Medication Use Evaluation
Levalbuterol (Xopenex®)
[Hospital X]
July 20XX – December 20XX

Background

Levalbuterol is a beta-2 agonist that relaxes smooth muscle in the airways (1). It is the enantiomerically pure form of racemic albuterol. Levalbuterol contains only the R(-)-isomer, the isomer responsible for bronchodilation (2). The S(+)-isomer found in albuterol may contribute to some of the adverse effects (i.e., tachycardia) seen with racemic albuterol, but head-to-head clinical trials between levalbuterol and racemic albuterol have failed to show significant differences in heart rate 30 minutes after administration (1, 3). Levalbuterol is a much more expensive drug than albuterol ($6.44/unit dose of nebulization solution or $67.85/HFA inhaler for levalbuterol compared to $1.66/unit dose of nebulization solution or $21.64/HFA inhaler for racemic albuterol) (1, 4). I, the Pharmacy and Therapeutics Committee at [Hospital X] approved implementation of an automatic therapeutic interchange to albuterol when levalbuterol is ordered. Levalbuterol continues to be available and is dispensed as ordered when the prescriber specifies "Do Not Substitute" in the order. The objective of this MUE was to examine the prescribing and usage trends of levalbuterol during the July 20XX – December 20XX time period.

Methods

This was a retrospective chart review. Patients were identified using a report generated by the Business Intelligence (BI) Tool and included all patients whose medication record reflected at least one transaction of levalbuterol nebulization solution or HFA inhaler between July 1, 20XX and December 31, 20XX. Medical records for these patients were then reviewed in ChartView. Data points collected for this evaluation included the following:

- Patient age group (Pediatric, defined as <18yo; or Adult, defined as ≥18yo)
- Month during which an order for levalbuterol was written for the patient
- Number of levalbuterol unit doses patient used during hospital stay
- Levalbuterol delivery method (inhaler, nebulization, or both)
- Provider who prescribed the levalbuterol and their service line
- Do Not Substitute (DNS) specified in the levalbuterol order (yes or no)
- Do Not Substitute (DNS) reason stated in the levalbuterol order (atrial fibrillation, tachycardia, etc.)
- Documented albuterol allergy (yes or no)

Results

Patient Population

A total of seventy-four (74) patients were included in this analysis. Zero (0) patients had a documented albuterol allergy. The majority (97%) of the patients were adult patients (defined as patient age ≥18yo). Only two pediatric patients met inclusion criteria (defined as patient age <18yo). Five (5) patients had two separate hospital admissions during the July 20XX – December 20XX time period for which they received levalbuterol; all five of these patients were adult patients. All other patients had only one hospital admission for which they received levalbuterol. Thus, a total of seventy-nine (79) unique albuterol orders were analyzed.

Figure 1. Patient Population by Age Group.

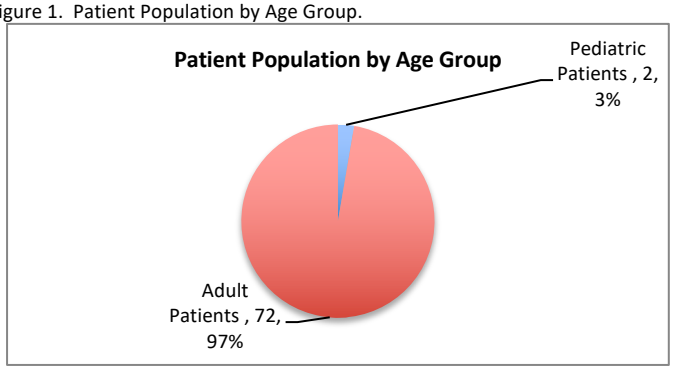
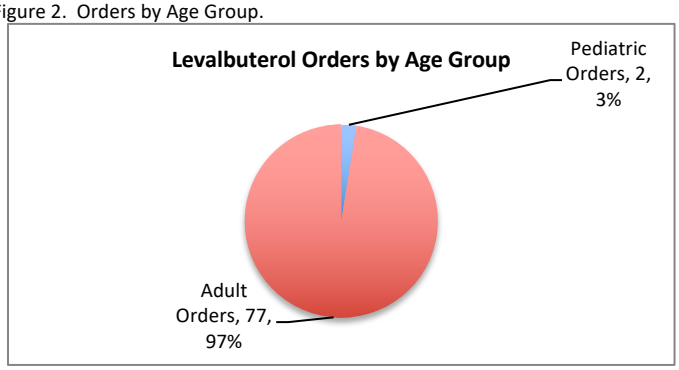


Figure 2. Orders by Age Group.



