The ergonomics of safe needle disposal following venous cannula insertion - in search of a solution to a problem

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Needlestick injury remains a persistent and unresolved problem in the various working environments in which anaesthesiologists practice, a problem which is anxiety-provoking, time-consuming, costly and potentially dangerous. In spite of comprehensive protocols in our hospitals addressing the safe handling of sharps, most anaesthesiogists will acknowledge that hollow-bore needle disposal is often haphazard and unpredictable. This is particularly true of emergency situations, when dealing with cannulation.

The extensive but often conflicting literature concerning needlestick injury reveals that approximately 30 needlestick injuries occur per 100 hospital beds per year.[1] Two different studies have shown that 1/3 of full-time practicing anaesthesiologists or anaesthesia personnel will experience a blood-contaminated needlestick per year.[2,3] If these figures are true for this country and one considers the current prevalence of HIV seropositivity, 5% of local anaesthesia personnel will suffer a HIV+ contaminated injury per year.

Again two studies have demonstrated that 40% of needlesticks occur during the actual procedure and almost 40% of injuries occur during needle disposal.[3,4]

ERGONOMICS literally means the study of the efficiency of work, and has developed into the engineering discipline that describes the relationship of man with his working environment, and reconciles the design of products and systems with human capabilities and limitations. Also required are an understanding of physiology and the psychology of human behaviour. Ergonomic factors are intimately involved with many aspects of safety in anaesthesia. It is therefore an inexact science, where, in the words of Peter Pleasant, one attempts to "fit the task to the human". The converse would compromise safety standards.

There have been numerous studies looking at the influence of various ergonomic factors on the incidence of needlestick injury.

The Universal Precaution Guidelines for the Prevention of Needlestick Injury were proposed 20 years ago by the Centers for Disease Control and Prevention. The effects of their introduction and the associated training programs have been monitored, and the results have been disappointing except in situations where the precautions have been rigorously applied. The poor results have been attributed to poor compliance.[1,5,6]

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Two-handed recapping of needles is specifically prohibited by the Universal Precautions. In spite of this, studies report that up to 30% of injuries are caused by this practice. There are commentators who advocate single-handed recapping (the so-called "scooping method"), but this is often a cumbersome procedure.

Improving the availability of "sharps disposal containers" has decreased the number of needles that are recapped prior to disposal, but has yet to show a decrease in the number of injuries.[7]

Routine gloving, a recommended practice, has low compliance levels, particularly amongst older anaesthesiologists. Gloving does provide some protection for surface contamination, but does not alter the severity of needlestick injury should it occur. [3]

Safety needles and needle guards have been shown to have a beneficial effect on the incidence of needlestick injury and are recommended for routine use by the CDC. For reasons ranging from cost, ease of insertion and acceptance by medical personnel, these needles are yet to become exclusively available.

No studies have pinpointed the specific reasons for the very real risk of needlestick injury following venous cannulation. Whether the process is too difficult to be consistently safe or whether we practitioners are inherently clumsy or careless remains unanswered. There are no "time and motion" studies looking at the full duration of the risk period i.e. from removal of the needle stylet at the insertion site to the disposal in an impenetrable closed container. This is presumably due to great variation in the process from location to location.

By observing clinical practice in different hospital locations and applying the ergonomic principles used in industry for the handling of dangerous substances, the following list of potential risk factors and potentially hazardous behavior patterns was drawn up:

1. The duration of the risk period, as defined above.
2. The needle transit distance i.e. the distance from the site of insertion to site of disposal.
3. The number of rotational or turning movements (>90 degrees) made by the needle carrier.
4. Extraneous people between patient and "sharps container".
5. Number of people handling the needle.
6. Number of times the needle is picked up.
7. Needle transfer movements involving the crossing-over of hands, or hands moving towards one another.
8. Needle out of practitioner's visual field.
9. Physical obstacles to the path of the needle.
10. An over-full "sharps container", with protruding needles.

