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Potential compromise of hospital hygiene by clinical waste carts

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Summary Bulk waste storage carts are common in hospitals and undoubtedly assist in the day-to-day management of clinical wastes. They are used for the transport and interim storage of primary clinical waste containers and are often located close to or within hospital buildings to receive such wastes from clinical departments. Examination of a random selection of bulk clinical waste carts at nine acute hospitals across Greater London revealed external soiling in all of 23 carts. Eight of 13 carts were also soiled on the inner surfaces, with evidence of bloodstains and free fluids in the base of five carts. *Staphylococcus aureus* and enterococci were recovered in low numbers from the lids ($N = 7$) and wheels ($N = 10$) of carts and *Escherichia coli*, *Enterobacter* spp. and *Pseudomonas aeruginosa* were recovered from the wheels of a further five carts. Two carts were heavily contaminated with *Aspergillus* spp. Pathogens originating from clinical wastes may be transferred from contaminated bulk waste carts to the wider hospital environment. It may be advisable to keep bulk carts outside clinical areas, and preferably outside all hospital buildings. This becomes particularly important in circumstances where carts supplied by contractors are not dedicated to a single hospital or National Health Service trust.

Introduction

The prompt and careful disposal of clinical wastes is an essential step in the reduction of risk associated with these wastes. A well-documented risk of infection exists; most serious is bloodborne virus infection associated with sharps injury, although other infections have been recorded including soft tissue and enteric infection.[1,2] Yellow bags are appropriate for soft clinical wastes, while more bulky or wet wastes and sharps are placed into rigid plastic bins. Primary waste containers, either bags or bins, are colour coded and clearly marked to identify their purpose and content. These containers

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must be located close to the point of use. This avoids the need for disposal at a remote location, which can be associated with an increased incidence of error and 'lost' wastes that increase the risk to ancillary and laundry workers.[3]

When not more than two-thirds full, primary waste containers are sealed and removed for onward disposal. In most establishments, secondary bulk waste carts are used to facilitate waste collection from clinical areas, and for the interim storage of wastes until removal by contractors for end-disposal. These four-wheeled bulk carts (Eurocarts), which should comply with the provisions of UN3291,[4,5] are now ubiquitous in hospitals. They facilitate the collection and internal transport of primary waste containers, intermediary storage and final transport of wastes for off-site processing. It is important that they are appropriately colour coded, indelibly labelled with a description of their content and a recognized biohazard warning, and reserved exclusively for clinical waste.[6]

Despite improvement in the standard of clinical waste disposal at ward level, relatively little attention has been directed to subsequent clinical waste management issues and the relationship to issues of safety and hospital hygiene. Effective infection control policies logically demand the prompt and careful disposal of wastes to an appropriate container, and the timely removal of those containers from clinical areas. Support staff and/or contractors generally transport clinical wastes to a central collection point using Eurocarts. These carts, used to receive wastes from wards and departments, are often located within or wheeled through hospital buildings. They commonly circulate between different clinical areas of a single hospital, and between different hospitals served by a single disposal contractor. The extent of contamination of bulk clinical waste carts and the implications to hospital hygiene have been evaluated.

Methods

Randomly selected yellow, heavy-duty, high-density polyethylene (HDPE) clinical waste carts (Eurocarts) of 1100-L capacity were sampled at nine acute hospitals across Greater London. Carts were examined for overall condition and security fittings, for evidence of soiling on internal and external surfaces, and for the presence of loose items, debris and free fluids within the cart.

Samples were obtained from each cart by swabbing the upper and outer front edge of the hinged lid and from the outer rim of one wheel. Probact™ viscose-tipped transport swabs were lightly moistened with sterile water and rubbed vigorously over the upper and outer surface of each cart lid. The sample area was at least 25 cm^2 on each side of the mid-point as these were considered to be the most likely contact points for hands. Similarly, one wheel of each cart was sampled by running the swab circumferentially around the accessible area of the outer wheel rim, avoiding contact of the swab with the floor or with the supporting wheel bracket and hub. Swabs were inoculated within 6 h of collection on to Columbia agar containing 5% horse blood (Oxoid PB0122A) and MacConkey agar (Oxoid PO0148A). Broth enrichment was not used. Plates were incubated in air at 35 °C and examined daily for up to three days. Isolates were identified using standard techniques, including the use of Staphytect Plus™ and relevant API galleries. Antibiotic susceptibility testing of potential pathogens was not performed.

