

# Cost drain of anesthesia emergency drugs in a quaternary care hospital

## ABSTRACT

**Background:** Anesthesiologists draw up a selection of drugs for emergency use at the start of their list; unused drugs are discarded at the end of the list, to prevent contamination and spread of infections. We audited the practice in our department to evaluate the scale and cost impact of anesthesia emergency drugs wastage.

**Subjects and Methods:** A questionnaire was randomly given to anesthesiologists in our department, working in some of the operating rooms in our main floor, every morning over 7 working days. Completed forms were collected at the end of respective lists.

**Results:** A total of 93 completed forms were returned. Ephedrine (96%) and phenylephrine (95%) were the most frequently drawn drugs; atropine (96%) and suxamthonium (92%) were the most frequently discarded drugs. Phenylephrine was the single most expensive item wasted, representing 160% of the cost of all other drugs wasted together, and the price of discarded ephedrine and phenylephrine together represented 3/4<sup>th</sup> of the total wastage. Some practices carried room for rationalization, such as drawing up of atropine and glycopyrolate simultaneously, of both the vasopressors in patients unsuspected for developing significant hypotension, or of suxamethonium in a patient planned to be intubated and postoperative ventilation.

**Conclusion:** Significant savings may be realized through switching to prefilled syringes, making protocols available for rational use of emergency drugs, and safe pooling of expensive drugs between adjacent operating rooms, in an anesthesia department.

**Key words:** Cost; emergency drugs; wastage

## Introduction

It is a common practice among anesthesiologists, to draw up a selection of emergency drugs at the start of every operating list, to reduce the “decision to administration” time in case of a critical emergency. The Royal College of Anaesthetists, London, produced guidance for novice trainees for setting up their operating room (OR); it recommends drawing up suxamethonium, atropine, and vasopressors (ephedrine and metaraminol) as a routine.<sup>[1]</sup>

These emergency drugs are used only sparingly; often those are discarded unused, or partially used, at the end of the list. This practice of safe disposal prevents contamination and spread of infections.<sup>[2]</sup>


Efficient use of resources can be achieved by practicing better waste reduction strategies of anesthetic drugs. This may reduce costs, and help avoid the drug run out situations, to ensure the effective patient management while preserving

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appropriate healthcare budget utilization. With special focus, the amount of unused drugs wastage can be optimized without affecting the patients' outcome.<sup>[3-5]</sup>

We conducted an audit in our quaternary care hospital, to assess the local practice of anesthesia emergency drugs usage, and wastage, and to evaluate the cost of wasted anesthetic drugs.

### Subjects and Methods

A questionnaire was developed [Appendix A]. A total of 100 forms were randomly given to anesthesiologists assigned on our main operating floor, one form per OR, for 7 days during normal working hours, excluding weekends. At the end of every list, the completed forms were collected. For the purposes of this audit, of all the drugs drawn up specifically for use in case of emergency, even partially used drugs were counted as "used," and only completely unused drugs were counted as "wasted."

### Results

Completed forms (*n* = 93, response rate of 93%) were analyzed after populating a Microsoft Excel sheet. Majority of the respondents were consultants (64%); other respondents included assistant consultants (25%) and residents/fellows (9%). A diverse range of surgical specialties representing the case mix involved was noted [Table 1].

Emergency drugs were mainly drawn by consultants (57%) and anesthesia technologists (41%). The range of drugs drawn up [Figure 1] also included propofol, fentanyl, and glycopyrolate in some cases, in addition to the suggested standard.<sup>[1]</sup> Of these, propofol and fentanyl were mainly drawn up by physicians, whereas glycopyrolate was predominantly selected by technologists [Figure 2]. The choice of drugs drawn up for each surgical specialty was generally consistent across the board [Figure 3].

Comparison of the proportion of drugs used and wasted was made [Figure 4]. The most frequently drawn up drugs were ephedrine (96%) and phenylephrine (95%), and the most frequently wasted ones were atropine (96%) and suxamethonium (92.4%).

The pricing per unit of the drugs included in the audit was requested from the hospital pharmacy [Table 2]. Based on this information, the total cost of all drugs audited over 7 days was calculated [Figure 5]. The single most expensive drug wastage, for the audit period, was phenylephrine (SAR 899.60), which was more than double of the next two drugs together (suxamethonium = SAR 216.58, and ephedrine = SAR 198), and 160% of the sum of all other drugs wasted.

The total wastage amounted to SAR 1440.07 (SAR 205.65 per day), compared with usage of SAR 1439.55, revealing a 50% wastage. Extrapolating those figures returned the annual price of wasted drugs at SAR 53,448.51 (SAR 205.65 per day multiplied by 260 days or 52 working weeks of 5 days each).

