmission rates in the study population were similar at pre-intervention (7.3%) and at the second retrospective chart review (7.5%). However, there was a statistically significant relationship between OPP-utilization and 30 day readmission rates (Table 2;  $\chi^2 = 52.49$ ;  $p < 0.001$ ). OPP users had a lower readmission rate than non-OPP users in the second retrospective chart review (2.3% and 10.9%, respectively).

#### *Differences in Readmission by Selected Characteristics*

Of patients readmitted within 30 days, there were differences in type of readmission by OPP utilization (Table 3). There was a statistically significant relationship between OPP-utilization and admission type during the pre-intervention phase ( $\chi^2 = 20.79$ ;  $p < 0.001$ ) and at the second retrospective chart review ( $\chi^2 = 8.67$ ;  $p = 0.007$ ). OPP users had lower emergency department and inpatient admission rates than non-OPP users in the pre-intervention phase. Within 30 day readmissions, there were no significant relationships between OPP-utilization and age or insurance type (Table 3).

Differences in age and insurance status according to type of admission also were analyzed for patients readmitted within 30 days (Table 4). There was a statistically significant relationship between type of admission and OPP-utilization in patients less than 4 years old who were readmitted within 30 days during the intervention phase ( $\chi^2 = 10.58$ ;  $p = 0.007$ ) and patients ages 5-11 who were readmitted within 30 days during the pre-intervention phase ( $\chi^2 = 31.93$ ;  $p < 0.001$ ). There were lower emergency department readmission rates in pediatrics less than 4 years old who utilized the OPP pharmacy during the intervention phase and ages 5-11 who utilized the OPP pharmacy during the pre-intervention phase. There were no other significant differences by age.

There also was a statistically significant relationship between admission type and OPP-utilization in patients with Medicaid as their primary insurer who were readmitted within 30 days in both the pre-intervention ( $\chi^2 = 23.86$ ;  $p < 0.001$ ) and intervention ( $\chi^2 = 11.08$ ;  $p = 0.001$ ) phases. Of patients who were readmitted with Medicaid insurance, there were less OPP-users than non-OPP users during pre-intervention (7.3% for OPP users, 92.7% for OPP non-users) and at the second retrospective chart review (11.4% for OPP users, 88.6% for OPP non-users). There were no other statistically significant differences by insurance type.

## Discussion

Results from the second retrospective chart review indicated that the *Don't Leave Without Them* program significantly increased OPP utilization rates, and children who were discharged from an ED or IP visit for an asthma exacerbation and picked up discharge medications from the OPP were significantly less likely to be readmitted within thirty days. In the pre-intervention chart review, there were no statistically significant differences between OPP users and non-OPP users with regard to readmission rates. However, non-OPP users did have higher readmission rates.

The difference between readmission rates from the pre-intervention chart review to the second retrospective chart review was likely due to the significant increase in the percent of these patients utilizing the OPP, not a change in practice. The efforts of the pharmacists during the intervention were mainly focused on communication, education, and marketing. The actual practices of the pharmacy did not change during the intervention, but more patients were receiving the benefits that the pharmacy offers. By increasing the utilization of the OPP, there were enough OPP users to detect differences. Post-hoc power analyses indicated the pre-intervention retrospective chart review did not provide sufficient power to detect statistical differences, assuming an effect size of 0.1. A sample size of 785 OPP users was needed to detect differences at the 80% power level, which was achieved through the intervention for the second retrospective chart review (N=836).

