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Prevention of transmission of AIDS and hepatitis viruses in health care workers: evaluation of waste containers for injection, blood sampling and incision materials after use

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Summary

Given the risk of health care workers becoming infected (particularly by HIV, hepatitis B and non-A and non-B viruses) when manipulating contaminated injecting or blood sampling equipment, the authors have assessed four devices currently available for collecting and disposing of these waste products. Several criteria are proposed for evaluating the qualities of these devices. These criteria should allow a standardised assessment of the devices, and enable the most suitable choice to be made in view of protecting health care workers.

Introduction

The risks of accidental transmission of HIV and hepatitis viruses at the workplace have been assessed, especially in North America (Werner and Grady, 1982; McCray, 1986; MMWR, 1987). A recent study conducted in the United States (Jagger et al., 1988) shows clearly that the risks of accidental injury in health care personnel are for the most part related to the manipulation, particularly the racapping of injecting and sampling needles.

We have attempted to analyse, and where possible assess, according to various criteria, the current possibilities of reducing the number of accidents among health care workers.

Materials and Methods

Four containers, available in Europe, for collecting and disposing of equipment used for incising, injecting and sampling were studied. Figs. 1 to 4 show cross-sections and overhead views of these devices.

1. Recup-Aiguille (Amedis): a small compact container made of butadiene styrene (80 × 33 × 10 mm), with a tamper-proof lid provided with a

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push button controlling the opening. This box can only be used for needles (Fig. 1).

2. Securoject (Astrium): a cylindrical jar (Fisch et al., 1987) made of high density translucent polyethylene. It has an anti-reflux narrow neck and a lid of the same substance with a circular opening with two notches. These notches are used for detaching the needles with one hand from syringes, vacutainer-type sampling systems and tubulatures. The receptacle contains a tablet for the preparation of antiseptic chlorinated solution made by adding water. The jar has a self-sealing hermetic stop-valve for the removal of the receptacle. Sizes available are 0.5, 1, 1.5 and 2 l (Fig. 2).

3. Sharpsafe (LSA): a yellow square or rectangular-sided box made of polypropylene. The lid is yellow or white and has a safety closing device. There is a wide opening to insert the contaminated material. Certain models have a transparent removable stop valve which opens and shuts automatically. An adjoining lid is used to close the recipient when it is full. The lid also has a notch so that the needles can be detached from the syringes, and an opening in which the cap of the needle is placed. Five models are available: 0.5, 4, 7, 11 and 21 l (Fig. 3).

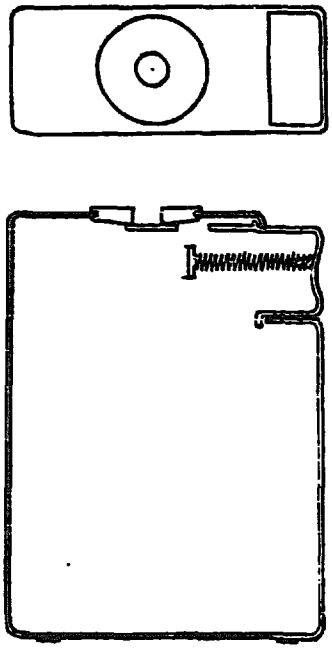

Fig. 1. Recup-aiguille; scale = 0.5.

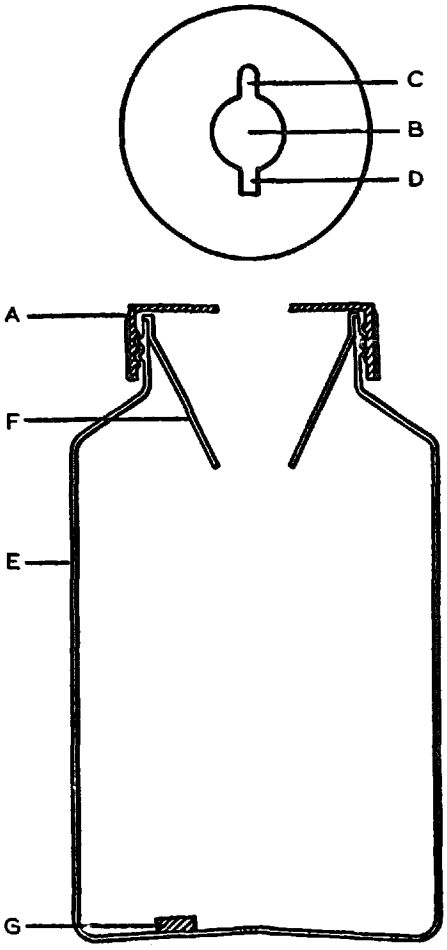

Fig. 2. Securoject; scale = 0.5. (A), lid made of high density translucent polyethylene; (B), circular opening; (C, D), notches for detaching needles from syringes; (E), cylindrical jar made of high density translucent polyethylene; (F), anti-reflux narrow neck; (G), tablet for preparation of antiseptic chlorinated solution.

