

# Cross-infection risk of felt-tipped marker pens in cataract surgery

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## Abstract

**Purpose** To assess the potential of bacterial transmission using felt-tipped marker pens on forehead skin before cataract surgery.

**Methods** A total of 64 marker pens taken from clinical stock were tested. Forty-eight new pens were cultured in the laboratory. They were first left to desiccate for 0, 4, and 16 h, then dipped into solutions of 0.5 Macfarlane's concentration of coagulase negative staphylococci (CNS), methicillin-resistant *Staphylococcus aureus* (MRSA) and coliforms, and transferred onto the culture medium after 5, 10, 30, and 120 min intervals of exposure to air. A further 16 pens were collected after routine clinical use for 5 working days and cultured.

**Results** Positive cultures were observed in 100% of pens at 0 min, and 44.4% at 5 min after the organism was exposed to air. *Escherichia coli* showed least transmissibility with no growth in all plates after 5 min of exposure. Only MRSA showed heavy growth after 10 min of exposure. No pattern emerged with reference to the length of time; each pen was left to desiccate. No growth was observed in the cultures of all 16 marking pens after clinical use.

**Conclusions** The potential for transmission of bacteria through felt-tipped marker pens has not been explored in cataract surgery. This study demonstrated that a theoretical risk of transmission exists in a laboratory setting, and survival times of the bacteria decreased with time. This suggests that the interval in which patients are marked with the same pen may play a role in bacterial transmission.

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## Introduction

Wrong-site surgery has been a popular topic of discussion in the mainstream press in the past decade. Although its occurrence is relatively rare, the consequences can be disastrous. As wrong-site surgery is an error that is entirely preventable, and several organizations and governing bodies have advocated marking of the surgical site.<sup>1–4</sup> This has been used routinely in many ophthalmic units performing a high volume of cataract surgery to reduce the unnecessary risk of wrong-site operations.

Felt-tipped marker pens are used to mark a serial number of patients before surgery, often within a short space of time. The potential for bacterial transmission through felt-tipped marking pens used in surgical site marking on forehead skin before cataract surgery has not been explored.

Nosocomial infections have been a major concern and are associated with important consequences. Putative sources of hospital infections have been investigated intensively over the recent years. Doctor's writing tools,<sup>2</sup> stethoscopes,<sup>3</sup> and inefficient handwashing procedures,<sup>4</sup> have all been shown to be sources of infection transmission.

In this study, we assess the potential of surgical site marker pens as a source of nosocomial infection, and address the following questions: (1) the transmissibility of different types of bacteria, (2) survival times of bacteria on marker pen tips after exposure to air, and (3) transmission risks with fresh *vs* desiccated pens.

## Materials and methods

We conducted this study in two phases; the first with new pens and second with pens in routine clinical use. A total of 64 marker pens taken from clinical stock were tested.

In the first phase, 48 brand new felt-tipped marker pens (Dry Wipe, Banner) were divided

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into three groups of 10, and left to desiccate for 0, 4, and 16 h to emulate new and older dried-out pens (Figure 1). Three pens, one from each group, was used as controls and cultured after being dipped in distilled water. The three groups of marker pens were further divided to test three different organisms: *coagulase negative staphylococci* (CNS) ( $n = 15$ ), *methicillin-resistant Staphylococcus aureus* (MRSA) ( $n = 15$ ), and *coliforms* (*Escherichia Coli*) ( $n = 15$ ). Marker tips were dipped into solutions of 0.5% Macfarlane's concentration for each test organism and transferred onto the culture medium. In all subgroups ( $n = 5$ ) (Figure 1), each pen tip was exposed to air for either, 0, 5, 10, 30, or 120 min before plating.

In the second phase, a total of 16 pens were collected after each pen was used for 5 working days; 10 full operating lists; with each pen marking 10–16 patients per day. Pen tips were plated under standard conditions for 48 h.

Culture medium and incubation used for both phases were, Columbia blood agar in carbon dioxide at 37°C, and CLED in air at 37°C.