There are many reasons why OPP users may have had a lower rate of 30-day readmissions. As previously discussed, pediatric asthmatics may be at increased risk to encounter barriers to obtaining the prescription medications they need to prevent exacerbations.<sup>1,10-13</sup> Patients who utilize the OPP are able to avoid several of these barriers. The OPP is easily accessible to those already on the hospital campus, and is open into the evenings and during the day on weekends to accommodate patients discharged at those times. The OPP offers a billing service which ensures that patients are able to take their medications home that day without any delays due to gaps in insurance coverage or ability to pay. The patients who utilize this service may not have been able to get their medications in a timely manner or at all at another pharmacy. The OPP also counsels every family when they pick up their medications. Counseling by a pharmacist can make a great impact in asthma due to complex inhaler administration techniques and confusion over the purpose of each medication.<sup>19-24</sup> Although other community pharmacists are capable of providing this teaching, they may not act on their intent to provide asthma counseling to pediatric patients due to barriers (e.g. lack of time, lack of parent interest, no

placebo devices).<sup>25</sup> The OPP pharmacists and interns are trained to work in pediatric medicine and have access to the patient's EMR and are able to easily contact providers to make necessary recommendations. They also have access to medical interpreters to serve the institution's diverse patient base. Overall, the continuity of care provided by the OPP likely decreases barriers to obtaining first-fill medications and increases medication adherence, thereby resulting in lower readmission rates.

The results of this study may be especially relevant due to the location of the hospital and the population it serves. As addressed previously, children with asthma who are ethnic minorities, from low-income households, inner-city residents, or who are exposed to tobacco smoke or air pollution are at higher risk for morbidity and mortality.<sup>1,4,7</sup> The hospital is located in the inner-city and over 20% of the OPP's patients are from the zip codes surrounding the hospital. In 2008, an average of 47% of the households in these five zip codes had an income < \$25,000.<sup>26</sup> Of note, over 50% of patients who utilize the OPP have state Medicaid insurance. Also, patients in the study had at least one asthma exacerbation, which meant they were at risk for future exacerbations and hospital readmissions.<sup>7,8</sup> Any change in practice, such as the intervention proposed in this study, that could decrease readmissions in high-risk populations would be beneficial and should be further investigated.

The results from the secondary objectives identified a few sub-groups of the population that should be focused on due to their higher than expected rates of readmission. First, ED patients who were non-OPP users had higher rates of readmission in both phases. Since *Don't Leave Without Them* focused heavily on inpatients, the higher rates of readmission in ED patients were not unexpected. Lower rates of OPP use in ED patients may also be attributed to the hours of operation of the OPP, which is not open during the overnight hours. It is very possible that since ED visits are patient/family directed as opposed to physician directed, there is a need for asthma management education in this population. Looking at non-OPP ED patients by age we see that children  $\leq 4$  years old had significantly higher readmissions than their counterparts who were OPP users. This shows that there is a great potential to prevent readmissions in this patient population if they use the OPP. Non-OPP ED patients aged 5-11 years had higher than expected readmissions in the first phase but not the second, which shows that readmissions in this age group may not be as dependent on OPP use as the younger population. Another group that had higher than expected readmission rates in both phases was ED, non-OPP users with Medicaid. Future research should focus interventions

specifically aimed towards ED patients, specifically those  $\leq 4$  years old and those with Medicaid as the primary payer.

There were several limitations to this analysis. Picking up prescriptions at the OPP was used as a measure of adherence to medication, but there are many other factors which could affect adherence, such as: medication availability and acquisition from other sources (i.e., home supply, another pharmacy), lack of proper inhaler technique, and patients who pick up medication but do not use it. Readmissions to urgent care centers or other institutions were not investigated. Furthermore, the clinical appropriateness of discharge therapy was not assessed, although it is monitored closely by the OPP pharmacists upon dispensing.

### Conclusion

In conclusion, this study found that providing discharge medications from a pediatric hospital's outpatient pharmacy to children with asthma exacerbations may be linked with decreased rates of readmission within thirty-days. This could be attributed to increased adherence to medication therapy and the continuity of care facilitated by the OPP. In addition, several groups were identified as target groups for future

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efforts to decrease readmissions: ED patients; ED patients  $\leq 4$  years old; and ED patients with Medicaid.

