

Decontamination of Blood Gas Analysers

Situation	<p>Blood gas analysers have been implicated in the transmission of nosocomial infection in several outbreak reports. There have also been anecdotal reports from healthcare workers of blood spraying from analyser inlet ports, and of visible blood contamination on analysers and on the surrounding environment, which presents a risk of bloodborne virus transmission.</p> <p>There is currently no national guidance on decontamination of blood gas analysers.</p> <p>This SBAR provides recommendations for clinical practice for NHSScotland.</p>
Background	<p>Blood gas analysers are commonly used by healthcare workers for convenient point of care testing (POCT). The literature reports: two outbreaks of <i>Enterobacter cloacae</i>, one of <i>Pseudomonas aeruginosa</i> and one of <i>Klebsiella oxytoca</i> on neonatal intensive care units (NICU) associated with contaminated blood gas analysers.¹⁻⁴ There has also been one report of an outbreak of <i>Pseudomonas cepacia</i> on an intensive care unit (ICU) associated with a contaminated blood gas analyser.⁵ In all cases, the outbreaks were a combination of colonisations, true septicaemias and pseudobacteraemias (blood culture contamination).</p> <p>Although conclusive evidence of the route of transmission was lacking in the outbreak of <i>Pseudomonas aeruginosa</i>, gross blood contamination at the analyser inlet port was observed, and was believed to have been caused by frequent over-filling.² The outbreak report authors theorised that the organism was transferred from the analyser to patients and to blood culture bottles via contaminated healthcare worker hands. The outbreak ceased when care was taken to ensure there was no over-filling of the analyser inlet port, and when hand hygiene was performed after all procedures, including after handling the blood gas analyser.²</p> <p>In the ICU outbreak of <i>Pseudomonas cepacia</i>, both the reservoirs of distilled water used to flush the machine after sample analysis and the plastic squeeze bottles used to refill the reservoir were found to be contaminated with the organism.⁵ The report authors noted that during the process of flushing the machine, healthcare worker hands became contaminated with the water, and hand hygiene was not always</p>

performed before subsequent patient care activities, including obtaining further arterial blood samples.⁵ Environmental decontamination, discontinuing the use of squeeze bottles to refill the reservoir, and replacement of the analyser machine were reported to have terminated the outbreak.⁵

In both outbreaks of *Enterobacter cloacae* the mechanism by which cross contamination occurred was unclear. However, in one outbreak the pathogen was detected on the analyser inlet port and on the cover of the machine and in the other outbreak, samples of the washer and effluent fluid were found to be contaminated.^{1:3} Implementation of infection control measures - the use of gloves when using the machine and decontamination of the analyser sampling port - terminated the outbreak in one NICU.³ Implementation of aseptic techniques and hand washing before and after procedures reduced transmission in the other NICU, with termination of the outbreak after thorough decontamination of the analyser.¹

Safety Action Notices issued in 1996 by NHS Scotland and the Medical Devices Agency Adverse Incident Centre acknowledged that blood gas analysers used in POCT may be a source of cross-infection.^{6:7} Both Safety Action Notices advise that 'care should be taken to ensure the opportunities for cross-infection between blood gas analysers and patients are minimised.' The measures outlined to achieve this are rigorous adherence to equipment maintenance and decontamination procedures, and to hand washing procedures before and after using the equipment.^{6:7} These notices advise that decontamination should be carried out in accordance with locally agreed procedures, and highlight that manufacturer's guidance can be found in the user manual.^{6:7}

Different analyser manufacturers provide different guidance on surface decontamination of their particular machines in terms of cleaning frequency. For example, OPTIMedical recommend **weekly** cleaning of their *CCA-TS Analyzer* surface and screen⁸, while the operator manual for the *AVL Compact 3 pH/Bloodgas Analyzer* recommends **daily** cleaning of the analyser surface 'if necessary'⁹, and the user manual for the *IRMA TruPoint Blood Analysis System* recommends **immediately** wiping any spilled blood from the analyser surface.¹⁰ Many analysers have automatic cleaning cycles for internal cleaning that can be programmed to the required frequency.¹¹

There is also variation in manufacturer recommendations for cleaning methods and products. For example, OPTIMedical recommend cleaning of their *CCA-TS Analyzer* surface with a mild detergent and a soft cloth⁸, while the user guide for the *i-STAT®1* hand-held blood gas analyser recommends that the analyser display and case should be cleaned with a gauze pad moistened with a mild non-abrasive cleaner, detergent, soap and water, alcohol or 10% bleach solution before rinsing with another pad moistened with water and drying.¹²