## Results

### Phase 1

#### Transmission risks with different types of bacteria

*E. coli* showed least transmissibility with no growth in all plates after 5 min of exposure. CNS showed minimal growth (+) in all pens after 5 min, and scanty growth after 10 min of exposure (Figure 2). MRSA showed the highest level of transmissibility with heavy growth (++++) in 33.3% of pens at 5 min and heavy growth after 10 min of exposure (Figure 2), as the only bacteria that showed any growth at 10 min.

#### Survival times of bacteria on marker pen tips after exposure to air

Positive cultures were observed in 100, 44.4, and 33.3% of pens at 0, 5, and 10 min after the organism was exposed to air. There was no growth on any plates after 30 min of exposure (Figure 2).

#### Fresh vs desiccated pens

No pattern emerged with reference to the length of time; each pen was left to desiccate (Figures 2 and 3).

#### Control pens

There was no growth from control pens (Figure 1).

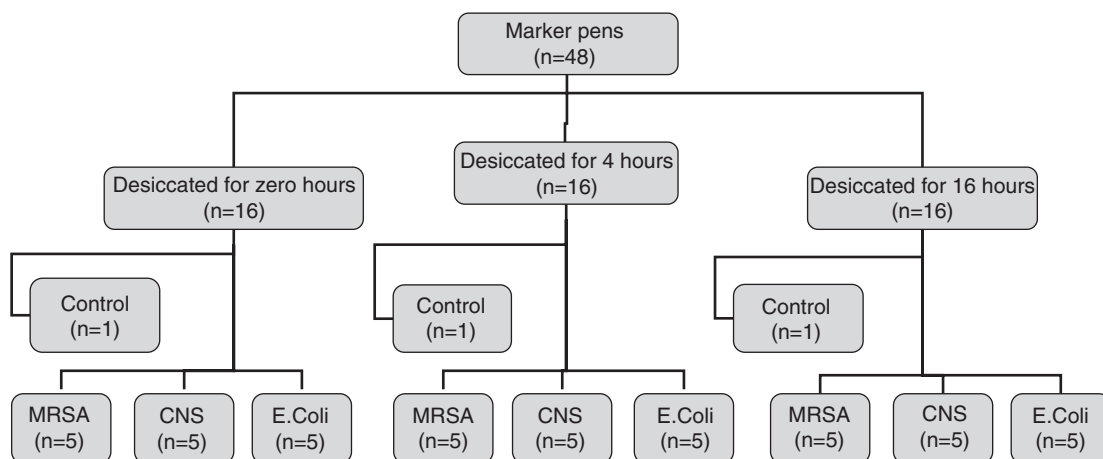
### Phase 2

There was no growth in the cultures of all 16 marker pens after routine clinical use for 5 working days.

## Discussion

Numerous studies have explored the potential risk of skin bacteria among patients with the use of a marker pen.<sup>5–10</sup> Results from these studies are conflicting, with both subject (type of pen) and methodology varying widely among studies. However, among these studies, alcohol-impregnated pens seems to be less likely to transmit bacteria than older, dried-out pens.<sup>5,6</sup> A few studies failed to demonstrate any transmission,<sup>7,8</sup> and no study has cultured bacteria from pens collected in clinical areas.

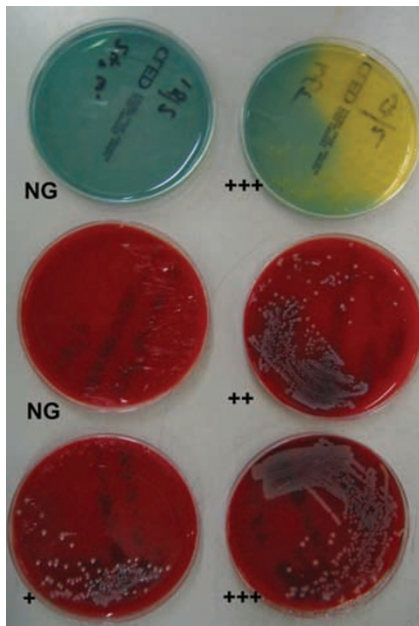
This exploratory study was designed to investigate Dry Wipe markers, which are non-alcohol-impregnated, and widely used in our trust, particularly in a high volume of cataract surgery. In the first experiment, its



**Figure 1** Allocation of marker pens for testing in phase 1. N = number of marker pens, MRSA = *methicillin-resistant Staphylococcus aureus*, CNS = *coagulase negative staphylococci*, *E. Coli* = *coliforms*.

