margin, turnover times, prediction bias, and amount of underutilized and overutilized hours of OR time [1,2]. According to macroeconomic theory, efficiency may be defined as the use of scarce resources to achieve all opportunities in production (output) [3]. Operating room efficiency also may be defined as the allocation of limited resources (labor, time, space, equipment) to maximize OR use. Efficiency also implies a tradeoff between the quantity of one good produced relative to the quantity of one or more other goods produced; there is no way to produce more of one good without producing less of the other goods [3].

The tradeoff in using scarce OR resources to perform one surgical procedure instead of other procedures forms the basis for analyzing OR efficiency by the production possibility frontier. The production possibility frontier is an economic model that graphically illustrates the tradeoff between the maximum output of one good that may be produced given the quantity of the other goods produced (Fig. 1) [3]. The intersection of the two coordinates creates a point on the graph. There is a crucial distinction between a point located inside the curve (the shaded area), on the curve, or outside the curve. A point that lies inside the curve (ie, Point A) may be achieved (ie, feasible) given the output of the other good. However, such points also represent missed opportunities and inefficient allocation of limited resources. Points that lie along the curve (ie, Point B) are feasible and represent the most efficient allocation of resources. An inefficient organization can move from Points A to point B by reorganizing its resources to increase the output of Y without having to reduce the output of X. If the point lies outside the curve (ie, Point C), then production is not feasible and thus is impossible to achieve with the given resource allocation. In the context of the OR, the production possibility frontier may illustrate OR output for one surgical service versus the sum total output for all the other services in a specified time period, based on available labor, time, space, and equipment. By charting the intersection point on a daily basis, it would be possible to ascertain the OR's proximity to its production possibility, as represented by the production possibility frontier curve. Extending the data collection period to one year would provide more data points and a more robust production possibility frontier. Output that falls under the production possibility frontier curve is conceivable, suggesting that there are sufficient OR resources available to achieve it. However, the OR is not maximizing its output given the potential of its resources. In this case, reallocating OR resources (labor, equipment, technology) may increase the output of one service without reducing the output of all other services. Although the production possibility frontier is a basic microeconomic model that simplifies real-world complexities, it gives us a model from which to analyze the effects of reorganizing OR resources on OR efficiency. If there were a change in labor, technology, or number of ORs – assuming that the other items remained the same – output would increase and the production possibility frontier would move outward.

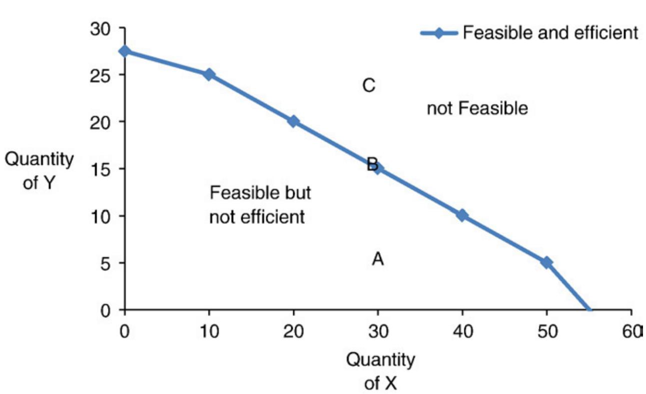

Fig. 1 Production possibility frontier.

Additional study is needed to show how increasing OR personnel, replacing old equipment with new, upgraded equipment, and increasing capital spending on electronic recordkeeping and telecommunication devices leads to an outward shift of the production possibility frontier and an expansion of the OR's production possibilities. The production possibility frontier model of an OR may provide an additional metric to use in analyzing OR efficiency.

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References

[1] Macario A. Are your hospital operating rooms "efficient"? A scoring system with eight performance indicators. Anesthesiology 2006;105: 237-40.

[2] Strum D, Vargas L, May J. Surgical subspecialty block utilization and capacity planning: a minimal cost analysis model. Anesthesiology 1999; 90:1176-85.

[3] Krugman P, Wells R, Olney M. Essentials of economics. New York (NY): Worth Publishers; 2007. p. 20-40.

