

Sharps Injuries in Healthcare Waste Handlers

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Received 20 November 2007; in final form 17 February 2008; published online 29 April 2008

Clinical waste disposal carries with it a risk of serious and possibly life-threatening infection. Combining confidential questionnaires and structured interviews with discrete observation, the attitudes and approach to safe handling of bulk clinical wastes by staff in a specialist waste treatment facility were assessed. With particular attention to glove use and hand hygiene, observations were supplemented by review of group-wide accident and incident records, with emphasis on sharps injuries and related blood and bloodstained body fluid exposures. Deficiencies in glove selection and use, and in hand hygiene, were noted despite extensive and on-going training and supervision of waste handlers. Though ballistic puncture-resistant gloves protect against sharps injury, these were uncomfortable in use and were sometimes rejected by waste handlers who preferred thin-walled nitrile gloves that were more comfortable in use though provide no resistance to penetrating injury. Among the waste handlers working for a single specialist waste disposal company, sharps injuries ($n = 40$) occurred at a rate of approximately 1 per 29 000 man hours. Injuries were caused by hypodermic needles from improperly closed or overfilled sharps boxes ($n = 6$) or from sharps incorrectly discarded into thin-walled plastic sacks intended only for soft wastes ($n = 34$). Most injuries occurred to the fingers or hands. No seroconversions occurred, though two individuals suffered anxiety/stress disorder necessitating prolonged leave of absence with professional counselling and support. Glove use and hand hygiene must feature prominently in the on-going training of waste handlers. Though ballistic gloves afford protection against sharps injury, the initial segregation and safe disposal of clinical wastes by healthcare professionals must provide the primary control measure. Despite robust and unambiguous legislation and good practice guidelines, serious errors by healthcare staff that result in the disposal of hypodermic needles and other sharps to thin-walled plastic waste sacks places waste handlers at risk of bloodborne virus infection. Further improvement in the standards of waste segregation and disposal by healthcare professionals are still required to protect ancillary and support staff and waste handlers working in the disposal sector.

Keywords: clinical waste; healthcare waste; needlestick injury; sharps injury; waste disposal

INTRODUCTION

Clinical or healthcare wastes, comprising the detritus of human or veterinary healthcare, are highly variable in composition. A substantial proportion may comprise relatively innocuous packaging and other non-hazardous materials, though some fractions may be contaminated with blood or body fluids that may contain potentially harmful microorganisms. Cross-contamination renders the entire load potentially harmful to health. Though bloodborne virus (BBV) transmission is the foremost risk, the literature re-

cords a substantial list of pathogens causing infection following accidental exposure to blood and body fluids (Tarantola *et al.*, 2006). Sharps or 'needlestick' injury, a cut or puncture wound resulting in penetration of the skin by a hypodermic needle, surgical blade, fragment of glass or metal or other sharp item including rigid plastic, is the primary hazard for those working with healthcare wastes. Though much attention is paid to the safety of healthcare workers and their protection from sharps injury, the welfare and safety of those in the waste disposal sector has received very little attention. No report exists to define the incidence of sharps injuries to this key worker group.

All sharp items capable of causing injury must be discarded to robust tamper-proof and puncture-resistant

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containers. Soft wastes are discarded to thin-walled plastic sacks that afford no protection against penetration by sharps or spillage of fluids. The overarching principles of the US Centers for Disease Control and Prevention (CDC) Universal and Standard Precautions mandate a standard of safety for those generating and disposing these wastes. This requires that all wastes contaminated with blood or bloodstained body fluids are considered potentially hazardous and managed with a degree of care that should not diminish as wastes progress along the disposal chain (Blenkarn, 2006). Effective segregation at source and the correct use of waste containers provide the most effective safeguards. The incidence of sharps injury in healthcare workers is well described and much attention is given to prevention through education and training, product design and changes to clinical practice (Centers for Disease Control and Prevention, 2004; Elder and Paterson, 2006). However, a significant risk of sharps injury to waste handlers responsible for the onward disposal of healthcare wastes may have been overlooked.