There are 22 ORs functional on our main operating floor. An overall activity level of 154 theater-days was expected for the audit period (22 × 7). The 93 forms returned, thus represented 60.38% of anesthetic activity (93/154 × 100), which once adjusted to 100% activity (53448.51 × 100/60.38) would point to a wasted sum of SAR 88,520.22.

### Discussion

Our audit confirmed adherence of our staff with the practice of drawing up of emergency use drugs before the start of a surgical list, and appropriate disposal of unused drugs at

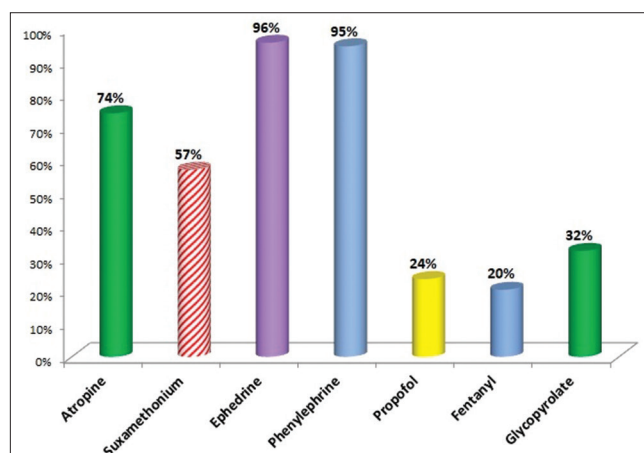


Figure 1: Drugs drawn up in preparation for emergency use if needed

Table 1: Surgical specialties represented in the ORs where audit was conducted

Surgical specialties	Percentage	Surgical specialties	Percentage	Surgical specialties	Percentage
Urology	15	Pediatrics	8	Plastic	3
General surgery	12	Ophthalmology	6	Vascular	3
Neuro	11	Gynecology	4	Liver	2
Ortho	11	HIPEC	3	Breast	1
ENT	9	Maxillofacial	3	Pain	1

the end of it, which is in line with the available guidelines for anesthesia usage in hospitals.<sup>[6-8]</sup> It is possible that the practice of utilization of unused drawn up drugs, for the next case on the same list, in our institution may have accounted for a lower estimate of drug waste costs. Moreover, we audited only the main OR floor; almost a similar number of anesthesia activity areas, such as cardiac and liver transplant ORs, and outlying areas, were excluded. Their inclusion would generate a higher, more realistic figure.

**Table 2: Pricing in Saudi Arabian Riyals (SAR) per ampoule of the drugs, as supplied by the hospital pharmacy in April 2018**

Drugs	Price (SAR)	Drugs	Price (SAR)
Atropine (500 mcg)	0.48	Propofol (200 mg)	3.26
Suxamethonium (100 mg)	4.42	Fentanyl (100 mcg)	4.50
Ephedrine (30 mg)	4.40	Glycopyrolate (200 mcg)	2.81
Phenylephrine (10 mg)	22.49		

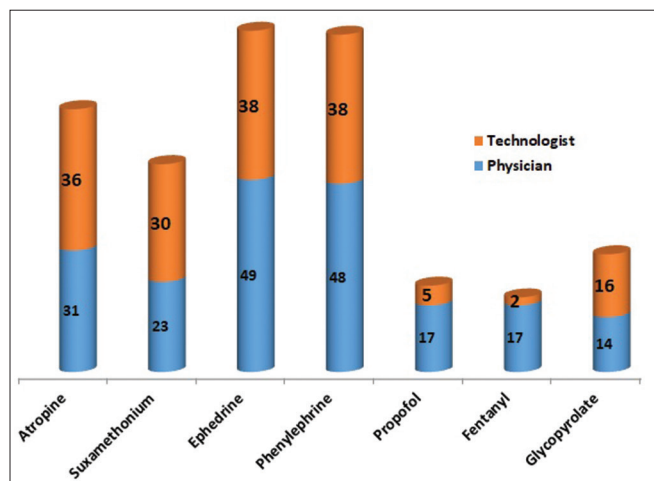


Figure 2: Grades of the individuals drawing up each drug (number of instances)

