The risk of cross-infection when marking surgical patients prior to surgery – review of two types of marking pens

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ABSTRACT

INTRODUCTION Two types of marker pens were compared to find whether they produced different risks of infection transmission over different time intervals.

PATIENTS AND METHODS Twenty-four patients were marked according to the type of surgery: each had a set of new dry white-board marker (DWM) and a permanent marker (PM) pen. Once used, their tips were used to inoculate blood agar plates at different time intervals.

RESULTS At 0 min, 96% of the DWM pens and 29% of the PM pens were positive for growth. At 3 and 10 min, all of the DWM pens remained positive. The rate dropped to 16.67% in 3 min down to none at 10 min for the PM pens.

CONCLUSIONS DWM pens carry a significant risk of transmitting infection between patients. It is recommended that they are not used in marking. PM pens should not be used between patients in less than a 10-min interval.

KEYWORDS

Infection – Transmission – Marker pens

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Hospital-acquired or nosocomial infection has become the centre of debate in both the medical and public forums. It has been claimed that one-third of all nosocomial infections can be prevented.¹ Attempts have been made to minimise the spread of pathogenic micro-organisms between patients including the emphasis on barrier nursing and good standards. There were concerns that communal equipment could potentially cause a problem with the transmission of pathogens.^{2,3} Equipment including stethoscopes² and pens have been identified as vectors of harmful organisms. In surgery, side marking is an essential safety precaution to prevent confusion of staff in operating theatres. The National Patient Safety Agency and The Royal College of Surgeons of England strongly recommend that the surgeon pre-operatively marks and initials the surgical site with an indelible marker that must still be visible when the patient is draped,⁴ but this did not specify the type of marker pen to be used. Markers are also used directly over lesions, *i.e.* thyroid, breast, axilla, lipoma, *etc.*; in the Day Care Unit setting, the operating surgeon may well go round 'pen in hand' marking up a series of lesions before commencing a day-care/minor operation list.

Marker pens were found to carry the risk of transmitting MRSA infection in a previous study.⁵

The aim of this study was to assess the potential of two types of marker pens with different alcohol concentrations in carrying skin organisms. We also assessed the potential for transmission of skin organisms and potential pathogens between patients through the use of these marking pens and determined the minimum time required between uses to decrease the risk of infection.⁵

Patients and Methods

Previous studies have reported a 90% or more positivity rate of micro-organism growth when different types of medical equipment were inoculated.⁶ A previous study described a reduction in culture positivity after a given time period at about 40%.⁵ Hence, to detect a significant difference of positivity of 90% at 0 min to 43% after any waiting time, a sample size of 12 inoculations is required to achieve a power of 90% and alpha of 0.01. In our study, we chose two types of marker pens easily available on the ward – the dry white-board marker (DWM) pen with alcohol concentration of 75.5% (Steadtler Lumcolor Whiteboard marker) and the permanent marker (PM) pen with alcohol concentration of 60% (Penflex permanent markers). We

Table 1 Culture results at 0 min in both groups

	0 minutes		Total	Positive rate
	Positive	Negative		
DWM	23	1	24	96%
PM	7	17	24	29%
Total	30	18	48	

DWM, dry white-board marker pen; PM, permanent marker pen.
Chi square value, 22.75555556; *P*-value, 1.840E-06.

analysed the effect of time on culture positivity at two time intervals (1–3 min and 10 min), selected on the basis of previous literature⁴ and clinical practice in our unit.

Between October 2004 and December 2004, 24 consecutive orthopaedic and trauma admissions in a district general hospital were included in a prospective study. Patients undergoing elective surgery, for example total knee/hip replacements or emergency admissions for example wound debridement, cellulitic limbs and dynamic hip screw fixations of fractured neck of femurs, *etc.*, were included.

The patients were divided into two groups of 12 patients. The first group of patients (Group A) had their marker tips inoculated at 0 and 3 min after marking whereas the second group (Group B) had their tips inoculated at 0 and 10 min.

Each patient had a set of two new marker pens, DWM pen and PM pen, allocated. The site of surgery was marked conventionally with a DWM pen and a PM pen. Once the pen had been used, one side of the tip was immediately used to inoculate blood agar plates (Oxoid) and the other side was inoculated after the specified time interval. Every marker was sealed and stored separately after which it was inoculated again in blood agars after 24 h then discarded safely. Four patients with MRSA-positive ulcers with associated cellulitis were included and had the cellulitis margins marked.