The first three factors were measured in three different hospital locations: the operating theater, the intensive care unit and the emergency unit. 10 sets of measurements were done by a covert observer in each of the three locations during the course of normal practice. Only the ranges of the measurements are included in Table 1, as the results are not intended to prove that these are indeed risk factors in needlestick injury. These measurements are purely illustratory of a system which fails and where the precise risk factors have never been successfully identified.

Table 1: The ranges for needle disposal in three hospital locations. 10 measurements per location in the course of normal hospital practice.

	Operating theater	*ICU*	*Emergency Unit*
Duration of risk period	0: 05 – 2:00 min	0:10 – 4:30 min	0:10 – 12:00 min
Transit distance	2 - 8 meters	2 –6 meters	2 –6 meters
No. of rotational movements > 90°	0 - 4	0 - 2	0 - 4

A list of the ideal criteria for needle disposal was established (Table 2), and a system that addresses all the identified, potential risk factors was devised.

Table 2: CRITERIA FOR IDEAL NEEDLE DISPOSAL

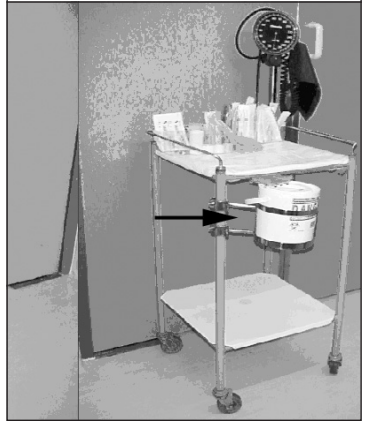
- quick but not hurried
- short transit distance
- remain in full view of the operator
- no rotational movement or hand crossing maneuvers
- no second handling of needle by practitioner or assistant
- no opportunity for recapping of needle
- occur in a direction away from the operator
- no obstacles in the path of disposal

A prototype "infusion trolley" was made (Figure 1). The essential features of this trolley are that:

It is small and mobile for easy maneuvering into the correct position.

It is affordable, easy to make, using equipment readily found in most hospitals.

Figure 1: The prototype infusion trolley.



It carries all the equipment required for cannulation, including cleaning and dressing materials, disposable gloves and a range of venous cannulae, as well as a sphygmomanometer and cuff for venous occlusion, and an appropriately placed, fixed sharps container. This disposal container is held in a bracket at the front of the trolley.

This trolley is moved to the opposite side of the patient's arm to the position of the anaesthesiologist. In this position needle disposal is a rapid, short single movement, and fully supervised procedure. It involves one person, the movement is away from the operator, and involves no rotation.

This trolley was placed in the Gynaecology and Urology Operating Theater and a short demonstration was given to the anaesthetic assistants as to its use. The previously used equipment was left in place. Within two days the new trolley was used exclusively and correctly without any further prompting, primarily because the anaesthetic assistants had bought into this new system. The question is: Why?

The answer lies in the human behaviour aspect of ergonomics. For the sustainable use of a system there needs to be an immediate benefit or incentive beyond the threat of possible harm. This is born out by the fact that the Universal Precautions have had only a small impact on the incidence of needlestick injury.

In this situation, the benefit is convenience - not so much because disposal is made easier, but more, of having the equipment for cannula insertion to hand. Having the sphygmomanometer with relatively short tubing attached to the trolley ensures the correct positioning of the trolley. The trolley makes the anaesthetic assistant's job easier, and in so doing, the sharps container is presented to the anaesthesiologist or practitioner. Needle disposal is thus emphasized and becomes a priority activity.

At the request of the anaesthetic assistants and nursing staff, these infusion trolleys are being made for all operating theaters, and emergency and intensive care units.

Conclusion

The safe disposal of sharps, particularly contaminated hollow-bore needles, is the responsibility of the practitioner.

Needlestick injury is an ongoing problem. Apart from the introduction of safety needles, there has been little progress in the last 15 years.

Using ergonomic principles, potential risk factors for the full duration of the risk period have been identified. No attempt has been made to prioritize or prove the relevance of these factors because of the large variability in this procedure in clinical practice.

Rather an attempt has been made to provide an alternative system which practical, affordable, well-accepted and therefore sustainable. Importantly this system addresses all of the potential risk factors identified.

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