	Time of exposure (min)	0	5	10	30	120
Time left to dessicate (Hours)	MRSA					
	0	+++	NG	+++	NG	NG
	4	+++	NG	NG	NG	NG
	16	+++	+++	NG	NG	NG
	CNS					
	0	+++	+	Scanty	NG	NG
	4	+++	+	Scanty	NG	NG
	16	+++	+	NG	NG	NG
	E.coli					
	0	+++	NG	NG	NG	NG
	4	+++	NG	NG	NG	NG
	16	+++	NG	NG	NG	NG

**Figure 2** Table summary of results. NG=no growth, and +, ++, +++ and scanty are typical microbiology descriptions for heaviness of growth on purity plates (refer to Figure 3).



**Figure 3** Cled and blood agar plates illustrating different intensities of bacterial growth. NG=no growth, and +, ++, +++ and scanty are typical microbiology descriptions for heaviness of growth on purity plates.

methodology was designed to emulate surgical practice in our unit. The pens were desiccated for the specified periods of time to represent new and older dried-out pens. Time intervals between exposure to air (ie uncapping a pen), and inoculation of bacteria, were

chosen to emulate the short periods of intervals in which patients are seen and marked before a surgical list. The three test bacteria were chosen for the following reasons: CNS, a common skin commensal, is the most common causative organism in bacterial endophthalmitis.<sup>11</sup> *E. Coli*, representing Gram-negative organisms associated with inefficient handwashing, and MRSA, though rare in bacterial endophthalmitis, a favourite with the popular press.

These chosen bacteria showed variability in their transmissibility, and were observed to be highest in MRSA. Survival times of the bacteria on marker pens decreased with time, suggesting that the interval in which patients are marked with the same pen, may play a role in bacterial transmission. Unlike earlier studies, we did not demonstrate greater transmissibility with desiccated *vs* fresh pens. Although a theoretical risk has been shown in the laboratory, the difficulty lies in the quantification and clinical application of this risk. Negative cultures were obtained on all pens used in clinical practice, suggesting that this risk may be very small, and bring into question its role in the prevention of endophthalmitis.

The best available evidence for increased endophthalmitis risks include the following: patients who are aged above 80 years, the use of preoperative povidone iodine<sup>12</sup> in the eye before surgery, using intracameral cefuroxime when the operation is completed,<sup>13</sup> placing the main incision on the sclera rather than on clear corneal,<sup>14</sup> and the lack of intraoperative complications.<sup>9</sup> Interpreting evidence

regarding the prevention of endophthalmitis after cataract surgery is fraught with difficulty.<sup>15</sup> There are numerous methodological hurdles because of the relative rarity of the condition and the multiple approaches of surgeons to preoperative measures of prevention.<sup>15</sup> Some of these practices are not based on evidence, yet are carried out with rigorous fervour. This results in numerous variables that need to be measured in studies assessing endophthalmitis risk. Interpreting and applying evidence regarding postoperative endophthalmitis rates in cataract must therefore be integrated individual clinical expertise.<sup>16</sup>

Further research is required to clarify the role of marker pens in transmission of bacteria. We feel that the risks of wrong-site surgery should always be balanced against transmission risk and our findings do not sanction withdrawal of surgical site marking. The use of disposable marking pens at a cost of approximately £0.70 per pen represents a substantial sum to the trust in a high volume of cataract surgery. There is no evidence currently that supports implementing this. However, simple measures, such as increasing the intervals between marking patients with the same pen, not marking close to the surgical field, and wiping away the site mark during sterile surgical preparations can, and have already been employed in clinical practice. Further caution can be exercised by using disposable pens when marking MRSA patients, particularly with at risk individuals, such as the elderly or immunocompromised.

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