date of admission. A telephone call to establish this is much quicker and easier than performing full processing of faeces.

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Are contaminated flush solutions an overlooked source for catheter-related sepsis?

Sir,

Microbial contamination of intravenous fluids used in patient management is an infrequent but important source of bacteraemia.[1,2] In the recent study by Calop *et al.*, the microbial contamination of 0.9% sodium chloride in disposable syringes manually filled by nursing staff, for the maintenance of peripheral and central venous catheters, was investigated.[3] Eight percent of the saline infusions were contaminated with micro-organisms, which was similar to the findings of Trautmann *et al.*, where 7.8% of intravenous fluids were contaminated.[4]

We undertook a similar study of the microbial contamination of saline following withdrawal from single-use ampoules into sterile disposable syringes by nursing staff. One hundred nurses (grades D–H) who work on the intensive care, oncology or dialysis units or surgical wards were asked to prepare a solution for injection as per standard practice using a sterile disposable syringe and needle, and a single-use ampoule containing 0.9% sterile saline. The components of each syringe (tips, needle attachments and transportation caps) and the saline contents were subsequently examined for the presence of micro-organisms by standard microbiological methods. We demonstrated that eight (8%) out of 100 infusates were contaminated with micro-organisms. Of these, two were associated with contaminated syringe tips and needles. A further four (4%) of the syringe tips and transportation caps and three (3%) of the needles yielded positive cultures, but the infusates were sterile. The only micro-organisms recovered from contaminated infusates and syringe components were coagulase negative staphylococci. The results of this preliminary study highlighted the potential source for microbial contamination of saline solutions associated with syringes which are manually filled. In addition, the contaminated syringe tips and saline infusions may lead to the subsequent contamination of central venous catheter stopcocks and hubs to which the syringes are attached. Indeed, in a previous study by Tebbs *et al.*,[5] we demonstrated that the microbial contamination rate of stopcock entry ports and arterial line hubs after 72 h in situ was 22 and 31%, respectively. This high rate of luer contamination may partly reflect the problem we have highlighted with the preparation of sterile solutions.

In a subsequent study, the microbial contamination of disposable syringes prefilled with 0.9% sterile saline was compared with the conventional syringe and ampoule following manipulation by nursing staff. The syringes included in the study were: (a) externally and internally sterile syringe prefilled with 10 ml of 0.9% sterile saline (Becton Dickinson, France); (b) externally non-sterile, internally sterile syringe prefilled with 10 ml of 0.9% sterile saline (Becton Dickinson, France); (c) externally non-sterile, internally sterile syringe prefilled with 10 ml of 0.9% sterile saline (prepared by the Pharmacy Sterile Fluids Department, University Hospital Birmingham, UK); and (d) sterile disposable syringe and single-use plastic ampoules containing 10 ml of 0.9% sterile saline.

A further 100 nurses participated in this part of the study and were asked to prepare flush solutions as if for administration through a central venous catheter stopcock. The details of the investigation were not disclosed to nursing staff prior to or during the study. The majority of nurses in the study were grades D and E (21 and 52%, respectively), and worked on the intensive care units (general, cardiac and liver) and surgical wards (thoracic). The method of aseptic technique adopted when

Table I *Microbial contamination rate and manipulation time of either syringes prefilled with 0.9% sterile saline or manually filled from single-use ampoules containing 0.9% sterile saline*

Syringe system	Contaminated syringe components (tips, barrel, plunger rod) (%)	Mean bacterial count (CFU) (range)	Contaminated saline infusates (%)	Mean manipulation time (sec)
A ($N=100$)	32	4 (1–13)	0	13
B ($N=100$)	29	4 (1–9)	0	15
C ($N=100$)	26	4 (1–24)	0	11
D ($N=100$)	48	11 (1–200)	2	48
E ($N=100$)	ND	ND	8	ND

A, externally and internally sterile syringe prefilled with 10 ml of 0.9% sterile saline (Becton Dickinson, France); B, externally non-sterile, internally sterile syringe prefilled with 10 ml of 0.9% sterile saline (Becton Dickinson, France); C, externally non-sterile, internally sterile syringe prefilled with 10 ml of 0.9% sterile saline (Pharmacy Sterile Services Department, University Hospital NHS Trust, Birmingham, UK); D, disposable syringe manually filled from an ampoule containing 10 ml of 0.9% sterile saline; E, disposable syringe manually filled from an ampoule containing 10 ml of 0.9% sterile saline. ND, not done.

preparing the flush solutions varied widely. Forty-four percent did not use any method of aseptic technique prior to, or when manipulating the syringes, whilst 33% wore gloves and 23% cleansed hands with either 70% (v/v) industrial methylated spirit or 4% (w/v) chlorhexidine gluconate. Furthermore, none of the nurses disinfected the external surface of the saline solution ampoules prior to opening and withdrawing the contents with the disposable syringe. The microbial contamination of the components of the syringes (barrel, plunger rod and tip cap region) and the saline contents, together with the corresponding manipulation times, are shown in Table I.

