



## Relative costs of anesthesiologist prepared, hospital pharmacy prepared and outsourced anesthesia drugs<sup>☆</sup>



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### ABSTRACT

**Background:** Anesthesia drugs can be prepared by anesthesia providers, hospital pharmacies or outsourcing facilities. The decision whether to outsource all or some anesthesia drugs is challenging since the costs associated with different anesthesia drug preparation methods remain poorly described.

**Methods:** The costs associated with preparation of 8 commonly used anesthesia drugs were analyzed using a budget impact analysis for 4 different syringe preparation strategies: (1) all drugs prepared by anesthesiologist, (2) drugs prepared by anesthesiologist and hospital pharmacy, (3) drugs prepared by anesthesiologist and outsourcing facility, and (4) all drugs prepared by outsourcing facility.

**Main results:** A strategy combining anesthesiologist and hospital pharmacy prepared drugs was associated with the lowest estimated annual cost in the base-case budget impact analysis with an annual cost of \$225 592, which was lower than other strategies by a margin of greater than \$86 000.

**Conclusion:** A combination of anesthesiologist and hospital pharmacy prepared drugs resulted in the lowest annual cost in the budget impact analysis. However, the cost of drugs prepared by an outsourcing facility maybe lower if the capital investment needed for the establishment and maintenance of the US Pharmacopeial Convention Chapter <797> compliant facility is included in the budget impact analysis.

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## 1. Introduction

Pharmacy administrators and anesthesia departments must determine how best to provide anesthesia drugs based on several factors including cost, safety, provider preference, and the hospital pharmacy's capacity. The American Society of Health-System Pharmacists (ASHP) has recently published a report that outlines the factors and processes

to be considered when deciding to contract with an outsourcing facility [1]. Given recent reports of adverse events associated with outsourcing facilities [2], hospital budget constraints and regulatory requirements [3], a closer look at preparation methods for anesthesia drugs is necessary.

Budget impact is an important determinant of the preferences for the preparation of anesthesia drugs. Whereas health systems have traditionally relied on anesthesiologist preparation, pharmacy preparation, or a combination of the two methods, an argument has been made that preparation by an outsourcing facility may provide lower overall costs due to time-efficiency gains, reduced wastage and reduced labor costs [4,5].

Although 71% of hospitals partially or completely outsourced some kind of drug preparation activities, only 24% of hospitals specifically outsourced anesthesia drugs on the most recent national survey by

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**Table 1**  
Time-capture parameters for syringe preparation of anesthesia drugs by pharmacy technicians and pharmacists

	Ephedrine (5 mg/mL 5 mL syringe)	Lidocaine (2% 10 mL syringe)	Phenylephrine (0.1 mg/mL 5 mL syringe)	Succinylcholine (20 mg/mL 10 mL syringe)
Pharmacy technician time per syringe in seconds	48.0 (96%)	57.6 (99%)	36.0 (98%)	57.6 (98%)
Pharmacy technician cost per syringe <sup>*</sup>	\$0.20	\$0.24	\$0.15	\$0.24
Pharmacist time per syringe in seconds	2.2 (4%)	0.6 (1%)	0.8 (2%)	1.2 (2%)
Pharmacist cost per syringe <sup>†</sup>	\$0.03	\$0.01	\$0.01	\$0.02
Total time per syringe for pharmacy technician and pharmacist in seconds	50.2	58.2	36.8	58.8
Total pharmacy labor cost per syringe	\$0.23	\$0.25	\$0.16	\$0.26

<sup>\*</sup> Pharmacy technician cost was calculated by multiplying the pharmacy technician time per syringe by pharmacy technician salary estimate per second of \$0.016 (see Appendix A).

<sup>†</sup> Pharmacist cost was calculated by multiplying the pharmacist time per syringe by pharmacist salary estimate per second of \$0.004 (see Appendix A).

ASHP in 2011 [6]. According to the survey, larger hospitals were more likely to outsource anesthesia drugs.

The aim of this study was to estimate the annual direct costs for 4 different strategies of anesthesia drug preparation using a budget impact analysis: (1) all anesthesia drugs prepared by anesthesiologist, (2) a combination of anesthesia drugs prepared by anesthesiologist and by the hospital pharmacy, (3) a combination of anesthesia drugs prepared by anesthesiologist and by an outsourcing facility, and (4) all anesthesia drugs prepared by an outsourcing facility.

