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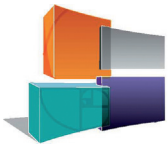

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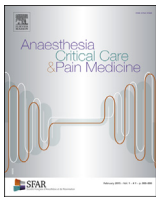

Original Article

Ready-to-use pre-filled syringes of atropine for anaesthesia care in French hospitals – a budget impact analysis

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ABSTRACT

Background: Patient safety is improved by the use of labelled, ready-to-use, pre-filled syringes (PFS) when compared to conventional methods of syringe preparation (CMP) of the same product from an ampoule. However, the PFS presentation costs more than the CMP presentation.
Objective: To estimate the budget impact for French hospitals of switching from atropine in ampoules to atropine PFS for anaesthesia care.
Methods: A model was constructed to simulate the financial consequences of the use of atropine PFS in operating theatres, taking into account wastage and medication errors. The model tested different scenarios and a sensitivity analysis was performed.
Results: In a reference scenario, the systematic use of atropine PFS rather than atropine CMP yielded a net one-year budget saving of €5,255,304. Medication errors outweighed other cost factors relating to the use of atropine CMP (€9,425,448). Avoidance of wastage in the case of atropine CMP (prepared and unused) was a major source of savings (€1,167,323). Significant savings were made by means of other scenarios examined. The sensitivity analysis suggests that the results obtained are robust and stable for a range of parameter estimates and assumptions.
Study limitations: The financial model was based on data obtained from the literature and expert opinions.
Conclusion: The budget impact analysis shows that even though atropine PFS is more expensive than atropine CMP, its use would lead to significant cost savings. Savings would mainly be due to fewer medication errors and their associated consequences and the absence of wastage when atropine syringes are prepared in advance.
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1. Introduction

The advance preparation of intravenous drugs is a common practice in healthcare in order to deal with emergency situations. However, due to the limited drug stability, unused syringes are discarded at the end of the working day or after every procedure [1–4]. This practice also has other drawbacks such as the potential confusion of drugs, mistakes when reconstituting medicine, labelling errors or the risk of contamination [5–11].

Atropine is an intravenous drug commonly used during anaesthesia and by both the emergency service and the intensive care unit healthcare providers. Atropine was among the four active substances considered as a source of risk in a review of reports by the French Health Products Agency (2005–2010) on medication errors in anaesthesia [12].

The guidelines of the French Health Authority (HAS) [13], the French Society of Anesthesia and Intensive Care Medicine (SFAR)

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[14] and the European Section and Board of Anaesthesiology of the European Union of Medical Specialists (EBAEUNS) [15] recommend the use of pre-filled syringes (PFS) in an emergency setting. The use of PFS increases safety because drugs are clearly labelled, no dilution is necessary, and sterility is preserved up to the moment of injection. Laboratoire Aguettant produces two concentrations of atropine PFS: 0.5 mg in 5 mL and 1 mg in 5 mL (0.1 mg/mL and 0.2 mg/mL, respectively). Although the unit cost of atropine PFS is higher than that of atropine CMP, a recent study focussed on ephedrine concluded that the PFS presentation contributes to treatment safety, saves nursing time and has economic benefits [16].

In this study we addressed the economic value of atropine PFS by means of a "budget impact analysis", which is essential in order to make a comprehensive economic assessment for a given healthcare technology [17]. The purpose of a budget impact analysis is to estimate the financial consequences of adopting and distributing a new healthcare intervention within a given therapeutic domain, taking into account inevitable constraints in terms of resources. This study carried out an analysis of budget impact by modelling various scenarios in which atropine PFS would be used instead of the customary atropine CMP for anaesthesia care in French hospitals.

2. Materials and methods

2.1. Objective of the model

The objective was to estimate the impact on hospital budgets [17] of switching from atropine CMP to atropine PFS. From the hospital's perspective, the budget impact analysis only took into account direct medical costs. The model was designed to simulate the economic consequences of generalized atropine PFS use for anaesthesia in the hospital setting. Two atropine indications were considered:

- atropine for bradycardia;
- atropine combined with neostigmine to reverse the effects of non-depolarising muscle relaxants.

We collected data from international literature and from official French healthcare databases. Where insufficient information was available, or data from French sources were considered inaccurate, estimates were provided by a panel of French experts.

2.2. Model design

The model was based on the annual sales of atropine and neostigmine and the estimated wastage of atropine syringes prepared prior to surgery and comprised two scenarios (Fig. 1).