METHODS

Studies were undertaken at a single UK specialist waste treatment facility receiving up to 3600 tonnes of hazardous healthcare waste per annum. This comprises wastes from hospitals, chronic care facilities and care homes, general practitioner and dental surgeries, pharmacists, from patients receiving domiciliary care and from veterinary establishments. Waste streams include soft clinical wastes, sharps, pharmaceutical and cytotoxic wastes, wastes from diagnostic and research laboratories and additional non-hazardous sanitary wastes.

Waste handlers ($n = 15$) were invited to complete a brief anonymous questionnaire and a comprehensive structured interview to explore attitudes towards the suitability and correct use of relevant personal protective equipment (PPE). Staff were questioned regarding the selection and use of gloves and about hand hygiene and the management of cuts and abrasions on hands and forearms, including those present before starting waste handling duties. Staff were asked to estimate the frequency of splash contamination from wastes and the particular tasks or manoeuvres that predispose to such contamination, of more extensive contamination by liquids leaking from primary waste containers that results in heavy soiling of workwear and of the suitability of that workwear to protect against skin contamination with spilled body fluids. Additionally, staff were asked to describe their attitudes towards and knowledge of the infection risks associated with clinical wastes.

Questionnaires and interviews were conducted in private with a single interviewer (J.I.B.) and were

voluntary, anonymous and confidential. Interviews and questionnaires were supported by discrete observation of waste handlers with emphasis on glove use and hand hygiene. Lastly, a comprehensive review of group accident and incident records was performed, including the records for two additional waste management facilities within the same group employing collectively up to 85 waste handlers at any time. Data were evaluated for infection risks through sharps injury and related exposure events that had occurred over a 3.5-year period for which detailed records were available. Review included the circumstances of the injury, the source of wastes causing injury, the description and packaging of those wastes, the use of PPE, the action taken following injury and the long-term outcome.

RESULTS

Waste was received in colour-coded thin-walled plastic sacks of 25–200 μm thickness compliant with UN 3291, the United Nations transport of dangerous goods, globally harmonized system of classification and labelling standard for bulk clinical wastes. Sharps and more bulky and wet wastes were in rigid puncture-resistant tamper-proof plastic bins compliant with BS 7320:1990 (British Standards Institute, 1990) and UN 3291. Approximately 40% of bagged or binned wastes were secondarily contained in yellow heavy-duty 770 l capacity high-density polyethylene wheeled and lidded bulk waste carts (Eurocarts). The remaining fraction was received without secondary containment and on arrival was transferred by hand to lidded carts for storage and later processing.

Waste handlers ($n = 15$) wore heavy-duty polycotton uniform workwear. PPE included a range of gloves including puncture- and cut-resistant ballistic gloves for handling bagged raw wastes. Heavy-duty nitrile gloves were available for tasks not requiring contact with raw wastes and those that were assessed not to carry a significant risk of sharps injury. Further protection was provided by safety boots or shoes with mid-sole protection, polycotton trousers with cut-resistant ballistic pads to the lateral aspect of the lower leg and lower part of the thigh providing cut resistance to EN 388 (British Standards Institute, 2003) ($n = 9$) or more basic polycotton trousers without reinforcement ($n = 6$). Eye or face protection was not used.

Questionnaires, structured interviews and direct observation revealed many deficiencies in hand hygiene and PPE use. All 15 staff were fully aware of the basic health implications of sharps injury and the action required if injury should occur. However, despite on-going training, it appeared that staff failed to recognize the risks of sharps injury from sharp