Results

Twenty-three bulk clinical waste carts were sampled at nine acute hospitals. Seventeen of these carts were in use at the time of sampling, containing one or more filled clinical waste bags or sharps bins; three carts were overfilled and had clinical waste bags projecting from the gaping lids that could not be closed fully. The remaining six waste carts were empty. Carts were located in hospital corridors, lobbies or stairwells, and generally close to wards or clinical departments ($N = 11$), or in outdoor areas ($N = 12$) close to an exit door or fire exit, on a walkway or in an access road.

Only five of 23 clinical waste carts had lid locks and none of these were engaged. All 23 carts were visibly soiled, although no cart showed external evidence of bloodstaining. Internally, more extensive soiling was apparent on the walls of eight clinical waste carts (Table I), with heavy staining and what appeared to be dried blood spots smeared on to the inner wall of two of these carts. Free fluids were present in the base of five of the 13 carts that could be examined properly; in at least two instances, this amounted to several hundred millilitres of dark brown fluid. Two carts that were part-filled with wastes from a nearby microbiology laboratory were particularly badly soiled, and had at their base a thick film of foul smelling and viscous gel apparently resulting from leakage of previously autoclaved laboratory waste. Five of the carts that were in use at the time of examination held loose items of clinical waste, mostly disposable gloves, that were not contained within yellow clinical

Table I Visual inspection of 23 clinical waste carts

Visible soiling of clinical waste cart?	
External	23
Internal	8/13[a]
Loose items inside cart?	
Clinical waste items	5
Non-clinical waste items	4
Free fluids present inside cart?	5/13[a]

[a] In several cases, the presence of wastes in carts made inspection for internal soiling impractical.

waste bags or other approved containers. In four carts, additional waste had been deposited and mixed inappropriately with clinical waste including cardboard boxes and other packaging materials, a drinks can and several black (domestic) waste bags. Two carts showed signs that cigarettes had been stubbed out on the edge of the lid.

All samples had been obtained in dry weather. The wheels of two carts were not sampled as these were standing on a visibly wet floor surface. In all other cases, the wheels and adjacent floor area appeared dry at the time of sample collection. The results of bacteriological cultures are summarized in Table II. Aerobic spore-bearing bacilli were the most common isolates. These were recovered from both lids (15/23) and wheels (18/21) of carts, generally in large numbers. In contrast, coagulase-negative staphylococci, micrococci and diphtheroid bacilli, although common on swabs taken from 19 of 23 cart lids, were recovered less often, and in lesser numbers, from just five of 21 wheels.

Several potential pathogens were isolated from the external surfaces of clinical waste carts. *Staphylococcus aureus* and enterococci were recovered from cart lids ($N = 7$) and wheels ($N = 10$) in low numbers. Gram-negative species, in even lower numbers, were recovered from the wheels of five of 23 carts. *Escherichia coli*, *Enterobacter* spp. and *Pseudomonas aeruginosa* were recovered from a single cart standing on a paved surface immediately outside a pathology laboratory complex, with *P. aeruginosa* recovered from the wheels of a further three carts, two of which were located inside hospital buildings. *Aspergillus* spp. were recovered in large numbers from the lid surface and wheels of two clinical waste carts located side-by-side in an open paved area at the rear of a general ward block. It was not known for how long any cart had been in situ at the time of sampling, or of any prior storage location.