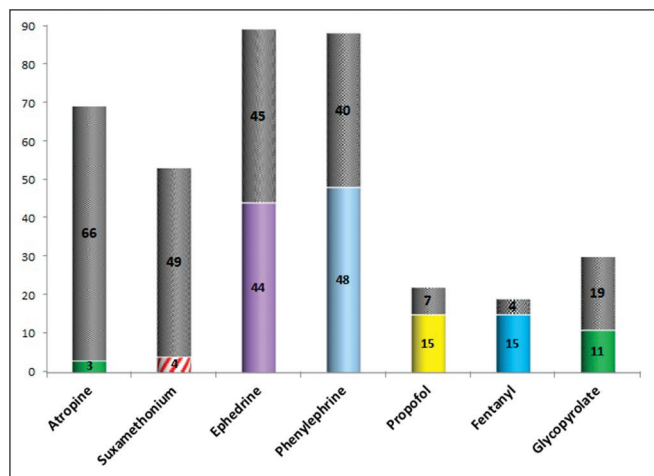


Figure 4: Drawn up drugs actually used (bottom, colored) versus discarded (top, gray shaded) expressed as number of cases

In instances where anesthesia technologists prepared the drugs before arrival of the physician, no significant departure was noted in the choice of drugs, except glycopyrolate. However, it could be argued that in some cases some drugs were drawn up as per routine even when possibly not needed, e.g., two vasopressors (one of those being the most expensive item on our list of wastage) where all cases for the day were expected to be short cases on young fit patients with minimal expectation for hypotension, or suxamethonium in an OR where a case expected to run for the whole day was booked, planned to be intubated with rocuronium, and for shifting to intensive care without extubation at the end.

Ephedrine and phenylephrine were discarded with notable percentages (50% and 45% respectively), with an annual cost of SAR 53,461.94, and SAR 11,766.85, respectively, jointly reflecting a whopping 3/4<sup>th</sup> (73.68%) of the total wastage bill. Drawing up of more than one vasopressor could be restricted to only the cases with higher risk of hypotension,

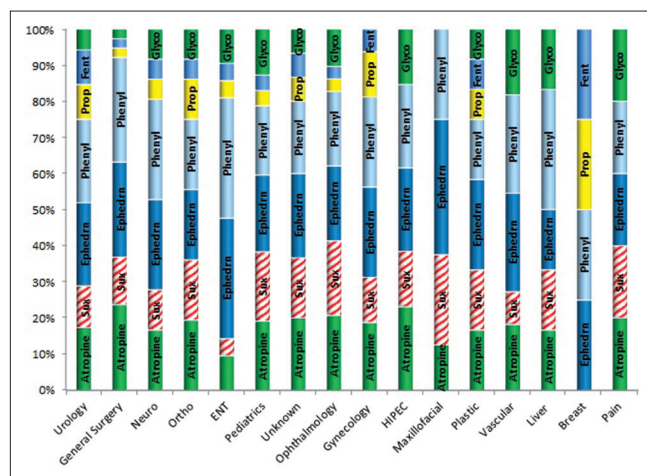


Figure 3: Drugs drawn up with surgical specialty wise distribution (percentages)

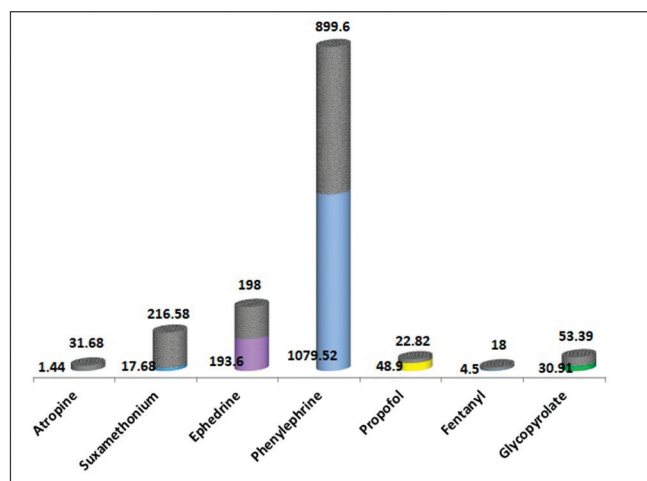


Figure 5: Cost of drugs wasted (top, gray shaded) and used (bottom, colored) during the audit period (in Saudi Arabian Riyals)

through introduction of local practice guidelines and frequent educational campaigns.

In our hospital, phenylephrine 10 mg is usually diluted in normal saline 0.9% 100 ml, and often only a few milliliters are used per case, if at all. The diluted prefilled ampoules of phenylephrine are not available in our hospital; hence, a direct estimation of potential saving could not be made, however sharing of this relatively expensive medicine across all ORs is another option, achievable through employing resources of the hospital pharmacy to dilute and dispense it in smaller volumes, e.g., 10 ml syringes.