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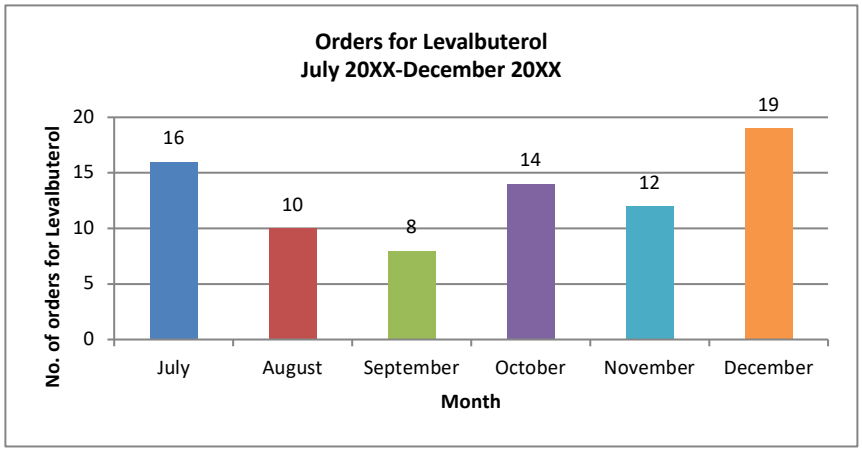
Results, cont'd

Prescribing Trends

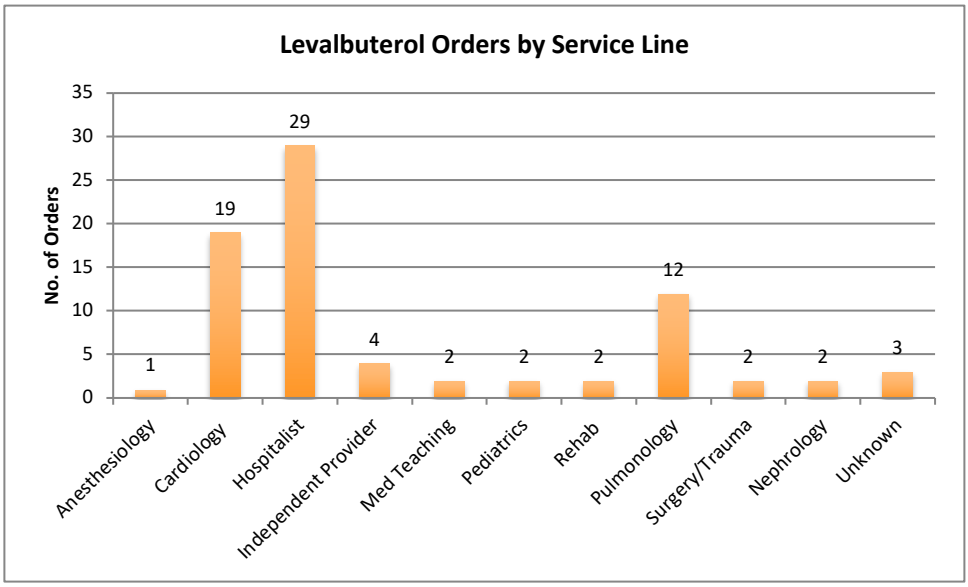
Of the seventy-nine (79) albuterol orders analyzed, the majority (62%) occurred in December (24%), July (20%), and October (18%) (Figure 3). Hospitalists (37%), Cardiologists (21%), and Pulmonologists (15%) wrote the majority (73%) of the orders (Figure 4). Most of orders (95%) were written for the nebulization solution dosage form of levalbuterol, with only 5% being written for the HFA inhaler (Figure 5). Eighty percent (80%) of the orders analyzed had a Do Not Substitute (DNS) directive designated in the order (Figure 6). Three (3) orders could not be tracked in ChartView even though the patient had a charge for levalbuterol at some point during their hospital stay, so their DNS status is unknown. Of those orders that utilized a DNS directive (n=63), only 32% gave a reason for why levalbuterol should be used over albuterol (Figure 7). The two most common DNS reasons given in an order were tachycardia and atrial fibrillation (Figure 8).

Figure 3. Orders for Levalbuterol by Month.



Month (Ranked Greatest to Least)	Percentage of All Orders
December	24%
July	20%
October	18%
November	15%
August	13%
September	10%

Figure 4. Levalbuterol Orders by Service Line.