	<p>Two analyser user manuals obtained outline specific recommendations for the cleaning of analyser screens. For example, OPTIMedical recommend that their <i>CCA-TS Analyzer</i> screen is cleaned with ammonia based cleaner or alcohol using a lint free cloth⁸, while the user manual for the <i>IRMA TruPoint Blood Analysis System</i> recommends cleaning with a soft cloth dampened with isopropyl alcohol, a 10% bleach solution, or distilled water, and drying with a soft cloth following cleaning, but caution against the use of strong detergents, concentrated bleach, or abrasive cleaning solutions that could scratch or damage the screen.¹⁰</p> <p>Some chemical cleaning agents are known to have a damaging effect on surfaces. The Medical and Healthcare products Regulatory Agency (MHRA) issued a Medical Device Alert in March 2013 to highlight the fact that detergent and disinfectant wipes can damage plastic surfaces of medical devices if they are not compatible with the surface material compromising the ability to decontaminate the devices adequately and potentially interfering with device function.¹³ The alert requires all staff involved in the decontamination of medical devices to:</p> <ul style="list-style-type: none"> • Ensure detergent and disinfectant wipes are compatible with the device; and • Always follow the device manufacturer's decontamination instructions.¹³ <p>Similarly, in their 2002 Good Practice Guidelines for Renal Dialysis/Transplantation Units, the Department of Health note that care should be taken to remove chlorine residues from the metallic surfaces of dialysis machines when cleaning with chlorine based disinfectants, and recommend that advice on the compatibility of chlorine-based disinfectants with dialysis equipment should be sought from the manufacturer.¹⁴</p>
<p>Assessment</p>	<p>Contaminated blood gas analysers have been found to be reservoirs of infection in several outbreaks. The evidence suggests that failure by healthcare workers to perform hand hygiene prior to undertaking further patient care activities after contact with contaminated blood gas analysers was the primary route of cross infection in these outbreaks. It is therefore reasonable to assume that performing hand hygiene before and after use of the analyser would help to prevent cross contamination, in line with the National Infection Prevention & Control Manual: Chapter 1 Standard Infection Control Precautions. Similarly, changing gloves after use of an analyser would help to prevent cross contamination.</p> <p>Both surface and internal contamination of blood gas analysers have been implicated in outbreaks reported in the literature. Decontamination of analysers may also therefore help to prevent cross contamination. Although there is currently no consistent guidance on the appropriate frequency of surface decontamination or internal cleaning, it is reasonable to recommend that surface decontamination is performed after every use to minimise the risk of cross-infection. It may not be practical to run an</p>

	<p>internal cleaning cycle after every use, and a pragmatic approach may be to carry out internal decontamination procedures as frequently as possible (at least daily).</p> <p>Chapter 1 of the National Infection Prevention and Control Manual outlines the procedures for decontaminating re-usable non-invasive patient care equipment and for the management of blood and body fluid spillages, and this guidance should be applied to the decontamination of blood gas analysers. However, due to the potentially damaging effect of cleaning agents, it is important to ensure that agents used are compatible with the device. It is necessary to take extra care when decontaminating analyser screens, as these may be particularly susceptible to damage.</p>
<p>Recommendations</p>	<ul style="list-style-type: none"> • Hand hygiene using an alcohol based hand rub should be performed before and after using a blood gas analyser. • Surface decontamination of blood gas analysers and surrounding areas should be carried out after every use using either: a general purpose detergent and 1000ppm available chlorine solution rinsed then dried; or alternatively a detergent wipe followed by 70% isopropyl alcohol wipe (check manufacturer instructions). • If the equipment is not contaminated with blood, decontaminate with disposable cloths/paper towels and fresh solution of general purpose detergent and water or a detergent wipe. • If there is visible blood present or a spillage decontaminate with disposable cloths/paper towel and a fresh solution of detergent followed by a disinfectant solution of 10,000 ppm av chlorine. • Gloves must be worn to obtain an arterial blood gas sample and changed following each task. • Internal cleaning cycles on blood gas analysers should be run as frequently as possible (at least daily). • It is the responsibility of the Board to ensure that cleaning agents used are compatible with analysers, and to take extra care when decontaminating analyser screens as these may be particularly susceptible to damage.