As control, 24 new DWM pens and 24 new PM pens were also inoculated without being used on patients as markers.

The agar plates were incubated aerobically at 37°C for 48 h and read by a qualified microbiology biomedical scientist. Growth after 48-h incubation was recorded, as were the type and number of colonies. Markers used in MRSA-positive patients were sealed and stored in a closed box for 24 h and then re-inoculated after 24 h. Statistical analysis was conducted using the chi-square test and the Yates correction.

Results

All control marker pens were negative on inoculation.

At 0 min in group A and group B, 23 out of 24 (96%) marker pens were positive of growth in the DWM pens

Table 2 Group A culture results at 3 min

	3 minutes		Total	Positive rate
	Positive	Negative		
DWM	12	0	12	100%
PM	2	10	12	17%
Total	14	10	24	

DWM, dry white-board marker pen; PM, permanent marker pen.
Chi square value, 8.571428571; *P*-value, 0.003414791.

Table 3 Group B culture result at 10 min

	10 minutes		Total	Positive rate
	Positive	Negative		
DWM	12	0	12	100%
PM	0	12	12	0%
Total	12	12	24	

DWM, dry white-board marker pen; PM, permanent marker pen.
Chi square value, 12; *P*-value, 0.000532006.

while 7 out of 24 (29%) were positive in the PM pens ($P = 0.00001$; Table 1).

In group A at 3 min, all 12 (100%) DWM pens remained positive compared with only 2 (16.67%) out of the permanent markers ($P = 0.003$; Table 2).

In group B at 10 min, 12 (100%) out of 12 DWM pens were still positive compared with none (0%) of the PM ($P = 0.0005$; Table 3).

After 24 h, all permanent markers were negative but one white-board marker grew one colony of coagulase-negative *Staphylococcus* spp.

The type of colonies detected were coagulase-negative *Staphylococcus* spp. in the majority of plates while ulcer sites grew coagulase-positive *Staphylococcus* spp. classified as MRSA positive.

All 8 marker pens used on the four MRSA-positive ulcer patients were positive at 0 min, one PM pen was positive at 3 min, and one of the DWM pens remained positive with heavy colonisation at 3 min and 10 min.

Discussion

Of hospital in-patients, 9% are believed to acquire an infection after their admission to hospital.⁷ Headlines, including such emotive words as killer bugs and 'super bugs', have raised anxiety in the general population which

Figure 1 Percentage of positive cultures for both marker pens as a function of time.

has, in turn, resulted in a significance loss of faith in the quality of care provided in hospitals. In addition, nosocomial infections have a high potential for significant morbidity and disability. This is particularly true of orthopaedic infections.

In our study, we found out that immediately after marking patients, 96% of DWM pens were positive for growth of micro-organism while PM pens showed 29% growth. As time passed, the number of PM pens growing organisms reduced to 17% at 3 min down to zero at 10 min where as 100% of the DWM pens remained positive of growth at 3 and 10 min.

The MRSA-positive sites remained positive for MRSA in all type of pens at all intervals up to 3 min and remained positive at 10 min in the DWM pens. This might raise the question of whether MRSA has some resistance to alcohol and this suggests a field for further investigation.

In this study, we noticed that dry white-board markers carry a significant risk of transmitting infection from one patient to another, especially if they are used to mark infected skin and subsequently used to mark another patient within 10 min. Permanent marker pens may also transmit infection if used immediately on a second patient. As time passes, the risk of infection decreases significantly in PM pens as the concentration of infection is reduced by time whereas is remains high in DWM pens (Fig. 1). Although the concentration of alcohol in the DWM pens is higher than that of the PM pens, this did not affect the high rate of positive culture growth in DWM pens.

Even though there is no direct evidence that the presence of micro-organism on the marking pen directly results in infection of patients, the findings of this study are important and significant.

Conclusions

It is suggested that permanent markers should not be used between patients at an interval of less than 10 min and that the use of dry white-board markers for marking patients should be abandoned. In case of high-risk patients, *e.g.* those with MRSA, marking should be with disposable marker pen, which should be immediately discarded. This study demonstrates a potential source of transmission of infection in a hospital environment; however, the clinical implication of this is not demonstrated.

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