Service Line (Ranked Greatest to Least)	Percentage of All Orders
Hospitalist	37%
Cardiology	24%
Pulmonology	15%
Independent Provider	5%
Unknown	4%
Pediatrics	3%
Rehab	3%
Surgery / Trauma	3%
Nephrology	3%
Med Teaching	2%
Anesthesiology	1%

Cardiology Included:
[Hospital Z] Cardiology (2)
[Hospital A] Cardiovascular Surgical Associates (3)
[Hospital B] Cardiology (1)
[Hospital C] Heart & Vascular Services (2)
North Carolina Heart and Vascular (3)
[Hospital Y] Cardiology (7)
[Hospital X] Heart & Vascular (1)

Nephrology Included:
Triangle Kidney Associates (1)
Nephrology Services (1)

Unknown Included:

	Those patients who had a charge for albuterol during their hospital visit, but no record of it could be found in ChartView

Figure 5. Levalbuterol Orders by Delivery Type.

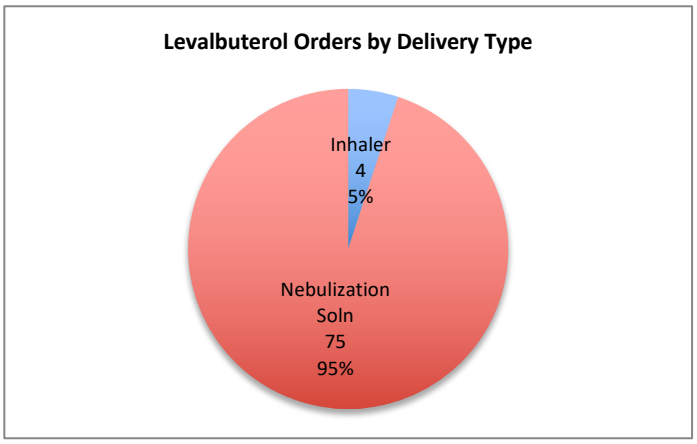


Figure 6. Levalbuterol Orders by Do Not Substitute (DNS) Designation.

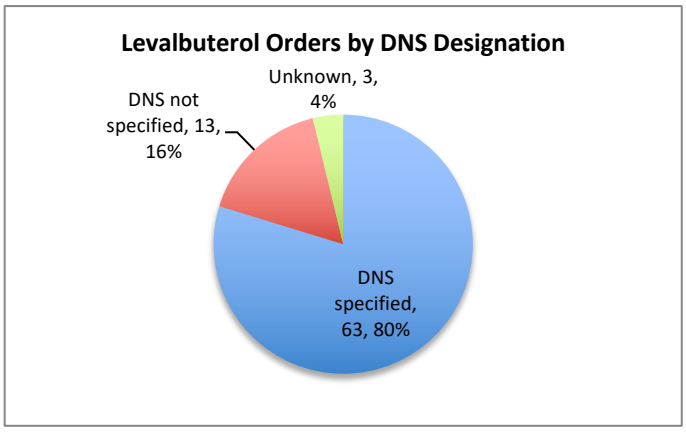


Figure 7. Where DNS was Designated, A Reason was Given.

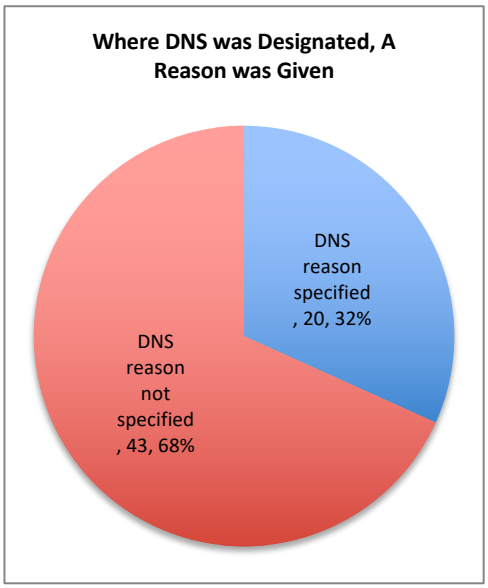
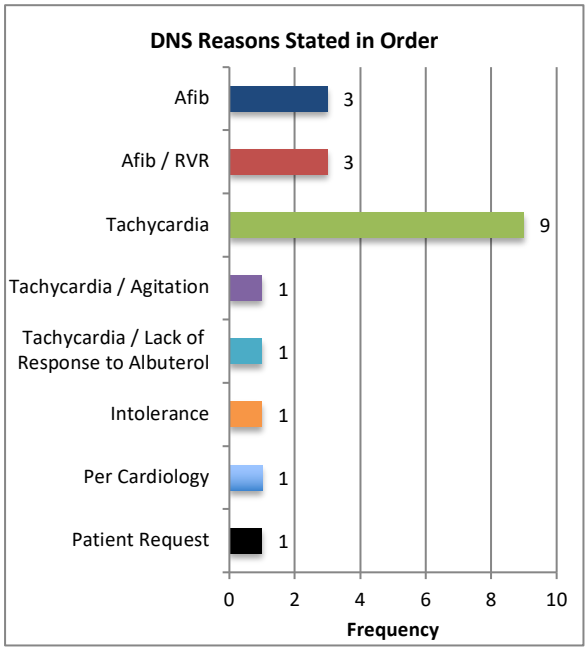


Figure 8. DNS Reasons Stated in Order.



