AIR tent for airway management of SARS patients

To the Editor:
The suspected culprit, a coronavirus, of the severe acute respiratory syndrome (SARS) is believed to spread mainly by droplets.[1] Positive airway pressure generated during coughing, tracheal intubation and extubation, and during assisted ventilation may facilitate the dispersion of droplets from infected patients.

We developed the airway intervention and resuscitation tent (AIR tent) to provide an extra layer of barrier between the patient and health care workers (Figure). The "tent" is an assembly of a clear transparent plastic bag mounted on a plastic frame. The anesthesiologist can use the gloves on the cephalic side of the tent while an extra glove on the caudal side can be used by the assistant to provide cricoid pressure and pass instruments. An airtight seal around the glove is produced by screwing two plastic rings over the plastic sheet with the glove first mounted on the inner ring. The inner and outer rings are cut from the top and the lid of a plastic container respectively. A rubber seal, fashioned from a feeding bottle tit and fixed by an adhesive dressing at the top of the tent, provides a conduit for bronchoscopy. The plastic frame and rings can be disinfected with sodium hypochlorite solution. Other parts are disposable. The AIR Tent is inexpensive to construct (plastic frame: US$ 15; gloves + plastic bag: US$ 1.5) and is easy to put together (setting-up time < 5 minutes). We believe the AIR Tent is suitable for use in operating rooms and other parts of the hospital where resuscitation takes place.

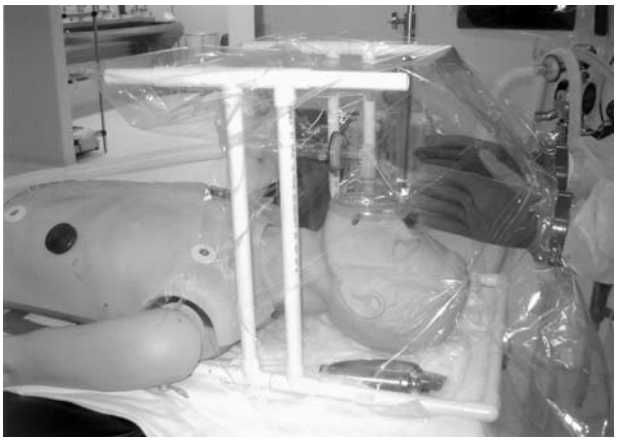

FIGURE AIR tent covering the head and the upper part of the chest of a manikin on an operating table.

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Programming errors from patient-controlled analgesia

To the Editor:
Vicente *et al.* recommend hospital-operating procedures to minimize programming errors associated with patient-controlled analgesia (PCA) and to enhance their detection before patients are harmed.[1] Most of the preventable incidents in anesthesia, however, involve human error.[2] Anesthesiologists are frequently exposed to stress, operating under difficult and sometimes critical conditions including emergency situations.[3,4] This requests a high ability to work under pressure. Stress is well known to occupy thought processes and decrease alertness. Drugs and alcohol (and hangover) can impair judgment, even in minor doses. Physical and mental strain, lack of sleep and immobility may cause lasting degradation of performance. Even minor illness can affect alertness. In addition, coordination and vision may be impaired by medication. Fatigue favours the acceptance of unwarranted risks. Emotional upset, including anger, depression, and anxiety decreases alertness, alters critical self-assessment and enhances risk-behaviour. Personal fitness and good health are important factors that influence situational awareness and performance. As generally in anesthesiology distraction means danger to the patient, all personnel involved in the use/programming of PCA pumps are strongly advised to avoid the following four situations:

- *S* tress;
- *A* lcohol (drugs);
- *F* atigue;
- *E* motional upset.

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To the Editor:

The recent case report by Vicente *et al.*[1] concerning a patient-controlled analgesia (PCA)-related opiate overdose demonstrates some of the potential safety hazards of complex medical technology. It is sometimes helpful to consider the various means by which hazards involving such technologies may occur. In this context, I would like to offer the following taxonomy of PCA safety hazards. I hope this classification will be useful to both designers and users of PCA systems.

[1] Use of wrong drug or wrong cartridge (e.g., insertion of a 5-mg·mL^{-1} morphine cartridge when a 1-mg·mL^{-1} cartridge is required).

[2] Accidental misprogramming, sometimes as a consequence of a hostile user interface.[2–4]

[3] False triggering, for example, due to a short circuit in the PCA button[5] or for other reasons.[6,7]

[4] False triggering by proxy (e.g., relatives pushing the PCA button because Granny is too sleepy to do it herself).

[5] Drug accumulation in *iv* deadspace.[8] This may occur with large *iv* deadspaces under low flow conditions.