## 2. Materials and methods

### 2.1. Model structure

The model was constructed according to the budget impact analysis good research practice guidelines endorsed by the International Society for Pharmacoeconomics and Outcomes Research [7]. The authors based their base-case budget impact analysis on anesthesiology drug utilization and cost at the University of Washington Medical Center (UWMC) in 2012. The UWMC is a 450-bed tertiary care academic medical center serving the Pacific Northwest region, which conducts approximately 15 000 surgeries per year in 24 operating room and 5 non-operating room sites. The UWMC operates two operating room satellite pharmacies serving two separate operating room areas. The satellite pharmacies are staffed by pharmacists and pharmacy technicians who batch several anesthesia drugs into syringes in addition to performing various other duties.

The authors assessed the costs associated with 8 commonly used anesthesiology drugs for each drug preparation strategy. In strategy 1 (all anesthesia drugs prepared by anesthesiologist), anesthesiologist would prepare the following syringes: midazolam, fentanyl, lidocaine, propofol, vecuronium, succinylcholine, ephedrine, and phenylephrine. In strategy 2 (anesthesia drugs prepared by anesthesiologist and pharmacy), the OR satellite pharmacy would batch prepare lidocaine, succinylcholine, phenylephrine, and ephedrine syringes; and anesthesiologist would prepare midazolam, fentanyl, propofol, and vecuronium. In strategy 3 (anesthesia drugs prepared by anesthesiologist and an outsourcing facility), an outsourcing facility would provide prefilled syringes of lidocaine, succinylcholine, phenylephrine, and ephedrine; and anesthesiologist would prepare midazolam, fentanyl, propofol, and vecuronium. In strategy 4 (all anesthesia drugs prepared by an outsourcing facility), an outsourcing facility would provide prefilled syringes of midazolam, fentanyl, lidocaine, propofol, vecuronium, succinylcholine, ephedrine, and phenylephrine. The likelihood of the OR pharmacy preparing propofol, vecuronium, fentanyl and midazolam syringes was low given the infection risk for propofol, stability issues with vecuronium and controlled substance concern for fentanyl and midazolam. Therefore, these drugs were not analyzed as pharmacy prepared syringes in any of the strategies.

### 2.2. Costs

For anesthesiologist and pharmacy prepared syringes, drug acquisition costs were obtained by performing a weighted average of the 2012 base cost of the ingredients of interest available from the institution's wholesaler using Wholesale Acquisition Cost pricing. The supply costs were obtained from the institution's supply distributor. The authors assumed facility costs were "sunk" (eg, the health system already has anesthesiology and pharmacy facilities available for syringe preparation) and, therefore, were not included in the analysis.

The authors also included labor costs associated with anesthesiologist and pharmacy prepared drugs. The average time required to prepare a single syringe by anesthesiologists was 35 seconds, which was based on a previously published study [8]. The reported average preparation time was determined by timing 27 anesthesia providers with varying levels of training who were instructed to prepare a single syringe for emergency administration. The authors did not repeat anesthesiologist preparation time measurements since the syringe preparation steps have not changed and performing them as quickly as possible minimizes the costs associated with anesthesiologists' labor. Pharmacist and pharmacy technician times to prepare relevant syringes were estimated from time-motion studies of anesthesia syringe batch preparation at UWMC (Table 1).<sup>1</sup> These time estimates were then multiplied by national wage estimates for anesthesiologists, pharmacists, and pharmacy technicians in 2012 from the United States Bureau of Labor Statistics in order to estimate the average labor cost per syringe (Appendix A).

Outsourcing facility syringe drug pricing was obtained from a national outsourcing facility using UWMC's 2012 Group Purchasing Organization pricing. The outsourcing facility used by the institution did not have non-contract pricing.

The estimated annual cost for each drug was calculated by multiplying the estimated number of drug syringes used in 2012 with the individual drug syringe cost, which included acquisition, supply, and labor costs. The number of drug syringes used in 2012 was estimated using pharmacy billing data. The estimated annual cost for each strategy was calculated by adding the estimated annual costs for each drug.

### 2.3. Wastage

The authors did not include drug wastage in their budget impact analysis since they were unable to accurately measure drug wastage due to the limitations of their manual billing system.

## 3. Results

Strategy 2 (drugs prepared by anesthesiologist and hospital pharmacy) was associated with the lowest estimated annual costs of \$225 592

<sup>1</sup> Unpublished data collected as part of the pharmacy residency research project by one of the authors (JAK).

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