Composite of DNS Reasons

DNS Reason	n	Percentage of All Reasons Given
Tachycardia	11	55%
Afib	6	30%
Other	3	15%

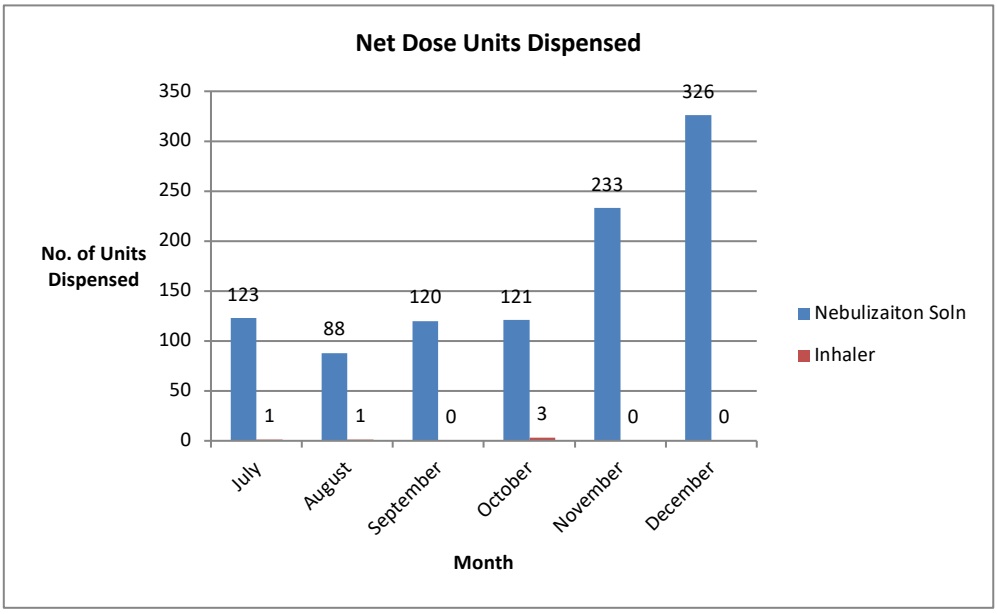
Results, cont'd

Usage & Dispensing Trends

A total of 1011 unit doses of levalbuterol nebulization solution were dispensed during the evaluation period. Twenty-five percent (25%) of these were associated with 4 orders (5% of total number of orders) prescribed to 4 unique patients. The mean number of nebulization unit doses dispensed was 13.48 and the median and mode were both 12 units. Five levalbuterol inhalers were dispensed during the study period to 4 patients (Figure 12). One patient received two inhalers, likely secondary to the first inhaler being lost when the patient transitioned to a different unit within the hospital, as this second inhaler was dispensed one day after the first. Zero (0) patients received both nebulization solution and inhaler dosage forms during their hospital admission.

The months corresponding to the greatest numbers of *orders* for levalbuterol during the July 20XX-December 20XX time period were December, July, and October (Figure 3). However, the months with the highest number of levalbuterol *units dispensed* were December, November, and July (Figure 9). Figure 10 provides a comparison of orders and dispensing trends. One possible explanation for the discrepancy between orders and units dispensed could be that some orders were written near the end of October and the patient did not begin requiring doses until early November when the charge to the patient would have been documented. Another factor to note is that the patient hospital visit where the most units of levalbuterol nebulization solution were dispensed was in November (see Figure 11). This skews the trend in units dispensed toward November instead of July or October.

Figure 9. Levalbuterol Net Dose Units Dispensed.



Dispensing Totals	#
Total # of levalbuterol nebulization solution units dispensed	1,011
Total # of levalbuterol inhaler units dispensed	5
Total # of patients who received both dosage forms	0

Figure 10. Levalbuterol Orders Compared to Net Unit Doses Dispensed.

