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Intensive care unit drug costs in the context of total hospital drug expenditures with suggestions for targeted cost containment efforts

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ABSTRACT

Purpose: To assess costs of intensive care unit (ICU) related pharmacotherapy relative to hospital drug expenditures, and to identify potential targets for cost-effectiveness investigations. We offer the unique advantage of comparing ICU drug costs with previously published data a decade earlier to describe changes over time.
Materials and methods: Financial transactions for all ICU patients during fiscal years (FY) 2009–2012 were retrieved from the hospital's data repository. ICU drug costs were evaluated for each FY. ICU departments' charges were also retrieved and calculated as percentages of total ICU charges.
Results: Albumin, prismasate (dialysate), voriconazole, factor VII and alteplase denoted the highest percentages of ICU drug costs. ICU drug costs contributed to an average of 31% (SD 1.0%) of the hospital's total drug costs. ICU drug costs per patient day increased by 5.8% yearly versus 7.8% yearly for non-ICU drugs. This rate was higher for ICU drugs costs at 12% a decade previous. Pharmacy charges contributed to 17.7% of the total ICU charges.
Conclusions: Growth rates of costs per year have declined but still drug expenditures in the ICU are consistently a significant driver in this resource intensive environment with a high impact on hospital drug expenditures.

1. Introduction

Increased health care costs are a global concern that is expressed more prominently in the United States (USA) [1]. In 2011, the USA national health expenditure (NHE) was estimated to be $2.7 trillion, accounting for 17.9% of the gross domestic product (GDP) which comparatively is the highest worldwide [2]. The USA dedicates a higher percentage of its hospital resources to intensive care medicine compared to other countries. For example, adult intensive care unit (ICU) beds as a percent of all acute care hospital beds were 9% in USA versus 1.2% in United Kingdom and 3.4% in Canada [3]. Craig et al. estimated in 2008 that between $121 and $263 billion was spent on patients who required intensive care, which accounted for 17.4–39.0% of the total hospital costs and 5.2–11.2% of total USA healthcare spending [4]. Critically ill patients are a resource-intensive population that utilizes expensive drugs and precious technologies, in addition to requiring highly trained staff for exerting optimal care [5].

The number of ICU beds and their occupancy are essential determinants of ICU expenditure. The number of ICU beds in the USA increased by 6.5% from 2000 to 2005 [6]. Increasing the number of ICU beds raises the fixed costs of hospital care. The cost per day for ICU care also increased by 30.4% over the same period [5]. The cost of a day in the ICU is the highest on the first day and decreases the second day while stabilizing after day 3 [7].

Personnel, automation, duration of ICU stays and drugs are significant cost drivers in the ICU [8]. Drug costs in the ICU relative to hospitalization costs account for 38.4% of total drug costs compared to other departments [9]. Furthermore, the growing rate of ICU drug costs was found to be higher than that of non-ICU drug costs (12% vs. 6%) [9]. Recognizing the impact of drug use as a significant contributor to total ICU costs and targeting optimal use could be an effective cost containment strategy.

The purpose of this study was to evaluate costs of ICU related pharmacotherapy relative to patients' hospital drug expenditure and to compare our findings to data published a decade previously [9]. The ultimate goal is to identify potential targets for cost effectiveness investigations that will help to assess current treatment options and to achieve the optimal use of resources without adversely affecting patients' well-being.

2. Material and methods

This study was conducted at an academic medical center with over 600 adult patient beds, including more than 150 ICU beds. UPMC

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Presbyterian has eight ICUs in the following clinical areas: cardiac surgery, coronary care, medicine, neurological (neuro and neurosurgical), surgery, solid organ transplant and trauma, within a single tertiary care academic medical center.

Financial transactions for patients admitted to an ICU from July 1, 2008, to June 30, 2012, were obtained from the hospital's data repository (Medical Archival Systems [MARS], Pittsburgh, PA). The MARS system is an information retrieval system for information forwarded from the health system's electronic clinical, administrative, and financial databases [10]. This data repository has been used previously for economic analyses [9,11].

Drug acquisition costs for each drug were obtained from the pharmacy billing system and then multiplied by the number of units of drug charged to a patient. ICU drug costs were calculated as the percentage of total drug costs for each fiscal year and adjusted for hospital volume (ICU patient days). Drug costs were calculated for each generic name (chemical ingredient) and ranked in a descending manner for each fiscal year. ICU and non-ICU charges were obtained for all patients who generated at least one ICU room charge during a hospital admission. All ICU charge transactions were collected and evaluated including those occurring from the first day of an ICU room charge to the last day of an ICU room charge. Remaining charge transactions were considered to be non-ICU. ICU charges were aggregated by departments including laboratory, medical/surgical supplies, operating room, organ procurement, pharmacy, radiology, respiratory, room, treatments, and other charges. ICU department charges were ranked as percentages of total ICU charges.

We did not exclude any patients from the analysis; however, the charge transactions for organ acquisition and devices were not included, so these one-time charges did not alter the analysis. Top charged drugs for patients whose ICU drug charges were within the highest ten percentiles of ICU drug charges per patient were also analyzed. Patients' readmissions to the ICU during the same hospital admission were analyzed separately as distinct ICU stays. Analysis was completed on the patient visit level.