4. Sharps containers (Sherwood): a red rectangular-sided box made of rigid plastic (polypropylene and polyethylene). The lid has a safety fastening device, and a chimney-type of opening as well as notches for detaching needles from syringes or from the holders of Vacutainer-type sampling systems. A plug adjoining the opening is available to close the recipient before removing it. Sizes available are 6, 10, and 17 l (Fig. 4).

Assessment Criteria

Ten criteria were chosen in order to assess the ability of the various containers to fulfill their function of prevention (Vincent-Ballereau, 1988). These criteria were assessed qualitatively, and where possible quantitatively, by nurses ($n = 80$) in seven different departments comprising the main medical and surgical specialities of the Regional University Hospital at Angers (France). This assessment was carried out over 3 months. The criteria were, in order of importance: 1. Ease with which the needle is detached from the syringe or the holder (Vacutainer-type). 2. Possibility of disposing of other types of material used for parenteral route (syringes alone or with needles, epicranial, catheters, trocars, lancets, etc.). 3. Risk of reflux of contaminated waste out of the recipient. 4. Quality of the material of the recipient: (a) Mechanical resistance; (i) Reaction of the device under a pressure of 50 kg. (ii) Resistance against perforation. (b) Chemical resistance against (i) chlorine derivatives and (ii) aldehyde derivatives. 5. Ability to be incinerated without releasing products of combustion which are noxious for man or which attack the incinerator. 6. Stability of the recipient. 7. Presence of the hermetically sealed system on the device for its disposal. 8. Size adapted to its use (trolley, treatment centre, outpatient's department): 2 l or less. 9. Presence of disinfectant. 10. Quality : cost ratio (prices net 1988 rates in France).

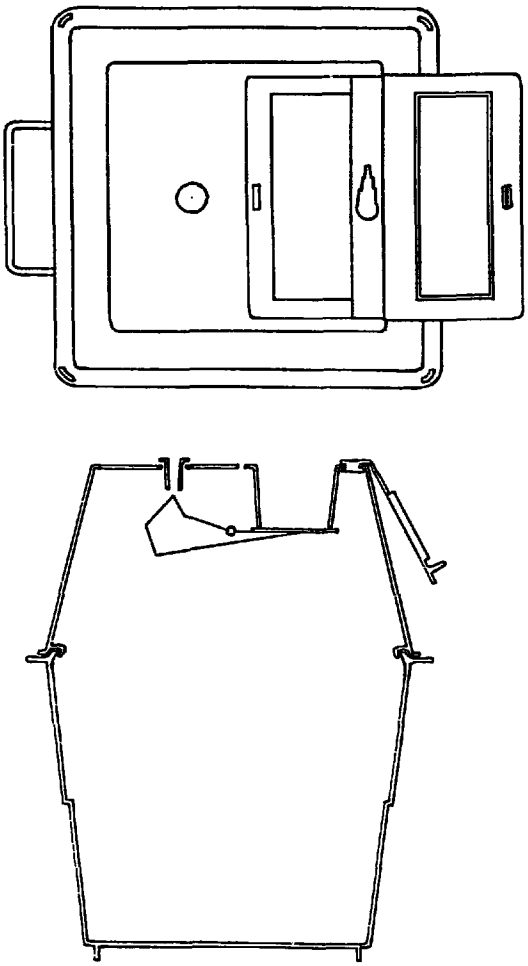

Fig. 3. Sharpsafe; scale = 0.5.

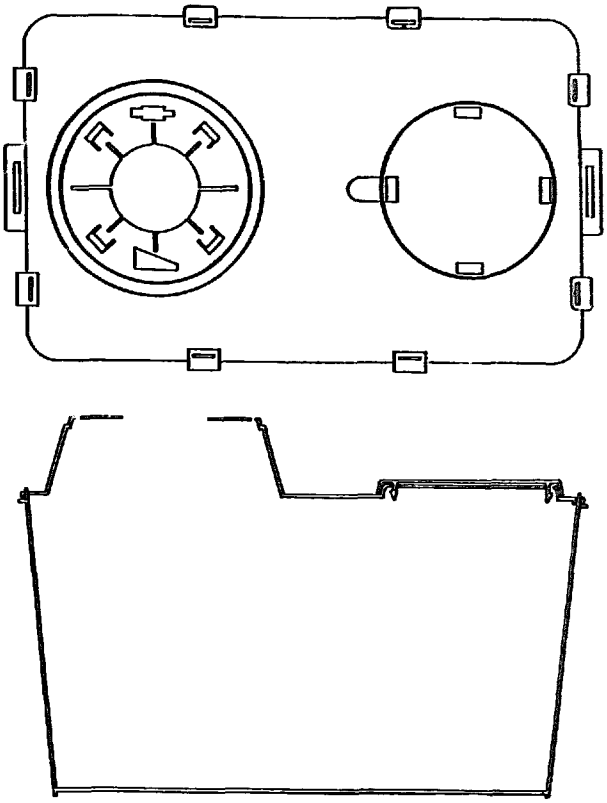

Fig. 4. Sharps container; scale = 0.5.