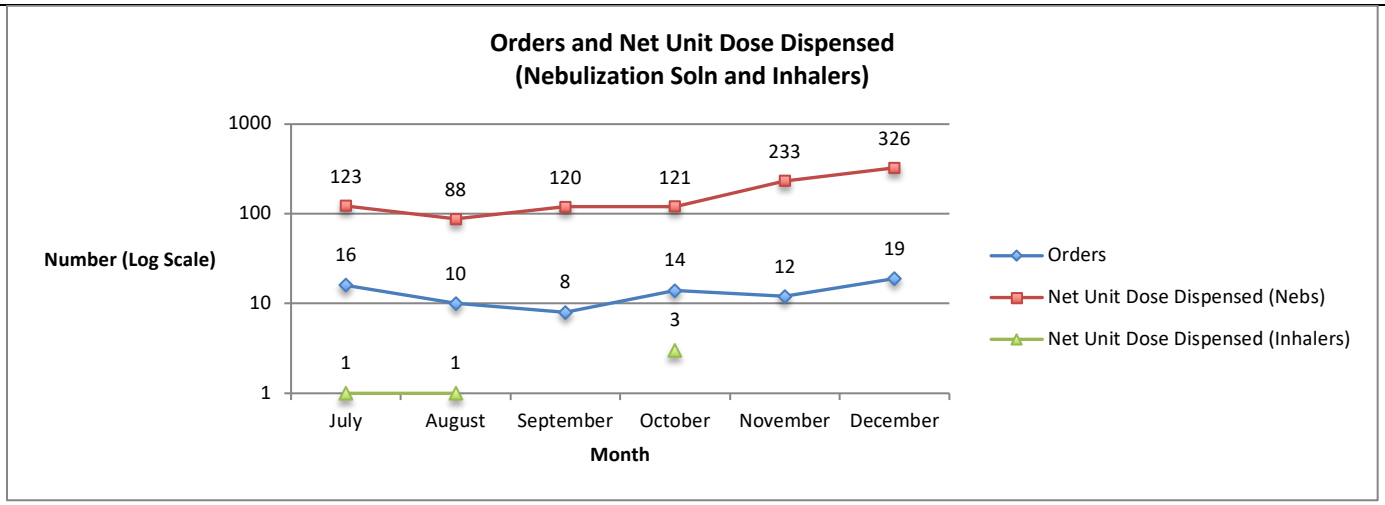
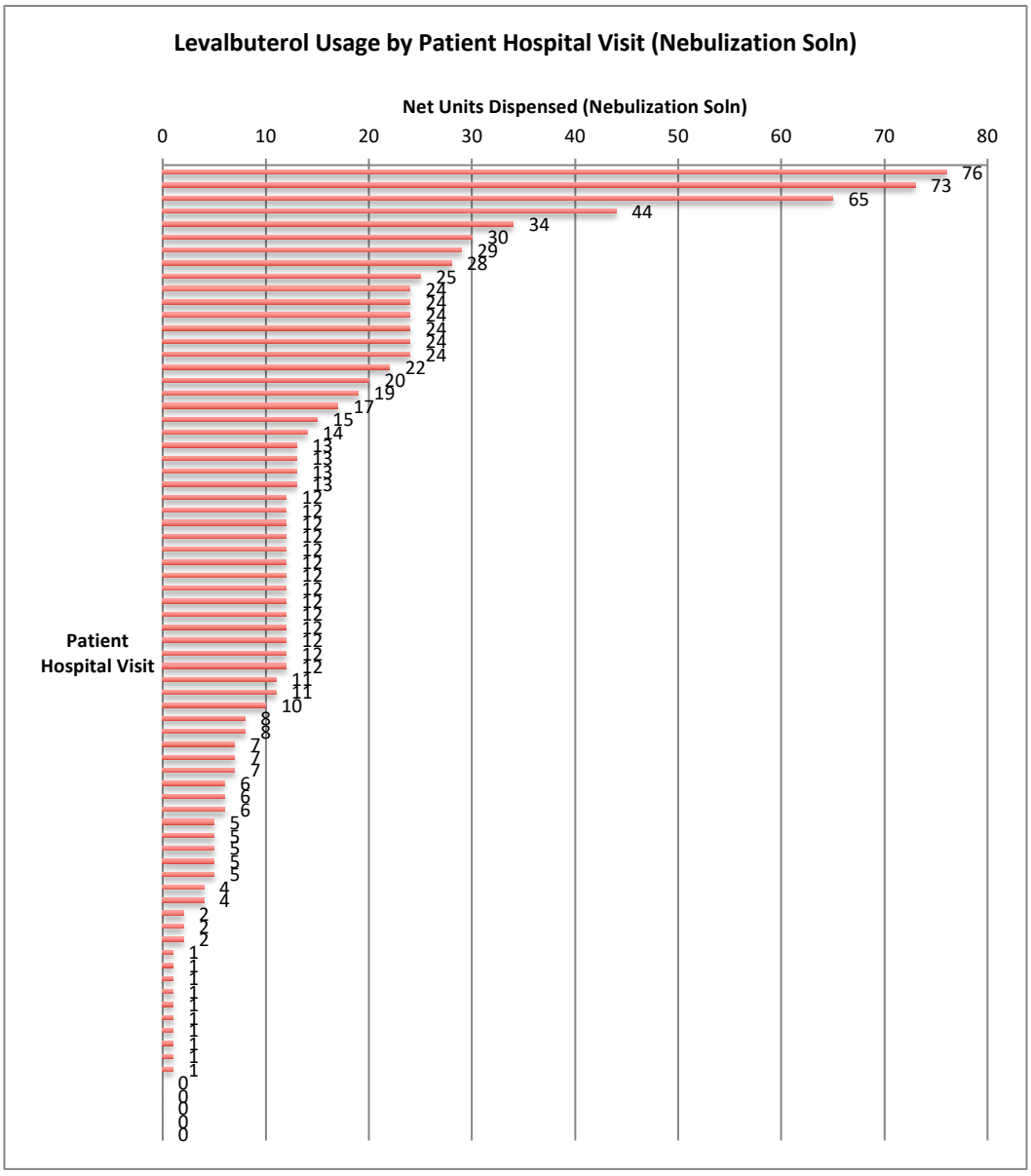