items within soft wastes and incorrectly associated this only with handling needle-filled sharps boxes. Gloves were rarely changed as staff moved between tasks; though waste handlers might select an appropriate glove type for a task, those gloves remained in use even when moving to another task for which another type of glove would be more appropriate. At least half of waste handlers were observed on occasions to omit glove use while handling wastes or use unprotected forearms to manoeuvre or support filled waste sacks when protected only by gloves terminating at the wrist. This was not apparently related to specific tasks, to staffing levels or workload factors, or to prior training and experience. Some makes of ballistic gloves were uncomfortable on prolonged use and caused interdigital skin abrasions from raised internal stitching. These unlined gloves caused troublesome sweating in prolonged use, yet were permeable to liquids and permitted contamination of skin surfaces after extensive contact with blood or body fluids from wastes. With concerns about permeability, restriction of dexterity and the difficulties of donning and removing tight fitting ballistic safety gloves, these were sometimes abandoned in favour of rubberized gloves that were easier to don, comfortable in use and provided protection against fluid penetration though not penetrating injury. Omissions in glove selection, by at least 5 of 15 waste handlers, were not apparently associated with training or experience or with any serious underlying skin irritation that might have prompted glove change. On at least six occasions during the period of observation, waste handlers were noted not to wear any gloves for waste handling tasks, particularly for non-routine tasks and those begun or undertaken hurriedly.

All waste handlers reported frequent splash or droplet contamination while handling waste sacks. Estimates of frequency varied, but there was consensus that this would have occurred several times daily. Chest, arms and legs were the common sites for splash contamination. Splashes to the face were infrequent but not unknown. Heavier contamination involving saturation of trousers and penetration of gloves or footwear with blood or body fluids from untreated waste occurred less frequently, with around one event reported every 6 months. These exposures occurred mostly to waste handlers collecting wastes from producer sites and were in each case linked to gross packaging errors by waste producers and not to demonstrable lack of care during subsequent handling.

Splash contamination was associated with overfilled waste sacks, with smaller waste volumes comprising items unsuitable for disposal in a plastic sack, with awkward or sharp-edged items tearing waste sacks and with compression of sacks in overfilled bulk waste carts. There was no correlation between the method of sack closure, using a cable tie or equiv-

alent, knotting the neck or using adhesive tape and the spillage of wastes. Waste handlers were aware that contamination would occur more frequently with wastes from some sources than others. This did not correlate with the type or grade of waste produced or with the type of healthcare establishment from which it arose and may have been associated simply with a more frequent lack of care by some waste producers.

Though all waste handlers reluctantly admitted occasional errors in glove use, while claiming an understanding of the implications of sharps injury, all claimed compliance with glove removal and handwashing rules for meal breaks or rest periods. Direct observation revealed breaches in this standard that was acknowledged on further questioning. Handwashing did not routinely follow glove removal; for breaks of <5 min, 12 of 15 staff members admitted failures in hand hygiene, though for formal refreshment breaks compliance was almost 100%. The explanations were time constraints and pressure of work, the location of handwashing facilities or lack of a nearby sink though there was no evidence to support these explanations. In no case did handwashing include forearms. Waste handlers/drivers collecting wastes from producer sites had few opportunities for effective hand hygiene. Customer welfare facilities were often inaccessible or unavailable to drivers who had to rely on other publically accessible facilities or the use of alcohol hand rubs and wet hand wipes (baby wipes) after glove removal.

Over the 3.5 years for which comprehensive group-wide data were available, 40 sharps injuries were recorded among waste handlers. With staffing levels varying between 58 and 85 individuals, sharps injury occurred at a frequency of approximately 1 per 29 000 man hours, most often as waste handlers attended producer sites to collect wastes for onward disposal ($n = 36$). Sharps injuries (Fig. 1) to the hands or forearms occurred among staff wearing gloves not incorporating ballistic protection properties ($n = 22$) or no gloves ($n = 2$). No hand injury occurred while wearing ballistic gloves. Injuries to the legs occurred while picking up or carrying waste sacks in a way that allowed these to brush against the legs and were more prevalent among those wearing trousers without ballistic reinforcement ($n = 9$) than with protective additions ($n = 2$). In these latter cases, one injury occurred beyond the zone of protection, while in the other the ballistic reinforcement failed to prevent a direct needle strike. Thirty-six of 40 waste handlers attended hospital immediately following injury. At the discretion of the attending physician, blood for baseline serological testing was drawn from 24 of these. Fifteen individuals for whom vaccination status was unknown received hepatitis B immunoglobulin, and two individuals received human immunodeficiency virus (HIV) post-exposure