Suxamethonium was wasted in 92.4% instances; costing SAR 12,871.04, taking up 14.5% of the total wasted sums. Replacing ampoules with prefilled syringes in case of high percentage medicinal waste is often a reasonable strategy, but point of care storage fridges is required for this particular medicine, which currently are not available in every OR, in our hospital. Another option is to rationalize drawing up of this medicine, through local guidelines and campaigning, to affect savings.

The choice of drawing up propofol and fentanyl for emergency use in most cases was unprecedented, as those would be drawn up for planned induction of anesthesia any way. Equally well, drawing up of both atropine and glycopyrolate simultaneously was perhaps inappropriate, more so when the latter is not the first choice for use in an emergency, and is six times more expensive. However, interestingly, it was used in 11 cases compared with only 3 in case of the former. It could be because perhaps some anesthesiologists use the already drawn up glycopyrolate as part of the reversal, which may explain the discrepancy.

Atropine 0.5 mg was discarded in 96% of cases, with a price of SAR 31.68 or SAR 1882.69 for the whole year. In contrast, 63% of glycopyrolate was disposed of, returning a bill of SAR 3172.89, which is almost double that of atropine. The price of prefilled atropine Abboject 1 mg (containing double the dose compared to the 0.5 mg ampoule) is SAR 12.25 with a shelf life of 3 years, according to our hospital pharmacy. Replacing the ampoules with these syringes in 22 ORs would cost SAR 269.50 over 3 years, or SAR 89.83 per year, returning a direct saving of SAR 1793.05.

The findings of this audit are similar to other published reports and studies.<sup>[9-11]</sup> The amount of waste varies from institution to institution and is operator dependent.<sup>[9]</sup> It is prudent to investigate variance among practice of individual anesthesiologists, and developing and optimizing local

strategies to reduce waste and improve efficiency while reducing costs. The need for repeated audits to compare the success and compliance of the measures suggested in cost containment cannot be overemphasized.

In our audit, the possible reasons for the drug wastage may include preparation of OR without tailoring to the surgical list at hand especially by the relatively inexperienced colleagues, easy availability of the anesthesia drugs at the point of use, unfamiliarity with the drug prices, an affluent culture of utilization without focus to reduce waste, and absence of comprehensive guidelines. The number of duty shifts in the hospital may also be another reason, when the outgoing anesthesia staff would discard the drugs they prepared and the incoming staff would draw up their own.

The possible strategies to reduce waste of these emergency drugs may include development of local guidelines related to their use, awareness campaigns regarding drugs prices and scale of wastage, and regular discussions among anesthesia staff and creation of forums stressing on decreasing the costs of anesthetic drug wastage and improving efficiency with rationalizing of drugs usage. Prefilled syringes may eliminate dilution error and lead to cost savings due to the elimination of waste.<sup>[12,13]</sup> Introducing adequate safeguards, like writing date and time of preparation, and identity of the person who prepared a syringe, it may be agreeable to hand over the prepared drugs from one shift to another. It may also be congenial to consider having a shared resource of drawn up drugs between two adjacent ORs.

Education programs on drug-wastage reduction practices need to be held repeatedly at 3–6 monthly intervals as the cost containment achieved is not sustained long after the educational measures are discontinued.<sup>[9]</sup> An appreciation/reward system for the physicians and OR team causing minimum wastage would be a good boost and ensure competitiveness for cost minimization.

## Conclusion

Improving efficiency and reducing waste is the need of the hour. The drain on anesthesia resources and budget could be effectively plugged, in part, by efficient usage and reduction of wastage of anesthetic emergency drugs. Audit of local practices, introduction of strategies to reduce waste, and repeating the audit, are the key to achieving this goal.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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**Appendix A**

**Peri-operative usage of emergency anaesthetic drugs**

We are conducting an audit of the perioperative usage of emergency drugs, i.e. drugs which are drawn up in the morning for use if and when required during the day. This does not include the drugs which are prepared for an individual case according to the anesthetic plan.

Filling this form should take less than one minute. Your cooperation will be highly appreciated.

Dr Attiya Firdous

Dr Amer Majeed

**QUESTIONNAIRE**

Date: _____	L2 OR # _____
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Surgical specialty list? \_\_\_\_\_

**1) Your grade**

Consultant       Assistant Consultant       Resident/Fellow

**2) Who drew up the drugs:**

Physician       Anesthesia technician

**3) Regarding drugs drawn up for emergency use (just in case needed), please tick:**

	Drawn up	Actually used (even if partially)	Discarded if not used at all
Atropine			
Suxamethonium			
Ephedrine			
Phenylephrine			
Propofol			
Fentanyl			
Glycopyrolate			
Others (specify)			