Figure 11. Levalbuterol Usage by Patient Hospital Visit (Nebulization Soln).



Total # of Nebulization Solution Units Dispensed = 1,011

Twenty-five percent (25%) of units dispensed were associated with 4 orders prescribed to 4 unique patients

Unit of Nebulization Solution Dispensed During Hospital Visit	Month
76	November
73	December
65	September
44	December

Descriptive Statistics

Measure of Central Tendency	Value
Mean	13.48
Median	12
Mode	12

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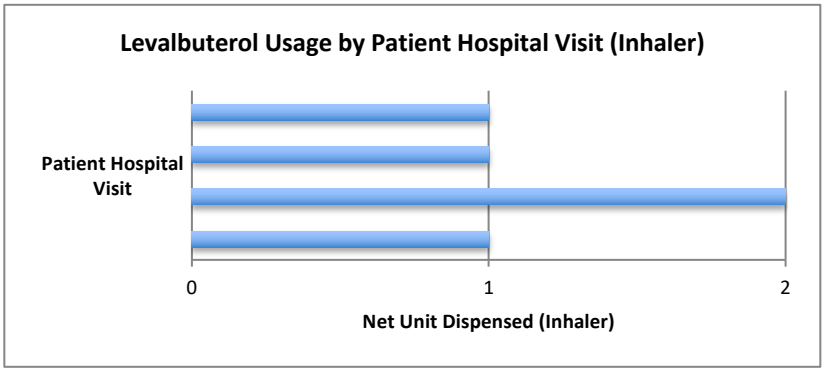
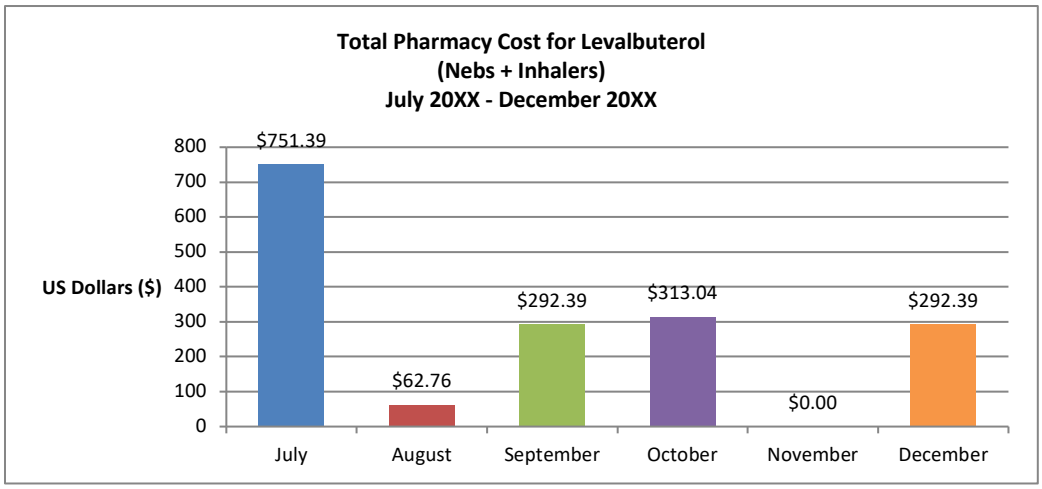
Figure 12. Levalbuterol Usage by Patient Hospital Visit (Inhaler).