Micro-organisms were not recovered from the saline contents of any prefilled syringe, whereas 2% of the saline solutions from syringes manually filled from ampoules yielded coagulase-negative staphylococci. There was also a significant reduction in the time taken to prepare the prefilled syringes compared with the conventional syringe system ($P < 0.0001$). The increased microbial counts detected on the components of the syringes manually filled from ampoules, may reflect the extended manipulation time required to prepare the saline flush and may indeed be a predisposing factor for subsequent infusion contamination. Furthermore, the wearing of non-sterile gloves taken from open boxes on the ward did not significantly reduce the microbial contamination rate on the external surface of the syringe systems ($P = 0.82$).

We conclude, therefore, that the risk factors associated with the microbial contamination of manually filled syringes include the amount of manipulation required, the lack of standardized aseptic procedure when preparing the flush solutions and the failure to disinfect the external surface of the saline ampoules prior to opening. The wide variation in the method of aseptic technique adopted by staff, despite the availability of defined hospital policies and procedures on fluid for injection preparation, highlights the need to reinforce a standardized procedure for preparing flush solutions. The incorporation of prefilled syringes and individually packaged sterile disposable gloves into clinical practice may therefore not only aid in reducing the microbial contamination of intravenous infusions and the significant costs of bacteraemia associated with central venous catheters,[6] but also facilitate the adoption of protocols for the flushing of indwelling intravascular devices.

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Endoscope washers – a protocol for their use

Sir,

Despite the statement of Marchetti *et al*. in their recent paper, for a growing number of endoscopy units in the UK and Ireland, 2% glutaraldehyde is not the disinfectant of choice for use in Automated Endoscope Reprocessors.[1]

The use of glutaraldehyde has severe restrictions imposed by the UK Health & Safety Executive to protect staff from its long-term toxic effects. COSHH regulations state that the employer's first course of action is to remove a hazardous chemical that may come into contact with an employee and replace it with a suitable non-hazardous alternative. Should there be no available alternative, then means of containment and monitoring of the hazardous substance must be instituted. The cost and inconvenience of containing and monitoring of glutaraldehyde below the Minimum Exposure Limit (MEL) of 0.05 ppm in the atmosphere is substantial. There are, in fact, disinfectants available, some of which have properties of efficacy, user safety, materials compatibility and cost effectiveness sufficient to be considered as the 'disinfectant of choice'.

At Antec International, much consideration was given to the requirements for an alternative to glutaraldehyde and with much experience in the field of cold liquid disinfection a formulation based on peracetic acid is now available commercially having been introduced in late 1998. The proprietary brand name is PeraSafe. There are several other commercially available alternatives to glutaraldehyde, ranging from superoxidised water to chlorine dioxide and including various forms of peracetic acid base formulations.

PeraSafe addresses the issue of efficacy as a priority, peracetic acid being well-known to have excellent biocidal properties. Proven to have rapid sporicidal and tuberculocidal properties, a standard contact time of 10 min is recommended to reduce colony forming units by a factor of $>10^5$. The principal criterion required of the 'disinfectant of choice' is that it is rapidly effective. The contact time quoted for 2% glutaraldehyde in Marchetti *et al*.'s paper, however, is 20 min.

The peracetic acid chemistry employed by PeraSafe is a proprietory formulation at pH 8.0 which, with a starting concentration of 0.26%, does not have the irritant properties and noxious fumes associated with commercially available peracetic acids which are of higher concentration and lower pH. Corrosion inhibitors also present in the PeraSafe formulation minimise oxidation of metals, making it compatible with flexible endoscopes and endoscope disinfection systems. It is supplied in a non-active powder form, requiring activation by dissolution in tap water. This enables transportation and storage in a safe condition and therefore hazardous spillage is not an issue. Furthermore the decomposition of peracetic acid to hydrogen peroxide and acetic acid and ultimately to water, allows disposal into normal drainage channels, without fear of environmental damage, a significant advantage over glutaraldehyde.

The issue of cost may appear to be a weakness of glutaraldehyde alternatives, in that most have less stability and higher actual unit costs. Glutaraldehyde is well-known to fix proteins and these must be removed during the pre-cleaning and disinfection process. The cost in labour and materials of enzymatic pre-cleaning of endoscopes, unnecessary with PeraSafe, must be accounted for when assessing true costs of glutaraldehyde use. The hidden costs of containing, monitoring and disposal of glutaraldehyde, together with costs associated with staff health and potential compensation make the direct costs of alternative disinfectants cheap when considered on a holistic basis.

Having presented the case for PeraSafe as a very attractive alternative to glutaraldehyde, we can say, however, that there is no perfect alternative to the need for a cold liquid disinfectant/sterilant for endoscope washers. We would, however, submit that there is indeed a significantly better alternative to glutaraldehyde from both the user's perspective, being safer, and from the patients' perspective, being more effective more quickly. These benefits alone make glutaraldehyde undesirable and even the perceived benefits of its non-corrosive properties