Scenario 1: atropine CMP exclusively used without atropine PFS. The use of atropine included in the model is based on atropine sales in France.[1] From July 2012 to June 2013, sales of atropine to all hospitals in France totalled 4,426,266 ampoules (breaking down into the following percentages: 22.4% = 0.25 mg/1 mL, 73.8% = 0.5 mg/1 mL and 3.8% = 1 mg/1 mL).

As atropine may be combined with neostigmine for the reversal of neuromuscular blockades, sales data for neostigmine over a given period, i.e. July 2012 to June 2013, were used to estimate usage of atropine ampoules in this indication as follows: 1,408,500 ampoules of 0.5 mg/1 mL and 27,223 ampoules of 2.5 mg/5 mL.

According to experts, atropine 1 mg is often used when neostigmine 2.5 mg is administered. Based on this information and sales data for atropine and neostigmine, the proportion of atropine ampoules used to treat for bradycardia alone was estimated. We considered that 1 mg/mL of atropine is usually administered with neostigmine, while 0.5 mg/mL atropine is predominantly administered to treat bradycardia.

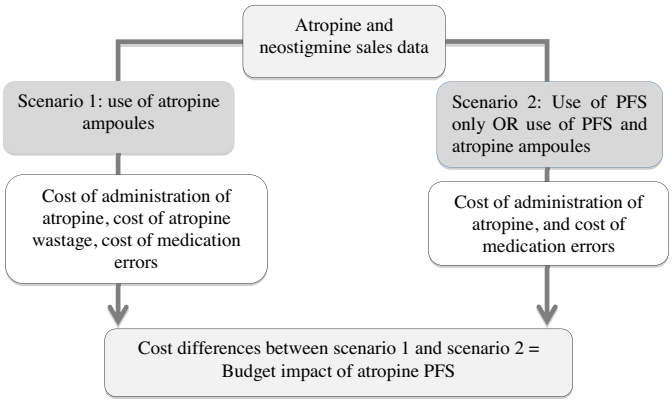

Fig. 1. General scheme of the model.

Since one atropine 1 mg/mL ampoule is normally added to neostigmine, we assumed that two ampoules of 0.5 mg/1 mL could be used in its place in the event of an insufficient number of the former being available.

Based on the number of atropine ampoules available for each indication (for bradycardia and in combination with neostigmine) plus the corresponding dosages (atropine 0.5 mg to treat bradycardia and atropine 1 mg for combination with neostigmine) the number of atropine 0.25 mg/mL ampoules for combination with neostigmine was estimated at 991,645 and the number of atropine 0.5 mg/1 mL ampoules for the treatment of bradycardia was estimated at 2,983,951. This translates to 283,496 standard atropine 0.5 mg/1 mL ampoules and 167,175 standard 1 mg/1 mL ampoules for combination with neostigmine.

Scenario 2: atropine PFS used occasionally or exclusively. Two PFS presentations are available: 0.5 mg/5 mL (0.1 mg/mL) and 1 mg/5 mL (0.2 mg/mL), allowing for at least three purchasing strategies:

- the hospital can buy just one atropine concentration for both indications (0.5 mg/5 mL or 1 mg/5 mL);
- the hospital can buy atropine 1 mg/5 mL PFS for combination with neostigmine and atropine 0.5 mg/5 mL PFS specifically to treat bradycardia;
- the hospital can buy both atropine 0.5 mg/5 mL PFS and 1 mg/5 mL PFS to treat bradycardia and draw on these as necessary for use in combination with neostigmine. With this strategy, the quantity of atropine PFS purchased for Scenario 2 includes an estimated proportion for Scenario 1. This scenario was divided according to three hypothetical situations.

Scenario 2(a) uses only atropine PFS (sterile trays and processing costs were not included). Atropine PFS 1 mg/5 mL is given with neostigmine while atropine PFS 0.5 mg/5 mL is used to treat bradycardia.

Scenario 2(b): atropine PFS are used for bradycardia and atropine ampoules for the reversal of neuromuscular blockade when administered in combination with neostigmine. This two-arm strategy would be based on the fact that bradycardia represents an emergency situation in which the use of atropine PFS could be considered advantageous. By contrast, since neuromuscular blockade reversal is not associated with a short time constraint, practitioners may accept to maintain the use of atropine CMP in this latter situation.

[1] Hospital Pharmaceutical panel's data from IMS Health was provided by Laboratoire Aguettant.

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