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Short report

Improved aseptic technique can reduce variable contamination rates of ward-prepared parenteral doses

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SUMMARY

Aseptic techniques are required to manipulate central venous lines and prepare intravenous doses. This study aimed to examine whether different aseptic techniques affect the contamination rates of intravenous doses prepared on hospital wards. Syringes of tryptic soy broth test media prepared by one pharmacy operator and five nurses were assessed for contamination. The pharmacy operator achieved lower contamination than the nurses (0.0% vs 6.9%; Fisher's exact test, $P < 0.001$). Contamination differed significantly between nurses (~2–17% of syringes; binary logistic regression, $P = 0.018$). In conclusion, appropriate training and experience in aseptic techniques should be embedded into routine clinical practice to reduce contamination rates.

Introduction

Catheter-related sepsis (CRS) is a widespread problem that affects patients managed on intravenous therapy in hospital and in the community. CRS contributes to bacteraemia, infective morbidity, line removal, hospital admissions and death.

Aseptic techniques are required to manipulate central venous lines and prepare doses for intravenous administration, but poor techniques may lead to contaminated doses and infected lines. It is not always easy to link contaminated doses directly with CRS, but, for example, administration of contaminated parenteral nutrition has repeatedly been reported to lead to deaths: 13 in Johannesburg, South Africa in 1990[1] and another eight in 1992;[2] two in Manchester, England in 1994;[3,4] six in Bloemfontein, South Africa in 2004;[5] three in Mainz, Germany in 2010;[6] and nine in Alabama, USA in 2011.[7]

Intravenous dose preparation can be undertaken in pharmacy aseptic services operating to defined standards, or in clinical environments such as hospital wards. Variable training and practice in the use of aseptic techniques may differ between healthcare workers (e.g. nurses and aseptic pharmacy operators) leading to different risks of CRS.

This study, which formed part of a local service development, aimed to test whether different techniques used by nurses and aseptic pharmacy operators can affect the variable contamination rates of doses prepared on wards.

Methods

One pharmacy operator and five nurses, each trained in aseptic techniques according to the requirements of their respective professions, participated in the study. The pharmacy operator was experienced in the techniques whereas the nurses were not. The infusate drawn up to make the flushes was

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a growth medium (certified sterile) in order to enhance detection of contaminants. Each operator was requested to use the aseptic techniques they had been formally trained to implement. The syringes were prepared in the treatment room of one of two wards in a single hospital. No individual session was shared between the pharmacy operator and any nurse. The airborne and surface environmental contamination (bioburden) was monitored during each session.

Syringe preparation and validation

Each syringe required 4 mL to be taken from a 10-mL glass ampoule of single strength (30 g/L) sterile tryptic soy broth aseptic test media (Torbay P.M.U., Torbay, UK) into a 10-mL luer slip syringe (B. Braun, Melsungen, Germany) using a 19-gauge needle (BD (Becton, Dickinson and Company) microlance 3, BD, Drogheda, Ireland), and the syringe sealed with a universal plug (Vygon, Aachen, Germany). Each operator was permitted to use any additional components necessary for their chosen aseptic techniques.

The prepared syringes were incubated at ambient room temperature (~22 °C) for seven days, and then at 32±0.5 °C for a further seven days.[8] Each syringe was blindly assessed and reported as either contaminated (visual turbidity) or not contaminated by a single independent operator from the Quality Assurance Section of the Pharmacy Department. No species identification of contaminants was performed.

Environmental contamination (bioburden)

During each session, two settle plates (90-mm diameter tryptone soy agar plates; Cherwell Laboratories Ltd, Bicester, UK) were exposed to airborne contaminants falling on them during the aseptic manipulations. At the end of each session, a single pharmacist pressed two contact plates (45-mm diameter tryptone soy agar plates; Cherwell Laboratories Ltd) on to the working area. All of the monitoring plates were incubated at ambient room temperature (~22 °C) for three days, followed by incubation at 32 ± 0.5 °C for a further four days. Each plate was independently assessed and the number of colony-forming units (cfu)/plate was reported by the single independent pharmacy quality assurance operator. Growth on the settle plates was standardized to the recommended 4-h period.[8] No species identification was undertaken.

Working surface cleaning

The pharmacy operator consistently elected to clean the working surface at the beginning of each session using 70% v/v isopropyl alcohol wipes (Sterets, Medlock Medical, Oldham, UK) as well as the neck of each ampoule, but none of the nurses chose to do so. In order to evaluate the effect of surface cleaning, further surface sampling was undertaken after completion of all syringe preparations. On two separate occasions, three contact plates were used to sample surface contamination at the front, middle and back of the bench and trolley surfaces used for syringe preparation, both before and after cleaning by the pharmacy operator. The plates were prepared and reported using the same techniques as before.

Statistical analyses

Point estimates and 95% confidence intervals (CI) for contamination rates were obtained for the nurses and pharmacy operator using the Wilson method.[9] General statistical analyses were undertaken using PASW Statistics Version 18 (SPSS Inc., Chicago, IL, USA). Comprehensive Meta Analysis Version 2 (Biostat, Englewood, NJ, USA) was used to combine the contamination rate results for different nurses. Unless otherwise stated, the results are presented as mean ± standard error.

Results

In total, 778 syringes were prepared over eight months, during 18 sessions taking 1130 min (Table I).

Syringe contamination

The pharmacy operator achieved a significantly lower syringe contamination rate than the nurses [0.0% (95% CI 0.0–0.8%) vs 6.9% (95% CI 4.5–10.5%); Fisher's exact test, $P < 0.001$]. Contamination differed significantly between nurses (~2–17% of syringes; binary logistic regression, $P = 0.018$). Using the nurse with the median syringe preparation speed (2.26 min/syringe, range 1.87–2.40 min) as a referent, three of the other four nurses had significantly different syringe contamination rates. Separate binary logistic regression analysis found no significant effect of ward ($P = 0.266$) or duration of syringe preparation ($P = 0.205$) on the contamination rates of the nurse-prepared syringes. The significant variation in contamination rates between nurses was supported by the presence of significant between-nurse heterogeneity ($I^2 = 66.46\%$, $P = 0.018$), which is why the results were amalgamated using a random effects meta-analysis. This revealed an overall contamination rate of 7.4% (95% CI 3.1–16.4%), which was significantly higher ($P = 0.0032$) than that of the pharmacist operator [0.1% (95% CI 0.0–1.6%)],

Table I
Operator dose preparation time and syringe contamination rates

Operator	Ward (1 or 2)	Sessions (*N*)	Syringe contamination rate (*N* of contaminated syringes/total syringes prepared)	Total time (min)
Nurse 1	1	1	1/50 (2.0%)	120
Nurse 2	1	2	1/56 (1.8%)	115
Nurse 3	1	2	5/30 (16.7%)	70
Nurse 4	2	2	5/98 (5.1%)	183
Nurse 5	2	1	7/42 (16.7%)	95
All nurses	1 and 2	8	19/276 (6.9%)	583
Pharmacy operator 1	2	10	0/502 (0.0%)	547