The results should not be applied to readmissions beyond thirty days, as this is the usual day supply of medication dispensed, and there is no reason to believe that the benefit of utilizing an on-campus pharmacy would extend beyond the supply of the medication. These results apply specifically to pediatric tertiary care centers with outpatient pharmacies, but future research is needed to determine the impact of similar programs at other institutions that provide acute care to individuals requiring medication therapy to prevent chronic illness exacerbations. While the study was not designed to determine a causal relationship between OPP use and thirty-day readmission rates, it provides evidence that promoting the use of the OPP for transitional care should continue to be part of future efforts to decrease readmissions, and can serve as a model for other institutions. While the official initiative at this hospital ended in March 2011, the efforts have been on-going due to the success of the program.

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Table 1. Differences in Utilization of Outpatient Pharmacy Services (OPP) by Intervention Phase

	Pre-Intervention Phase N=4903 N (%)	Intervention Phase N=1821 N (%)	Pearson Chi-Square	Significance
OPP Users	578 (11.8)	836 (45.9)	929.04	p < 0.001
Non-OPP Users	4325 (88.2)	987 (54.1)		

Table 2. Differences in 30-Day Readmission Rates by Outpatient Pharmacy Service (OPP) Utilization

	Pre-Intervention Phase 30-Day Readmission				Intervention Phase 30-Day Readmission			
	Yes N (%)	No N (%)	Pearson Chi-Square	Significance	Yes N (%)	No N (%)	Pearson Chi-Square	Significance
OPP Users	36 (6.2)	542 (93.8)	1.20	0.274	19 (2.3)	817 (97.7)	52.49	< 0.001
Non-OPP Users	324 (7.5)	4001 (92.5)			108 (10.9)	879 (89.1)		



Table 3. Differences in 30-Day Readmissions by Selected Characteristics and Outpatient Pharmacy Service (OPP) Utilization

	Pre-Intervention Phase Patients Readmitted within 30 Days				Intervention Phase Patients Readmitted within 30 Days			
	OPP User N (%)	Non-OPP N (%)	Pearson Chi-Square	Significance	OPP User N (%)	Non-OPP N (%)	Pearson Chi-Square	Significance
<b>Admission Type</b>								
Emergency Department	20 (6.7)	278 (93.3)	20.79	< 0.001	11 (10.6)	93 (89.4)	8.67	0.007
Inpatient	16 (25.8)	46 (74.2)			8 (34.8)	15 (65.2)		
<b>Age</b>			<b>Kruskal- Wallis Test</b>	<b>Significance</b>			<b>Kruskal- Wallis Test</b>	<b>Significance</b>
≤4 years	15 (12.4)	106 (87.6)	1.34	0.247	7 (15.9)	37 (84.1)	0.02	0.894
5-11 years	15 (10.2)	132 (89.8)			6 (12.2)	43 (87.8)		
≥12 years	6 (7.3)	76 (92.7)			6 (17.6)	28 (82.4)		
<b>Insurance Type</b>			<b>Pearson Chi-Square</b>	<b>Significance</b>			<b>Pearson Chi-Square</b>	<b>Significance</b>
Private	4 (4.8)	79 (95.2)	3.63	0.057	2 (7.7)	24 (92.3)	1.518	0.218
Medicaid	31 (12.2)	224 (87.8)			17 (17.5)	80 (82.5)		

Table 4. Differences in 30-Day Readmissions by Age, Primary Payer and Outpatient Pharmacy Service (OPP) Utilization