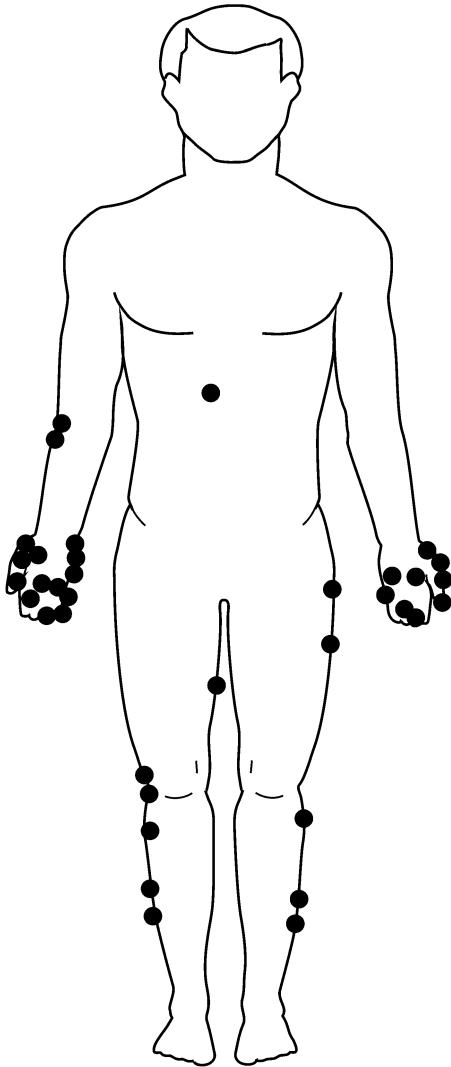


Fig. 1. Sharps injuries in healthcare waste handlers occurring mainly to the hands ($n = 24$) or legs ($n = 11$).

prophylaxis (PEP). Though it is recognized that speed of administration of PEP is crucial to success, many staff recorded considerable delay, in excess of 5 h, before being seen in a local Accident and Emergency Department, and for many the lack of referral to an appropriate clinical specialist or follow-up assessment was considered inadequate and unacceptable. No seroconversions were recorded, though two individuals suffered debilitating anxiety/stress disorder requiring prolonged leave of absence with professional counselling and support and prompted the resignation of one individual who felt unable to return to duties that involved work with clinical wastes.

Incident analysis identified incorrect and inadequate closure of sharps containers as a causative factor in 6 of 40 (15%) sharps injuries, while sharps

carelessly discarded into waste sacks intended only for soft wastes were responsible for 34 injuries (85%). Hypodermic needles caused injury in 37 cases (92.5%) while in two others injury was caused by broken glass in plastic waste sacks; in one case, the item causing injury was not identified. Puncture wounds were most common ($n = 38$, 95%), including deep puncture wounds in three individuals, while in two other cases (5%) injury was limited to a superficial cut or graze. Sharps injury occurred with wastes from General Practitioner surgeries ($n = 26$, 65%), hospitals ($n = 7$, 17.5%), nursing homes ($n = 5$, 12.5%), laboratories ($n = 1$) and veterinary surgeries ($n = 1$), closely mirroring the client profile and sources of wastes received across the group.

DISCUSSION

Healthcare wastes contain a wide range of micro-organisms among which hepatitis B virus (HBV) and hepatitis C virus (HCV) and HIV are the most significant pathogens. BBV infection may follow sharps injury, contamination of pre-existing skin lesions or splash inoculation to the eyes or mucous membranes. Infection may be transmitted by blood or bloodstained body fluids, even where bloodstaining is minimal and not visually apparent. The CDC Universal and Standard Precautions, intended to prevent parenteral, mucous membrane and non-intact skin exposures to BBV, offer protection to healthcare workers (Centers for Disease Control, 1987) and should provide an integrated framework for the protection of waste handlers also (Blenkarn, 2006).

