

Inventory management and the safety stock of disposable airway devices

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To the Editor,

Management of the difficult airway is one of the most challenging situations encountered by an anesthesiologist.¹ Airway devices are commonly used to facilitate tracheal intubation in patients with a known difficult airway or one that is suspected or unrecognized. Current single-use, disposable airway devices include the Clarus Video Scope disposable sheath (Clarus Medical, Minneapolis, MN, USA), the Airtraq® (King Systems, Noblesville, IN, USA), the King LTS-D™ (King Systems, Noblesville, IN, USA), the LMA-Fastrach™ (LMA North America, Inc, San Diego, CA, USA), the Pentax AWS (Pentax Medical, Montvale, NJ, USA), and Portex® Stylets (Smiths Medical, Rockland, MA, USA). The availability of a specific airway device in an emergency situation depends on a well-coordinated inventory supply chain of intermediate business transactions between suppliers, manufacturers, distributors, warehouses, and hospitals. Airway devices in the hospital inventory are associated with carrying and shortage costs.² Carrying costs can range from 20–40% of the inventory value per year and are associated with the storage, tracking, insurance, and opportunity costs of the items. Shortage costs include restocking and ordering costs, and maintaining safety reserves. The basic goal of inventory management is cost minimization.² However, efforts to minimize costs may lead to inadequate availability of airway devices to satisfy clinical demand. Hospitals typically reorder airway devices at a predetermined reorder

point that incorporates the time lag between reordering and arrival of the device (lead time). The economic order quantity formula determines the number of devices to reorder to minimize total inventory costs.² However, this formula assumes that inventory is reordered when reduced to zero. In order to minimize the risk of a stockout and depletion of the airway device inventory, a safety stock level should remain available in the inventory. The safety stock level of a particular brand of disposable single-use airway device optimizes the balance between maintaining minimal inventory while meeting clinical needs during the time that inventory is being replenished.

Safety stock level is calculated based on airway device demand during the lead time and the desired level of service, which corresponds to the percentage of time that the airway device will be available to meet clinical demand³ (Table 1). Although a service level of 95% is common in the retail and manufacturing sectors, service level should approximate 100% when calculating the safety stock level for the emergency airway device. Many of the mathematical tasks in the safety stock equation involve simple arithmetic. The more advanced functions, such as inverse of normal cumulative distribution and standard deviation, are easy to perform with the Microsoft Office Excel spreadsheet application.

Consider the example in the Table 1. An anesthesia department used a disposable airway device “X” seven times per day over the previous two-month lead time. The desired service level is 99.9%. In order to meet clinical needs without the risk of a shortage and achieve minimal inventory levels, three airway devices “X” should be available in inventory while waiting for new supplies to arrive. This approach, however, assumes a constant lead time. Other approaches to the safety stock calculation using advanced mathematics and tables are indicated when the

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Table 1 Safety stock calculations*Equation*

Safety Stock = demand variability over lead time (DV) \times service factor (SF)

- DV = (standard deviation of the mean daily demand per month during the lead time) \times (square root of the inventory lead time in months)
- SF = inverse of normal distribution of the desired service level

Example

Mean demand per month of airway device "X" = 7; Inventory lead time = 2 months; Service level = 0.999

DV = $(0.471) \times (1.414) = 0.664$

SF = 3.09

Safety Stock = $(0.664) \times (3.09) = 2.05 = 3$ airway device "X"s

lead times or clinical demands are variable.^{4,5} Calculating the safety stock of disposable airway devices will guide inventory management and satisfy clinical needs.

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