Age	Type of Admission	Pre-Intervention Phase Patients Readmitted within 30 Days				Intervention Phase Patients Readmitted within 30 Days			
		OPP User N (%)	Non-OPP N (%)	Pearson Chi- Square	Significance	OPP User N (%)	Non-OPP N (%)	Pearson Chi- Square	Significance
≤4 years	Emergency Department	12 (11.0)	97 (89.0)	1.65	0.199	3 (10.5)	34 (91.9)	10.58	0.007
	Inpatient	3 (25.0)	9 (75.0)			4 (57.1)	3 (42.9)		
5-11 years	Emergency Department	4 (3.4)	115 (96.6)	31.93	<0.001	4 (10.3)	35 (89.7)	0.70	0.402
	Inpatient	11 (39.3)	17 (60.7)			2 (20.0)	8 (80.0)		
≥12 years	Emergency Department	4 (6.7)	56 (93.3)	0.14	0.709	4 (14.3)	24 (85.7)	1.23	0.267
	Inpatient	2 (9.1)	20 (90.9)			2 (33.3)	4 (66.7)		
<b>Primary Payer</b>									
Private	Emergency Department	4 (5.7)	66 (94.3)	0.78	0.377	2 (9.1)	20 (90.9)	0.394	0.530
	Inpatient	0 (0.0)	13 (100.0)			0 (0.0)	4 (100.0)		
Medicaid	Emergency Department	15 (7.3)	191 (92.7)	23.86	<0.001	9 (11.4)	70 (88.6)	11.08	0.001
	Inpatient	16 (32.7)	33 (67.3)			8 (44.4)	10 (56.4)		

Figure 1

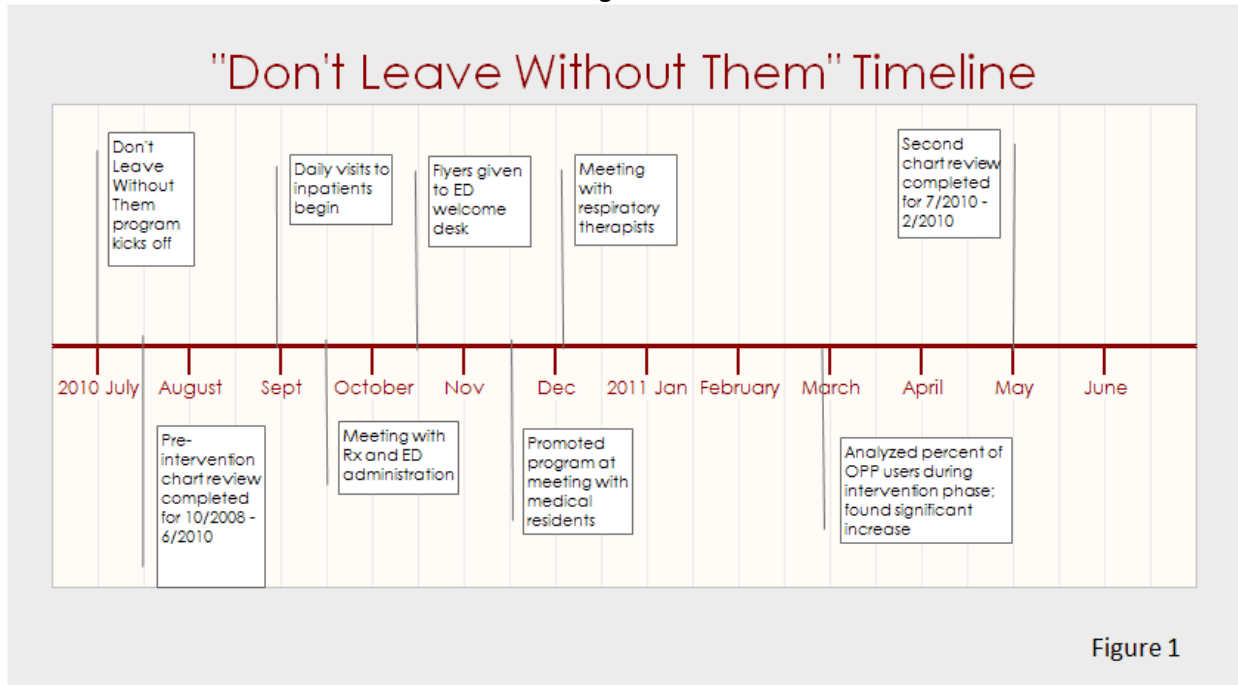


Figure 2

