SBAR: Masks for invasive spinal procedures	
Situation	Reports in the medical literature of bacterial meningitis following invasive spinal procedures necessitate an assessment of risk.
Background	There are a number of case reports in the medical literature of bacterial meningitis as an infectious complication following invasive spinal procedures such as spinal anaesthesia, epidural anaesthesia, myelography and diagnostic lumbar puncture. There is extant guidance from the Royal College of Anaesthetists and the Association of Anaesthetists of Great Britain and Ireland recommending that operators wear a mask when performing invasive spinal procedures to protect patients from infection. However, these recommendations are not currently included in any UK infection prevention and control guidance. The National Infection Prevention and Control Manual Standard Infection Control Precautions (SICPs) recommends the use of masks by healthcare workers to protect from the splashing of blood, body fluids, secretions or excretions when caring for patients, but currently make no recommendation on the use of masks by healthcare workers to protect patients from infection.
Assessment	For a more detailed assessment of the evidence, see **Appendix 1**. Bacterial meningitis is a rare, but serious complication of invasive spinal procedures. Although there are a several possible routes of infection, the evidence strongly indicates that most cases of bacterial meningitis are caused by droplet contamination with viridans streptococci from the

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	operator's nasopharynx/oropharynx. The fact that most cases are caused by commensals of the mouth and upper airways (often *Streptococcus salivarius*) rather than organisms usually implicated in meningitis supports the hypothesis that transmission occurs as a result of droplet contamination from the operator's nasopharynx/oropharynx. A number of reports the medical literature document clustering of cases of bacterial meningitis following invasive spinal procedures. Because this is a rare complication, the occurrence of clusters strongly suggests that the operator is the source of infection. Perhaps the most convincing evidence that contamination from the operator's mouth or upper airway is the primary route of infection are several case study reports in which bacterial isolates from patients have been molecularly matched to strains obtained from the operator's nasopharynx/oropharynx. Although information about the use of masks is often missing or unclear in the case reports, it is thought that in most cases the operator did not wear a mask, or where a mask was used, its integrity may have been compromised. There is convincing evidence from experimental studies that masks are effective in reducing bacterial contamination caused by dispersal from the upper airway. Use of a mask by operators when performing invasive spinal procedures is therefore an appropriate measure to reduce the risk of bacterial meningitis in patients. In 2004, the CDC investigated eight cases of post-myelography meningitis and concluded that 'droplet transmission of [operator] oralpharyngeal flora was the most likely explanation' for these cases. As a result, in 2005, the Healthcare Infection Control Practices Advisory Committee (HICPAC) reviewed the evidence and concluded that there is

	sufficient evidence to recommend the use of a mask for invasive spinal procedures. Their current recommendation is that an operator should 'wear a mask when placing a catheter or injecting material into the spinal canal or subdural space (i.e. during myelograms, lumbar puncture and spinal or epidural anesthesia'). This recommendation received a Category IB grading i.e. strongly recommended for implementation and supported by certain experimental, clinical epidemiologic studies and a strong theoretical rationale.
Recommendation	Infection and prevention and control guidance in Scotland should include a recommendation that operators wear a mask when performing invasive spinal procedures. This recommendation is intended to protect patients from infection, and should be included as part of Standard Infection Control Precautions.

Appendix 1 - Evidence review: masks for invasive spinal procedures

Bacterial meningitis is a rare, but serious complication of invasive spinal procedures such as spinal anaesthesia, epidural anaesthesia, myelography and diagnostic lumbar puncture.

In 2004, the CDC investigated eight cases of post-myelography meningitis and concluded that 'droplet transmission of [operator] oralpharyngeal flora was the most likely explanation' for these cases.[1] As a result, in 2005, the Healthcare Infection Control Practices Advisory Committee (HICPAC) reviewed the evidence, and concluded that there is sufficient evidence to recommend the use of a mask for invasive spinal procedures.[1]

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In the UK, the Royal College of Anaesthetists, supported by the Royal College of Nurses, the Association of Anaesthetists of Great Britain and Ireland, the British Pain Society, the European Society of Regional Anaesthesia and Pain Therapy, and the Association of Paediatric Anaesthetists of Great Britain and Ireland, recommend that 'epidural catheter insertion must be performed using aseptic technique', which they define as including 'hand washing, sterile gloves, sterile gown, hat, **mask**, appropriate skin preparation and sterile drapes around the injection site'.[2] In addition, in their Infection Control in Anaesthesia Guideline, the Association of Anaesthetists of Great Britain and Ireland state that certain invasive anaesthetic procedures, including spinal, epidural and caudal procedures require maximal barrier precautions which they define as 'full hand washing, the wearing of sterile gloves and gown, a cap, **mask** and the use of a large sterile drape'.[3]

There is, however, controversy around the need for an operator to wear a mask during invasive spinal procedures.[4;5] While some argue that masks have not been shown to reduce

the risk of surgical site infections and may increase shedding of skin organisms, others question whether the results of studies in specific surgical populations can be generalised, and question the methodology of studies evaluating the efficacy of masks.[5]

Several published reviews and systematic reviews have collated and summarised and synthesised the evidence from case reports in the medical literature of bacterial meningitis following invasive spinal procedures.[4-10]