Results

Table 1 shows the results of the trials according to the criteria chosen for use in various hospital departments.

TABLE 1

Evaluation, according to 10 criteria (1 to 10), of four containers for collecting incision, injection and sampling equipment after use

	Amedis (Récup Aiguille)	Astrium (Securoject)	LSA (Sharpsafe)	Sherwood (Sharps container)
1	+	+	+	–
2	–	±	+	+
3	+	+	±	–
4a (i)	–	+	–	–
(ii)	+	+	+	+
4b (i)	NA	+	+	+
(ii)	NA	+	+	+
5	+	+	+	+
6	NA	+	+	–
7	+	+	+	+
8	–	+	–(+ *)	–
9	–	+	–	–
10	±	+	+	±

NA, not applicable (pocket box); * 0.5 l model.

Overall, the results are relatively satisfactory for the four devices tested. However, certain disparities were observed, particularly for criteria 1, 4a (i), b, 8 and 9. The Securoject apparatus obtained the best score.

Discussion

Although the ten criteria chosen (Vincent-Ballereau, 1988) are necessary for an objective assessment of the devices, they must be complemented by the assessment of some criteria which are not as easy to measure.

There is the actual practical use of the device. For example, the Recup-Aiguille is proposed for "pocket" use. However, this may not be desirable for hospital use since it is not certain that this method is devoid of risk. Similarly, emphasis needs to be placed on whether the device can be used easily at all stages of injection and sampling procedures: laboratory beaches, trolleys, trays.

Criterion no. 1 should include an assessment of the ease with which one hand can be used. In this respect, with the Recup-Aiguille, the needle is situated a few centimetres from the hand which holds the device.

The advantage of the container being transparent should be clearly evaluated. This enables a better management of the system during use, and the visualisation of the level of antiseptic (Securoject). But the sight of the needles and blood is perhaps not psychologically beneficial when the container is located in a patient's room.

The risk of transmission of viral diseases among health care workers through needlestick with contaminated material is not negligible. For human immunodeficiency virus (HIV), 17 cases of professional contamination resulting in seroconversion have been published to date (BEH, 1986, 1987; Jagger et al., 1988). A prospective study conducted by the Centers for Disease Control (Atlanta) between August 1983 and 1987 included 883 health care workers who had been injured or who had cutaneous or mucous exposure to contaminated needles or equipment of biological products of human origin. Of 31 subjects who had been injured three presented with seroconversion. The risk calculated in case of accidental injection in this study was between 0.7 and 0.9% (McCray, 1986; Jagger et al., 1988).

In a study conducted by the National Institutes of Health (Henderson et al., 1986) on 531 health-care workers, 150 of whom had been exposed to contaminated fluids by injury or cutaneous or mucous contact, no seroconversions were observed. Similarly seroconversions were not reported in two prospective studies, one conducted by the University of California (Gerberding et al., 1987), and the other by the Communicable Disease Surveillance Centre in London (McEvoy et al., 1987), on respectively 270 and 150 exposed health care workers.

The transmission of hepatitis B is much more frequent, the prevalence being 12% in the Californian Study. The risk was 19% when the patient was a carrier of the antigen HBe (Werner and Grady, 1982). The risk of contracting viral hepatitis (Gerberding et al., 1987) seems to be 20 times that of HIV.

It is worth noting that the preventive measures against hepatitis B virus which have been complemented in hospitals for some years, have reduced the risk by 10% (1.2%) (Petithory, 1988).

The risk of accidental injection is 75 to 150 per 1000 employees per year in North American University Hospitals (Sheretz and Hampton, 1987). In

the university hospital at Angers (France), the reported numbers of accidental injections were 42‰ from 1984 to 1986, of which 21% in 1984, 16% in 1985 and 8% in 1986 were due to recapping needles.

We previously tried to implement a measure to prevent the risk of accidental injection by recapping by recommending the disposal of needles and other equipment in contact with blood into disposable high-density polyethylene containers originally used for antiseptic and liquid soap in the wards. Once full, the containers were disposed of. However, this system was not satisfactory given that the needle had to be detached from the syringe or the holder before placing it in the container. Thus, the risk of the health care workers injuring themselves remained, although the risk for the personnel dealing with the refuse bags was much reduced given the good resistance of high density polyethylene.

At the end of our survey, it was decided to equip the departments of our Hospital with the Securoject device. It is extremely difficult to assess the impact of such a measure on the incidence of accidental needlesticks. The reporting of accidents in the workplace is an unreliable indication of the true number of accidents which occur. A prospective survey is hindered by the inevitable sensitization of the personnel when the equipment is first used. Thus, the decrease in incidence might not be attributable to the equipment alone (as shown by the decrease in recapping injections at our Hospital mentioned above). Thus, the criteria determined for this study are useful tools in the evaluation and choice of equipment.

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