Pharmacy Purchasing and Cost

[Hospital X] [City X] Pharmacy spent a total of $1,711.97 on levalbuterol during July 20XX – December 20XX. Over half (64%) of this total cost was spent during the months of July and October, with forty-four percent (44%) belonging to the month of July. July was the highest cost month for pharmacy, but not the highest month for levalbuterol orders or units dispensed to the patient (Figure 14). Prices for levalbuterol remained the same during this six-month time period, so this discrepancy cannot be attributable to cost alone. Orders for levalbuterol declined from August to September and from October to November, but pharmacy purchasing and dispensing did the opposite (increased) during those time periods. Again, this could be attributable to orders being written near the end of the month and patients not requiring the levalbuterol until the beginning of the next month. August was the lowest cost month for pharmacy as well as the lowest dispensing month, while September had the lowest number of orders (Figure 14). August was the only month during this six-month time period when pharmacy purchased levalbuterol inhalers; three (3) of those inhalers were dispensed during the month of October (Figures 14, 15).

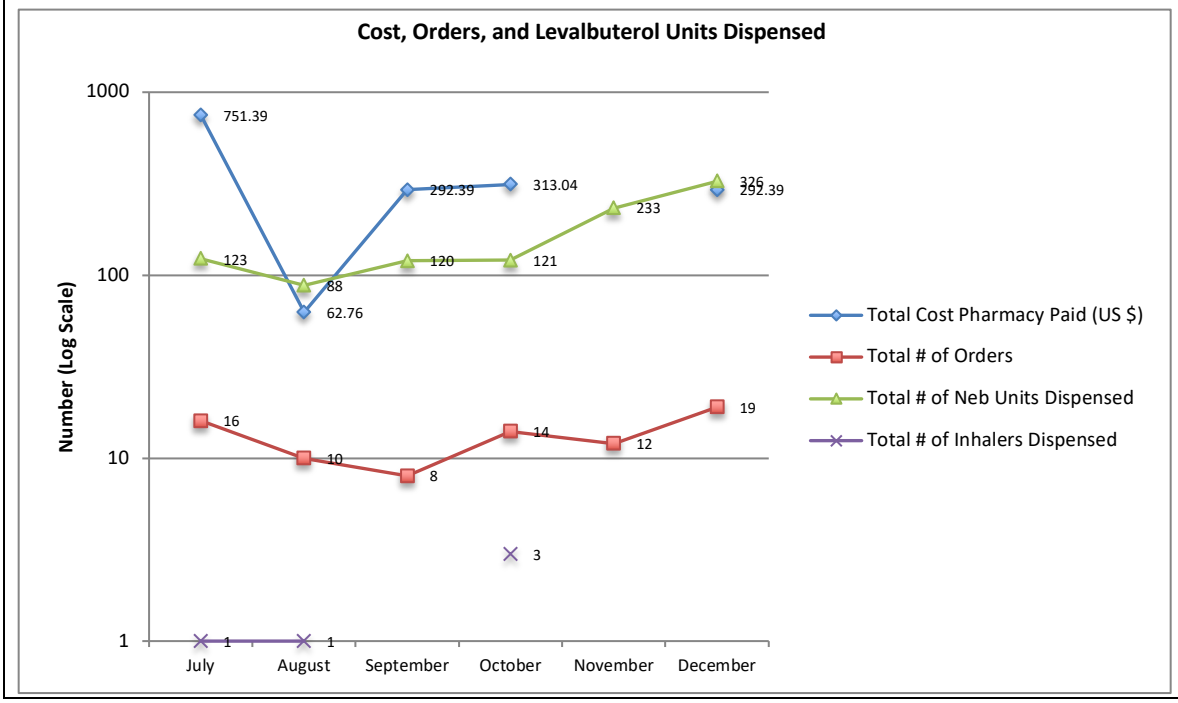
Figure 13. Total Cost for Levalbuterol.