Discussion

Creating a complete and effective seal of clinical waste bags is not practical and these are normally tied loosely at the neck or closed with a plastic tie. Leakage is likely to occur when bags have been damaged by rough handling, are put into the bulk carts in an inverted position, or are compressed in overfilled carts. Once deposited, spilled fluids and other items from waste bags should be adequately contained within leakproof bulk containers that are compliant with EN3291. However, compliance is lost in circumstances where carts are not locked, and where carts are stored in locations allowing unauthorised and

Table II Predominant bacterial isolates from 23 bulk clinical waste carts

	Lids		Wheels	
	Cart located within hospital building ($N = 11$)	External location ($N = 12$)	Cart located within hospital building ($N = 10$)	External location ($N = 11$)
Coagulase-negative staphylococci	10	9	4	1
Diphtheroids	10	8	—	—
Aerobic spore-bearing bacilli	7	8	8	10
Enterococci	3	1	5	3
Pseudomonas aeruginosa	—	—	2	2
Staphylococcus aureus	2	2	1	3
Aspergillus spp.	—	2	—	2
Escherichia coli	—	—	—	1
Enterobacter spp.	—	—	—	1

inappropriate access that may additionally breach Health & Safety legislation.[6]

Although contract terms may vary, most waste disposal contractors provide lidded Eurocarts for the bulk carriage of clinical waste, regularly remove these for transport to a remote treatment facility and return fresh carts. Processing of carts generally includes a wash cycle and, although drained by inversion, carts may still be wet on return to use. Commercial sanitation procedures are unlikely to decontaminate soiled carts adequately due to the short process times and low water temperatures, although these do remove individual spilled items. Few cart washers operate at temperatures above 50 °C and many older units use recycled water. However, this limited hygiene service may be preferable to occasional in-house cleansing of carts that often involves little more than the use of a small pressure hose or similar cold water jet operated without containment in a hospital car park or other open space.

Maki *et al*. noted contamination with *S. aureus* and enteric Gram-negative bacilli on the outer surfaces of at least 10% of clinical waste bags, with little difference between single- and double-bagged waste.[7] Similarly, Neely *et al*.[8] recorded the contamination of re-useable primary clinical waste containers, with *S. aureus*, enteric Gram-negative bacilli and *P. aeruginosa* on the outer surface of up to 25% of containers. These data are in accordance with the results of the present study, in which contamination with a range of potential pathogenic species was apparent in approximately one-third of bulk waste carts examined. It gives some concern that *Aspergillus* spp. were recovered from the lids and wheels of two carts at one hospital, though fungal contamination of re-usable clinical waste containers is not unknown.[8] Pathogen survival on the surface of HDPE bulk clinical waste carts may be prolonged. Gram-positive and Gram-negative bacteria as well as a range of common fungal pathogens have been shown to survive for prolonged periods, in many instances in excess of 30 days, under dry conditions.[9–11] Survival is enhanced by the presence of proteinaceous residues and this may reflect the conditions found in many bulk waste containers.[12]

The origin of the potential pathogens identified on the external surfaces of waste carts cannot be determined, although it is probable that these originate from deposited clinical wastes. These small numbers of micro-organisms are unlikely to present any particular hazard to the health of ancillary staff or waste contractors, or to the environment in general. However, the possibility of transfer of these potential pathogens to the hands of healthcare or support staff indicates a need for effective contact precautions. Although aerobic spore-bearing bacilli were frequently isolated, invariably in high numbers, coagulase-negative staphylococci and diphtheroid bacilli on the lids of most clinical waste carts suggest the possibility of contamination following contact from non-gloved hands.[8] This may be in accordance with a recent observation of poor hand hygiene and inappropriate and ineffective glove use among ancillary staff responsible for ward hygiene.[13] Ideally, individual waste containers should be carried to the bulk carts by staff having appropriate work wear that includes a disposable apron and gloves, and these should be removed and properly disposed on completion of the task. Taking carts into the clinical areas of hospital buildings may represent an avoidable breach of infection control measures. It compromises standards of hospital hygiene when there is a possibility of transferring potential pathogens originating from wastes to the wider clinical environment. Transfer of pathogens to the hospital environment may be inevitable and prudent management would require that bulk carts be kept outside rather than inside critical clinical areas, and preferably outside all buildings. This becomes particularly important in circumstances where carts are not dedicated to a single hospital or National Health Service trust.

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