[6] Runaway fluid column due to "siphoning".[9] (Should a crack occur in the PCA drug cartridge, entrainment of air into the system may lead to a free-flow of drug into the patient. Some manufacturers incorporate anti-siphon valves into their designs to prevent this).

[7] PCA machine malfunction due to hardware failure.[10]

[8] PCA machine malfunction related to software design error.[11,12]

[9] Retrograde flow of PCA analgesic drug into a secondary *iv* set (e.g., for administering antibiotics) due to a temporarily blocked *iv* catheter.[13] When the *iv* catheter is subsequently unblocked, the PCA drug that has accumulated in the secondary *iv* bag is then suddenly released into the patient. (The use of a one-way valve on the secondary *iv* set will prevent this).

[10] Bad medical judgment in formulating PCA prescription, or opiate orders from other physicians unaware that PCA orders have been written.

[11] Anaphylaxis (either de novo or despite knowledge of risk of reaction).

[12] Extraordinary sensitivity to opiates resulting in unexpected respiratory depression.

In addition to these situations, there is one safety situation that, while theoretically possible, is unlikely to be encountered in real life.

[13] Reprogramming with criminal intent.

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To the Editor:

I read with interest this case report of the tragic death of a young woman while receiving patient-controlled analgesia (PCA) post-Cesarean delivery.[1] The authors conclude their report with several recommendations. These are all very sensible. The most important recommendation, not mentioned however, concerns the initial nursing assessment of a loudly snoring and unarousable patient while receiving PCA on the ward. This obviously can be an urgent and life-threatening situation which must be dealt with expeditiously. Typically a nursing protocol exists which provides for an immediate and effective response. Did this not exist, or, if so, was it not followed? A different and more favourable outcome might have resulted.

An astute and appropriately trained nurse is the last line of defense for a wide range of untoward and potentially critical situations, such as could arise from a PCA programming error. This, in my opinion, is the paramount message in this tragic case, and not the programming error itself.

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Reference

1 *Vicente KJ, Kada-Bekhaled K, Hillel G, Cassano A, Orser BA.* Programming errors contribute to death from patient-controlled analgesia: case report and estimate of probability. Can J Anesth 2003; 50: 328–32.

To the Editor:

Patient-controlled analgesia (PCA) programming error is an important patient safety issue as highlighted by Vicente *et al.*[1] Drug overdose and death resulted when morphine 1 $mg \cdot mL^{-1}$ was set instead of the actual 5 $mg \cdot mL^{-1}$. I appreciate Dr. Vicente's reminder and sound recommendations but find the viewpoints somewhat misleading. The article seems to suggest that the Abbott Lifecare 4100 Plus II Infusion Pump is uniquely dangerous because there might be "relatively numerous mortalities … from user programming errors with this device".[1] The authors have singled out the Abbott PCA pump as dangerous without providing objective adverse outcome data for other PCA pumps as comparison. While I acknowledge that the Abbott PCA pump is not foolproof, we must realize that incorrectly entering a lower drug concentration than one actually used can happen with most PCA pumps currently on the market. For example, the factory preset PCA default drug concentration for the Baxter Ipump™ and Sims Deltec CADD® pump is 0 $mg \cdot mL^{-1}$ and 0.1 $mg \cdot mL^{-1}$ for the Abbott pump. To my knowledge, only the Alaris PCAM® pump can be programmed to a customized drug delivery profile at this time.

It is important that we read this article in the proper context recognizing that heightened vigilance to prevent human error and drug overdose is needed for all brands of PCA pumps. In the meantime, we wait in anticipation for the next generation of PCA pumps with the promised safety features of bar code reading capability and automatic drug identification.

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Reply:

We are pleased that our article generated interest in the anesthesia community.[1] Dr. Lederer identifies several well-known performance shaping factors that induce error. However, most of these are uncontrollable and cannot be eliminated; all health care providers will sometimes be stressed, tired, or emotionally upset. It is irresponsible to design medical systems that do not accommodate these harsh realities. Rather than wishing these factors will simply go away, we should design devices and systems so that providers can function more robustly - even under less than ideal conditions.

Dr. Doyle outlines an excellent taxonomy of patient-controlled analgesia (PCA) hazards to assist manufacturers and investigators improve patient safety. Dr. Lamb correctly reports that well trained, astute nurses play a key role in preventing tragic outcomes from drug errors. Dr. Chan raises questions about the context for our research that we are pleased to address.

Our primary goal is to use human factors engineering design principles to improve the safety of medical devices, not to denigrate any particular manufacturer or model.[2] The circumstances surrounding the patient death, not our personal preferences, dictated the particular model we investigated.