Can pre-operative skin marking transfer methicillin-resistant Staphylococcus aureus between patients?

A LABORATORY EXPERIMENT

J. Wilson, D. Tate

From the Freeman Hospital, Newcastle Upon Tyne, England

National guidelines state that in patients undergoing operations the site of the procedure should be marked. In clinical practice the same marker is used repeatedly. We are not aware of any investigation regarding the theoretical risk of transferring organisms such as methicillin-resistant Staphylococcus aureus (MRSA) between patients by a skin marker.

In an experimental setting, Penflex and Viomedex skin markers were tested 30 times each after contaminating them with a standard inoculum of MRSA. The survival of the organism on the tip of the markers was assessed by culture on MRSA-indicator nutrient agar plates at 0, 5, 15 and 60 minutes, 24 and 48 hours and at 1, 2, and 3 weeks after contamination.

There was a significant difference between the markers, with the Penflex showing no survival of MRSA after 15 minutes whereas the Viomedex product continued to produce MRSA cultures for up to three weeks.

The National Patient Safety Agency has issued recommendations promoting a standardised approach to pre-operative marking. These include using an indelible marker to draw an arrow at or near the site of the planned incision.

Commonly, in clinical practice, one skin marker pen is used on several patients. Theoretically, micro-organisms colonising the skin of a patient could contaminate the fibre tip of the marker pen, survive in the moist environment and be transferred to the next patient to be marked. The risk of surgical wound infection is greater if an organism of high virulence, or resistance to standard antibiotic prophylaxis, such as methicillin-resistant Staphylococcus aureus (MRSA), is passed from a carrier to a non-carrier.

Surveillance studies of hospital admissions have shown that between 1.5% and 7.3% of patients carry MRSA. This figure is higher in the elderly, those recently hospitalised and those transferred from other institutions. Therefore, during the routine pre-operative care of emergency and elective admissions, patients with undisclosed colonisation with MRSA may be encountered, potentially contaminating the pen.

To mark the site of operation prior to surgery, our hospital uses a commercially-available Penflex marker pen (Penflex, Cape Town, South Africa). However, another hospital in our region now provides each patient with their own Viomedex marker pen (VIO Healthcare Ltd, Uckfield, United Kingdom) on admission. Our aim was to test if these markers could act as a route of MRSA transmission in an experimental setting.

Materials and Methods

Four bacteriological plates with MRSA equally distributed on them were prepared on Iso-Sensitest agar (ISTA, Oxoid Ltd, Basingstoke, United Kingdom); two with 0.5 MacFarland standard dilution and two with this diluted tenfold. A 0.5 dilution represents a heavy growth with visible colonies. A tenfold dilution was used to mimic more closely a concentration that might be found on the skin of a patient. We obtained 31 Viomedex pens in their separate sterile packaging and 30 Penflex pens which had not been used but were not packaged in sterile conditions. A single line was drawn with each pen across the diameter of the MRSA culture plate to create a standardised contamination inoculum on each pen, which was then used to draw one arrow on a blood agar plate at intervals of 0, 5, 15 and 60 minutes, 24 and 48 hours and 1, 2, and 3 weeks after inoculation. Each pen was thus used eight times. Plates were sectioned into quarters, two plates per pen were used, with 122 plates used in total. The culture plates were then incubated at 37°C in air and read at 24
hours. Growth on the blood-agar plate which showed the characteristic colonial appearance and typical growth characteristics was assumed to be MRSA. *Staphylococcus aureus* has a characteristic colonial appearance and speed of growth. None of the plates showed any evidence of contamination with another organism. Given that half the pens were sterile before the inoculation, it is a reasonable assumption and in line with normal laboratory procedure to conclude that the growth on the plates represents the bacteria used to inoculate the pens.

The pens waiting to be used to inoculate the culture plates were left at room temperature on the desk of the researchers during the experiment to attempt to mimic normal clinical use.

**Statistical analysis.** This was performed using a significance test for two proportions. A p value of < 0.05 was considered significant.

**Results**

Figure 1 illustrates the combined survival percentage for each marker pen. None of the contaminated Penflex pens produced any growth of MRSA on the culture medium after the 15 minute inoculum. By contrast, at one week all the contaminated Viomedex pens still grew MRSA (Fig. 1). The difference at five minutes was not significant (p > 0.25) but was at 15 minutes (p < 0.0005). A plate was considered to be positive if even one colony-forming unit was visible.

**Discussion**

The results show that in this *in vitro* setting with rates of inoculation much higher than would be encountered clinically, MRSA does not survive on the Penflex marker beyond 15 minutes. However, it can survive on the Viomedex pen for up to three weeks, even at a one in ten dilution. This might be due to the type of solvent used in the pens. Penflex uses isopropyl alcohol and ethanol, whereas Viomedex contains diethylene glycol, urea, surfactant, dyes and preservatives, but has water as its main solvent.

The design of the pens also differs slightly with the Penflex marker having a broader tip than the Viomedex pen. The anticipated effect of this would be that the broader tip would collect a greater inoculation from the MRSA plate which might promote the survival of MRSA on the Penflex marker. The observed result was the opposite, thereby excluding this as a confounding factor.

Our *in vitro* study differs from the clinical situation in a number of aspects. First, the concentration of MRSA used to inoculate the pens was higher than would normally be encountered. Secondly, small amounts of nutrient agar may have been transferred to the pens during the marking, which would tend to promote survival of the organisms. Finally, this study takes no account of the antiseptic skin preparation immediately preceding draping of the patient in the operating theatre.

The repeated use of an alcohol-solvent based marker, such as the Penflex did not harbour viable MRSA beyond 15 minutes in an *in vitro* setting. The Viomedex pens should be reserved for single use on one patient only.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

**References**


