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A bacteriological survey of sanitary dressings, and development of an effective means for their disposal

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SUMMARY

A microbiological survey of over 400 sanitary dressings is reported: large numbers of bacteria are present, including species indicative of faecal contamination. The need for an effective bactericide in chemical bin exchange systems is thus demonstrated. Screening trials of several candidate formulations have been undertaken: buffered sodium metabisulphite, releasing sulphur dioxide as a vapour-phase bactericide, has now been introduced as an effective bin exchange system.

INTRODUCTION

During use sanitary dressings can be expected to become contaminated with bacteria. No previous studies have been carried out to determine the species and populations of bacteria present and hence no assessment of the likely health risks incurred during disposal has been made. In addition there has been no reported technical assessment of the various disposal methods available. The present work, therefore, reports a bacteriological survey of over 400 sanitary dressings together with an account of the development of a vapour-phase bactericide for use in chemical bin exchange systems.

BACTERIOLOGICAL SURVEY

Materials and Methods

Clean Rentokil chemical bins (called Sanitact Units) containing 1 litre (2·5 cm depth) of perfumed water instead of the usual bactericide were placed in female W.C. cubicles for 1–2 weeks in 50 premises (40 offices, 8 factories and 2 schools) in South-east England. A plastic mesh was supported 15 cm above the bottom of the units to prevent the dressings touching the water. Testing was carried out over 1 year, beginning in May 1977.

Dressings (towels and tampons) were removed from the units daily and classified according to observed degree of soiling as light, medium or heavy. In the laboratory each was placed in 250 ml of sterile water and macerated in a stomacher to ensure a homogeneous suspension. A sample of the suspension was streaked onto plates of blood agar, MacConkey agar, brilliant green agar and XLD agar. These were incubated at 37 °C for 24 h and the bacteria were then identified (Cowan & Steel, 1965; Cruickshank, 1968) and counted using a Colworth droplet counter (Sharp & Kilsby, 1971).

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Results

Over 400 sanitary dressings comprising 331 towels and 71 tampons were analysed and found to be normally contaminated with a large number of bacteria. Counts of 10^9 organisms per dressing were typical and counts as high as 10^{12} were recorded.

The degree of contamination of towels and tampons was similar, the number of counts over 10^8 being about 70 % for both. The observed degree of soiling of towels showed some relationship to bacterial counts: the frequency of counts between 10^{10} and 10^{11} bacteria for light, medium and heavy soiling was about 2 %, 11 % and 25 % respectively. No such relationship was evident for tampons.

Table 1. *Type and proportion of bacteria isolated from soiled sanitary dressings*

	Frequency of isolation (%)	
Organism isolated	Towels	Tampons
Escherichia coli	63·0	58·6
Streptococcus faecalis	33·9	28·6
Proteus spp.	13·0	21·4
Klebsiella aerogenes	19·5	1·4
Alkaligenes faecalis	2·7	1·4
Paracolon spp.	5·5	4·3
Micrococcus spp.	4·9	4·3
Staphylococcus albus	26·1	37·1
Others	12·4	2·9

The bacterial flora included several different species (Table 1). The frequency of occurrence of faecal contamination, indicated by the presence of *Escherichia coli* and *Streptococcus faecalis* (Mendes, Lynch & Stanley, 1978), was over 70 % for both towels and tampons. Most of the species of bacteria were found on both towels and tampons with the exception of *Klebsiella aerogenes* and *Alkaligenes faecalis*, which were rarely isolated from tampons.

Discussion

The results clearly show that sanitary dressings are grossly contaminated with bacteria. The presence of faecal organisms raises the possibility that women suffering from bacterial disorders of the digestive system (e.g. food poisoning or dysentery) could transfer pathogens onto the dressings. The presence of *Proteus* spp. or *Staphylococcus aureus* is also obviously undesirable.

DEVELOPMENT OF A VAPOUR-PHASE BACTERICIDE

Various methods exist for the disposal of sanitary dressings (Dickinson & Lynch, 1974); flushing down a W.C. is not a satisfactory method since it frequently leads to blockages. Mechanical methods such as incinerators and macerators might appear effective in principle, but in practice they are prone to failure and can cause embarrassment by their location outside the W.C. cubicle, and their noisy

and frequently odorous operation. The chemical-bin exchange system, whereby plastic containers holding a disinfectant fluid are placed within the W.C. cubicles and regularly changed, now offers an attractive alternative. It is essential, however, that all the dressings deposited in the bins are rendered sterile, and remain so until the bin is replaced with a fresh one. This is necessary to eliminate completely any health risk to users and service operators and to minimize problems caused by malodour.

A bactericide for use in chemical exchange bins must satisfy many additional requirements. It must:

(1) operate in the vapour phase with a relatively small amount of fluid in the unit;

(2) release bactericidal vapour at a controlled rate for several weeks;

(3) not harm humans under conditions of use;

(4) not be combustible as either liquid or vapour (lighted matches and cigarettes may be placed in the unit);

(5) be either odourless or capable of being masked by a perfume;

(6) be heavier than air in the vapour phase so that it will remain in the bin when the lid is open.