The incidence of sharps injury among waste handlers is unacceptably high. It may be prevented though the use of ballistic gloves and trousers, though there are serious deficiencies in the initial segregation and disposal of wastes by healthcare professionals that should provide the primary control measure. All 40 sharps injuries reported here were caused by improper disposal and packaging of wastes by users. The fingers and palms were the most common sites for injury, though several individuals suffered injuries to legs as they carried filled waste sacks having unprotected sharps hidden within them. The correct and timely use of PPE is particularly important, and adequate training and management supervision must ensure compliance with glove use and other PPE protocols (Health and Safety Executive, 2007a; Health and Safety Executive, 2007b). However, armoured gloves are expensive, difficult to fit, permeable to liquids and may significantly impair dexterity. Though offering maximum protection, some armoured gloves are uncomfortable in use and were abandoned by waste handlers in favour of nitrile gloves that offered no protection against penetrating injury.

PEP may be indicated after sharps injury or other significant exposure, with prolonged follow-up and serological testing until seroconversion can be excluded. The psychological impact of sharps injury may precipitate severe stress/anxiety and disabling post-injury morbidity, adversely affecting the lives of those suffering injury and of their partner or family group and may force job change or result in an inability to work (Sohn *et al.*, 2006; Worthington *et al.*, 2006). Waste handlers had a high level of awareness of the implications of sharps injury and the importance of immediate medical assistance. However, despite extensive training, sharps injury was associated only with handling of sharps bins and staff generally failed to recognize the higher risk from fugitive sharps in waste sacks. Hand hygiene deficiencies were common among waste handlers who, despite training, often failed to wash hands after removing gloves. Hand protection and associated hand hygiene among waste workers suffered the same lapses noted among healthcare workers (Jenner *et al.*, 2006; Gould *et al.*, 2007). However, the inevitable impracticalities of glove use and frequent handwashing while performing mixed manual labour tasks with a high workload create practical difficulties for which no effective solution may exist.

Though great attention is directed to the protection of healthcare staff, further down the disposal chain sharps injuries to waste handlers have been largely overlooked. Although sharps users are at greatest risk, support personnel and cleaners involved in the early stages of the disposal chain feature as the next most frequent group reporting injury (Garner, 1996). Under-reporting is widely assumed, particularly among support personnel, and may be particularly common throughout the waste disposal industry where occupational health services are unlikely to be co-ordinated and accurate statistical data impossible to obtain. Most sharps injury studies in the healthcare sector exclude support staff, though this group may be at particular risk (Shiao *et al.*, 2001). Inappropriate disposal is associated with >80% of these injuries (Erdem and Talas, 2006). The psychological consequences for affected individuals, even when seroconversion does not occur, highlight the need for much greater care in wastes disposal to prevent these entirely avoidable injuries (Sohn *et al.*, 2006). The inevitable lack of knowledge about prior use of any hollow-bore needle that may cause injury to a waste handler, and of the identity or antigen status of the source patient, complicates case management. This should weigh the clinical decision-making process in favour of HIV PEP, although it did not appear to influence the clinical management of the majority of cases reported here.

In almost every case, injuries were associated with unsheathed hypodermic needles in waste sacks intended only for soft wastes. Clearly, some healthcare

professionals fail in their Duty of Care to protect the welfare of others. The direct financial costs associated with occupational exposure to blood and body fluids may be substantial (O'Malley *et al.*, 2007), though the implications of seroconversion carry a cost that is immeasurably greater. The careless disposal of sharps fails to comply with the guidance of UK Health Technical Memorandum 07-01 (Department of Health, 2007) and is, in the UK, in breach of health and safety legislation that carries robust legal and costly financial liabilities. The reasons for failure in the safe disposal of sharps are unclear. Training, supervision and support in infection control and effective waste disposal practice for healthcare practitioners may still be inadequate, while a lack of resources and workload pressures might be proposed to explain or excuse the failure to ensure the safe disposal of hazardous wastes. Though improvement in the design of ballistic PPE together with extensive training and supervision for waste handlers may reduce the incidence of sharps injuries, this key worker group will remain at risk until there is further improvement in the standards of waste segregation and disposal by healthcare professionals.

Acknowledgements—We wish to thank those waste handlers who supported this investigation, completed questionnaires and submitted to sampling of workwear.

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