ICU drug costs and ICU department charges for each fiscal year (FY) were analyzed using commercially available statistical software (STATA, release 12; Stata Corp LP, College Station, TX) [12].

3. Results

Drug costs and ICU charges were analyzed for 50,769 visits of patients admitted to the ICU. The mean age for patients was 61 years old (SD ± 17.68), 56% were males, and the mean length of stay was 10.8 days (SD ± 14.07). Admissions by ICU type were as follows: medical 10,366(20.4%), coronary care 3551(7%), neuro/neurosurgical 12,882(25.4%), surgery 10,543 (20.8%), cardiac surgery 4053(8%), solid organ transplant 5909(11.6%) and trauma 3465(6.8%).

The ICU drug cost per patient day increased by an average of 5.8% yearly, whereas the non-ICU drug costs per patient day increased by an average of 7.8% yearly (Table 1). Table 1 also presents data from a previously published study at our site [9]. One decade earlier, ICU drug costs had a substantially greater % change by FY than the non-ICU, but our more recent data demonstrates that the ICU drug costs % change by FY is half compared to previous data.

Albumin, prismasate (dialysate), voriconazole, factor VII and alteplase contributed to the highest percentages of ICU drug costs (Table 2a). Also, the total cost and the number of patients treated for these results is provided in Tables 2b and 2c. Several drugs contributing to the greatest costs are still the same one decade later, although newer drugs have also entered the top 15 list. Furthermore, drug costs in ICUs averaged 31% (SD ± 1.0%) of total hospital drug costs over the most recent 4 years (Fig. 1).

The comparison ICU department charges as the percent of total charges by fiscal year showed that pharmacy charges ranked between third and fourth during 2009–2011 FYs and the second in 2012. Further, the contributions of each department are relatively consistent over time including the decade previous (Table 3).

Patients whose drug costs are in the top 10 percentiles of total ICU drug costs are around 10% of the total patients that visited ICUs each year. These patients contribute to 55–60% of the entire ICU drug costs. Albumin, prismasate (dialysate), voriconazole are examples of costly drugs for the ICU as well as for this subset of patients. Other drugs like meropenem and fluconazole are expensive for this subset of patients but are not included in the list of the 15 most expensive drugs (all ICU admissions) (Table 4).

4. Discussion

Critical care medicine is expensive and needs to be evaluated continuously through committed quality improvement efforts to ensure the best use of restricted resources. Institutions struggle to contain their pharmacy drug budgets. This study provides a template for cost analyses and suggestions for cost containment efforts. Additionally, previous financial evaluations of drugs in the ICU lack a significant sample size and have not looked at changes over time. To fill this gap, we offer a unique perspective by taking advantage of having a previous, similar study conducted in FY 1999–2002 [9]. In order to ensure the comparability of amounts and trends between our study and Weber et al. [9], we used similar methods in the same institution. We used both cost and charge data for our evaluation to stay consistent with the previous published analysis for comparison purposes.

ICU drug costs in FY 1999–2002 accounted for 38.4% of the total hospital drug costs and increased at a rate greater than non-ICU drug costs (12% vs. 6%) [9]. In our study, ICU drug costs accounted for an average of 31% of total hospital drug costs. Although this percentage is slightly lower than the average percentage previously reported, the baseline costs are higher. Specifically, the ICU drug costs per year were roughly $7 million in FY 1999 and increased to $12 million in FY 2002, while ICU drug costs were about$14 million in FY 2009 and increased to around$17 million in FY 2012. Of interest, from 1999 to 2013, the annual growth in the US for drug expenditures ranged from −0.6 to 26.8% [13].

Contradictory to the results by Weber et al., we found that the growth rates for both total drug costs and costs adjusted for patient days in the ICU are less than those in the non-ICU setting. Such findings indicate some improvement in ICU cost containment strategies and protocols. It might be related to some ICU strategies like caring for more critically ill patients in non-ICU locations, which might impede such relative change in the magnitude of drug costs growth rates between ICU and non-ICU settings.

Accurate and unbiased cost comparison between other studies is challenging and difficult to achieve because ICU costing methods differ substantially [14]. Differences in ICU size, staffing and technology are also hindering appropriate comparison across studies [14]. Carron et al. [15]investigated 5-year evolution of quantity and costs of prescription drugs in a university, adult ICU in Switzerland. Drug costs per

Table 1
Drug costs by fiscal year (FY) adjusted for intensive care unit (ICU) and non-ICU patient days.

	Previous published data [9]					Current study				
	FY 1999	FY 2000	FY 2001	FY 2002	% Change by FY mean (sd)	FY 2009	FY 2010	FY 2011	FY 2012	% Change by FY mean (sd)
ICU drug cost per patient day ($)	208	254	287	312	12.4 (5.2)	299	271	304	349	5.77 (10.8)
Non-ICU drug cost per patient day ($)	93	93	102	112	5.9 (5.6)	167	183	196	210	7.81 (0.85)