When research began in 1973 to find a suitable vapour phase bactericide the best sanitary-bin fluids then in use were little more than highly perfurmed pine-oil disinfectants, the worst were merely perfumed water. Neither had any effect on sanitary dressings above the liquid level; the latter had no effect at any level. Our work aimed to produce a bactericide meeting all the criteria listed above.

MATERIALS AND METHODS

Our methods for testing sanitary fluids have improved over the 6 years studies have been in progress. In early field trials, soiled dressings were taken for analysis from the top, middle, near bottom and bottom of a chemical exchange bin after 1 month in service. Laboratory trials involved attaching to the inside of the bin agar plates streaked with *Staphylococcus albus* and *Staphylococcus aureus*. The agar plates have now been replaced by three cotton-wool swabs seeded with known numbers of *Escherichia coli*, *Streptococcus faecalis* and *Staphylococcus aureus* suspended 20 cm below the top edge of a disposal unit containing the correct quantity of disinfecting fluid. A more rigorous test is the placing of medium and heavily-soiled sanitary towels in this position. The standard field test is made on soiled sanitary towels taken from bins in use when they have become half full. In all instances the test samples are exposed for 24 h and are subsequently examined for bacteria in a similar manner to that described in the previous experimental section.

RESULTS

The formulations tested are shown in Table 2. The laboratory test using seeded agar plates enabled side-effects to be recognized and assessed. Those formulations with serious problems were not tested further but the more promising compounds underwent further testing. Only one formulation, an aqueous solution of buffered

sodium metabisulphite, releasing sulphur dioxide as a vapour phase bactericide, proved entirely suitable and was introduced into service by Rentokil Hygiene Division in 1974 (British Patent 1 531 722; also patented in New Zealand, South Africa and the United States; patents pending in Australia, Belgium, Holland and Denmark).

Thus the present formulation releases sulphur dioxide at a controlled rate to maintain a concentration in the bin of 75–150 parts/10^6 over a period of 8 weeks. At this concentration of gas all bacteria in sanitary dressings throughout the bin, irrespective of how full it may be, are killed in less than 24 h. The concentrate is in powdered form mixed with a small amount of perfume. This product, called Sanitact Powder, is packed in unit dose, water-soluble polyvinylalcohol sachets to facilitate the charging operation and to minimize handling. When dropped into cold water in a Sanitact unit, the sachet dissolves in minutes releasing the Sanitact powder into solution.

Finding a suitable perfume proved a problem at first as it had to last for over 8 weeks, yet not be present in such quantities as to inhibit the vapour activity. Ultimately, a water-insoluble 'floral' type perfume that floated on the surface of the sterilizing fluid was decided upon. It was found that this was not so readily absorbed onto the cellulose material of the dressings as were soluble types and hence was more effective.

With the chemical-bin disposal system, safety is of prime importance and this was taken into consideration in the development work. The oral toxicity of the Sanitact formulation in both powder concentrate and liquid form is low. The acute oral LD 50 to both rats and mice is 5270 mg/kg. Assuming a similar toxicity to humans a 70 kg adult would need to consume 400 g of powder or over 5 l of fluid for a 50 % chance of death. Since sulphur dioxide is two and a half times heavier than air the gas will tend to remain in the bin even when the lid is opened. The likelihood of sufficient gas escaping to cause irritation is exceedingly small, while poisoning is impossible.

The liquid formulation and gas are non-combustible and the design of the bin is such as to smother quickly an internal fire.

CONCLUSIONS

The presence of large numbers of bacteria on sanitary dressings and hence the need for an effective means of disposal has been clearly demonstrated. Of the various disposal methods available the chemical-bin exchange system is undoubtably the most trouble-free. The present paper has shown that it is also capable of meeting the high standards of hygiene required in present-day society. After 5 years' commercial use sulphur dioxide released from sodium metabisulphite, as a vapour-phase bactericide, has proved to be completely reliable, with a performance that none of the other formulations examined could equal.

Table 2. *Testing and assessment of a number of possible vapour-phase bactericides*

Candidate compound	Initial screening: Seed agar plates attached to inside of bin (1 week)	Initial screening: Side effects	Initial field test (1 month)	Subsequent testing
Conventional sanitary disposal fluid (alcohol/phenol)	No effect			
Methylene salicate	No effect			
Methylene chloride	Active	Odour too strong		
Ammonium solution	Active	Odour too strong		
Iodine solution	Active	Extreme staining of bin		
Formaldehyde solution	Active	Odourous, irritant less dense than air		
Methylene bis-thiocyanate	Active	No serious side effects	No effect	
Chlorine solution	Active	Corrosion of steel lid	No effect	
Sodium dithionite	Active	No serious side effects	Active	Difficulty in obtaining controlled release
Buffered sodium metabisulphite	Active	No serious side effects	Active	Extensive field&lab tests → Introduced into service

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