A novel set-up to allow suctioning during direct endotracheal and fiberoptic intubation

To the Editor:

When intubating the tracheas of patients with gastrointestinal bleeding, vomiting, or copious secretions, standard suction often is inadequate to provide good intubating conditions. As soon as the suction catheter is removed and the endotracheal tube (ETT) is picked up, the liquid reaccumulates, preventing visualization of the airway structures. In these situations, we attach a neonatal meconium

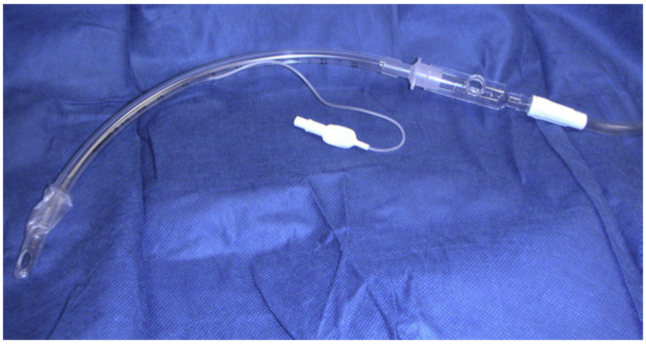

Fig. 1 Endotracheal tube attached to a meconium aspirator and suction.

Fig. 2 Swivel adapter attached to a meconium aspirator and suction.

aspirator (Neotech Products, Inc., Valencia, CA, USA) to the end of the ETT, then connect the ETT to suction (Fig. 1). By occluding the suction-activation hole with a finger tip, the ETT becomes a large-bore suction catheter. This action allows for continuous removal of the blood/secretions throughout ETT placement and provides a clear view of the glottic structures; the patient's trachea then is intubated with the same ETT. The trachea then may be suctioned before the meconium aspirator is disconnected.

One disadvantage of this method was that the ETT could not contain a stylet to allow for easier manipulation. We therefore devised the simple set-up, as shown in Fig. 2. This consists of the ETT attached to a common swivel adapter with a perforated rubber head (*Bodai Swivel, Sontek* Medical, Inc., Hingham, MA, USA). A meconium aspirator is then attached to the swivel adapter and suction. This configuration allows a styletted ETT to be used in the manner mentioned above (Fig. 3).

In the course of using this simple set-up, we realized that it may also provide a means to add suction to a number of fiberoptic stylets. One of the failings of these devices, as compared with standard intubating bronchoscopes, is the absence of a suction channel. Fig. 4 shows a Bonfils fiberscope (Karl Storz Endoscopy, Tuttlingen, Germany) with attached swivel adapter, ETT, and meconium aspirator. Depending on the model of fiberoptic scope, a small portion of the ETT will need to be removed in order for this set-up to fit; the depicted ETT was cut at 28 cm. This set-up allows suctioning during intubation and clearing of the fiberoptic camera without having to remove the scope from the mouth.

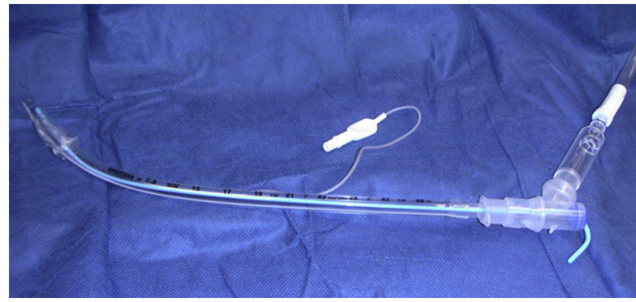

Fig. 3 Swivel adapter and meconium aspirator set-up, allowing for suctioning through a styletted endotracheal tube.

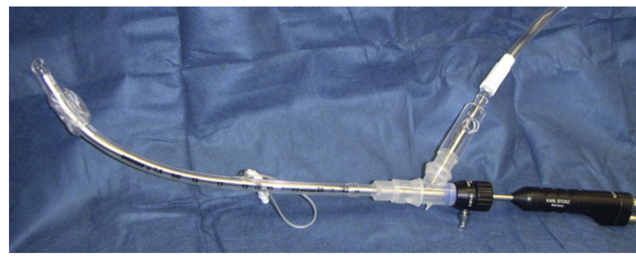

Fig. 4 Swivel adapter and meconium aspirator set-up, allowing for suctioning during fiberscope intubation.

A potential disadvantage of this set-up is that the ETT may be soiled by the patient's secretions. Nevertheless, we have used this set-up in many difficult airway situations and find that it offers excellent potential to improve airway visualization.

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