Total [Hospital X] Pharmacy Spent on Levalbuterol = $1,711.97

Month	Percentage of Total Cost (Ranked Greatest to Least)
July	44%
October	18%
December	17%
September	17%
August	4%
November	0%

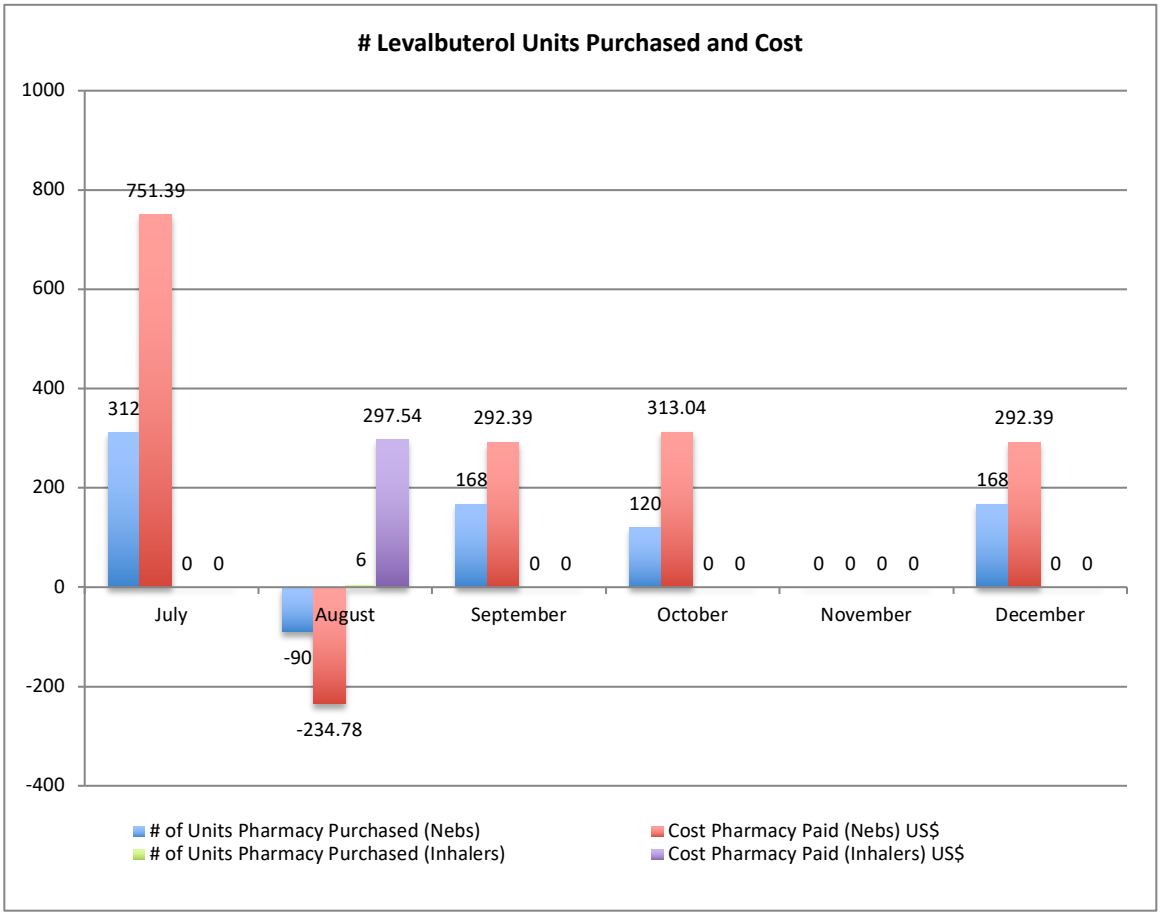
Figure 14. Cost, Orders, and Levalbuterol Units Dispensed.



Note:
Pharmacy spent $0 in November (not shown on graph because y axis is log scale)

Zero orders were placed for levalbuterol inhalers in September, November, and December (not shown on graph because y axis is log scale)

Figure 15. Levalbuterol Units Purchased and Cost.



Note: Pharmacy returned 90 nebulization solution units in August

Recommendations for Improvement

Over this six-month time period, levalbuterol was dispensed 16% of the time without DNS written specifically in the order. Due to levalbuterol's higher cost compared to racemic albuterol, pharmacists should be encouraged to ensure DNS is specified before approving an order for levalbuterol. Where DNS is *not* specified, the cheaper racemic albuterol should be interchanged. Only about one-third of DNS orders specified a reason for why the patient should receive levalbuterol; nearly 70% did not state a reason. This makes it difficult to determine if there was a legitimate reason for dispensing levalbuterol over racemic albuterol, other than just prescriber preference. Even though there is limited data supporting use of levalbuterol over racemic albuterol in patients with tachycardia and atrial fibrillation, prescribers should be encouraged to include a DNS reason so that pharmacists can ensure these reasons warrant the use of the more expensive drug.

References

1. Levalbuterol. Lexi-Drugs. Accessed 23 March 2015.
2. Levalbuterol. Micromedex. Accessed 23 March 2015.
3. Datta D, Vitale A, Lahiri B. An evaluation of nebulized levalbuterol in stable COPD. *Chest*. 2003; 124: 844-849.
4. Albuterol. Lexi-Drugs. Accessed 26 March 2015.