A number of studies have attempted to estimate the incidence of this complication, but estimates are subject to many limitations and vary substantially.[4;5;7;8;11] It is thought that there may be under diagnosis and underreporting of cases.[4;8] Reynolds (2008) states that the rarity of the complication 'makes incidence, relative risk and efficacy of preventative measures impossible to establish using high-quality evidence', and therefore case reports, indirect evidence and common sense must be relied on when considering the issue.[8]

Although there are a several possible routes of infection, such as contamination from the patient's skin flora at the puncture site, contaminated infusate, or from haematogenous spread from another infected site [5;11], the evidence strongly indicates that most cases of bacterial meningitis are caused by droplet contamination with viridans streptococci, frequently *Streptococcus salivarius*, from the operator's nasopharynx/oropharynx.[4;6-9]

The causative organisms of bacterial meningitis following invasive spinal procedures are different from those usually implicated in community-acquired meningitis.[8] Although a wide range of bacterial pathogens have been implicated in cases including *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterococcus faecalis* and *Corynebacterium xerosis*, the most commonly identified causative organisms are viridans streptococci.[4;6-10] A 2006 review of 179 cases of post-dural puncture meningitis identified in the medical literature from 1952-2005 reported that viridans streptococci were identified as the pathogen in 88 cases, i.e. 77% of the 114 cases for which a causative organism was identified or reported. For 30 of the cases attributed to viridans streptococci, *Streptococcus salivarius* was specifically identified as the causative organism.[4]

Viridans streptococci are part of the normal flora of the oral cavity and upper respiratory tract, the female genital tract and gastrointestinal tract.[6;8-10] They are typically low virulence, and have a poor affinity for the leptomeninges, which explains why they are not commonly associated with meningitis.[9] *Streptococcus salivarius* is the principal commensal organism of

the oral cavity, and although seldom pathogenic, it has been implicated in septicaemia in patients with cancer and advanced liver disease, and has been reported as the causative agent of meningitis in the setting of trauma, cancer and cerebral spinal fluid fistula.[9] The fact that most cases of meningitis following invasive spinal procedures are caused by commensals of the mouth and upper airways support the hypothesis that transmission occurs as a result of droplet contamination from the operator's nasopharynx/oropharynx.[4]

A number of reports the medical literature document clustering of cases of bacterial meningitis following invasive spinal procedures.[4;6;8;12-17] Because this is a rare complication, the occurrence of clusters strongly suggests that the operator is the source of infection.[4;6] Perhaps the most convincing evidence that contamination from the operator's mouth or upper airway is the primary route of infection are several case study reports in which bacterial isolates from patients have been molecularly matched to strains obtained from the operator's nasopharynx/oropharynx.[13;16-20] For example, in 2010 three cases of meningitis attributed to *Streptococcus salivarius* were identified in patients who underwent myelography at an outpatient radiology clinic performed by the same physician assistant and technician on the same day. The bacterial strain implicated in infection was found to be indistinguishable from that identified in an oral specimen taken from the physician assistant.[13]

Baer (2000) states that incidence, in particular clustering of cases, is likely to be related to certain characteristics of the operator that favour the organism's dispersal such as the presence of dental caries and pharyngitis, where there is an increased presence of viridans streptococci.[6] The author also suggests that the distance of the operator's mouth from the needle's lumen and the extent to which the physician talks during the procedure may also be a factor.[6]

Unfortunately, information regarding use of masks is missing or unclear in many of the case reports, so it is not possible to estimate the proportion of cases associated with unmasked operators. Yaniv and Potasman (2000) report that in only 3% of the 60 cases of iatrogenic meningitis included in their review the operator wore a mask, and in 53% of cases masks were not worn (data are missing for the remainder of cases).[10] Baer's (2000) review of 75 cases of post-lumbar puncture bacterial meningitis reports that in only three cases use of a mask by the operator was specifically mentioned.[6] It is possible a mask may have been worn in more cases, but simply not reported. However, the author highlights the fact that even in those cases where use of a mask by the operator was reported no information is given about

the type of mask worn, how long the operator wore it before and during the procedure, or whether other persons were present who were unmasked.[6] Thus, the integrity of masks used is questionable.

A 1992 study provides convincing evidence that surgical masks are effective in reducing bacterial contamination caused by dispersal from the upper airway. The study involved 25 anaesthetists who were asked to speak for 5 minutes, with agar plates positioned 30cm from their mouth, initially unmasked, and then wearing a surgical mask over the mouth and nose. It was reported that a fresh surgical mask almost completely eliminated bacterial contamination of the plate, with only a small and insignificant increase in the number of organisms isolated after the mask had been worn for 15 minutes.[21] A similar study conducted in 1998 found a statistically significant reduction in bacterial contamination of plates when a mask was worn, and the authors concluded that their results suggest that operators should wear a mask when carrying out procedures of less than 15 minutes, particularly when the face is in close proximity to the operative field, and the need for speaking is anticipated.[22]

Schulz-Stübner et al (2008), reviewed the evidence around infectious complications of regional anaesthesia, and formulated graded recommendations using the HICPAC grading system. Their recommendation that 'masks should be worn during regional anesthesia procedures' received a Category II grade i.e. suggested for implementation and supported by suggestive clinical epidemiologic studies or a theoretical rationale.[5] The recommendation that operators wear a mask when carrying out invasive spinal procedures is echoed in several reviews on the topic.[4;6-9]

The recommendation that masks are worn routinely by operators performing lumbar punctures was criticised in 2000 on the basis that the evidence underpinning the link between droplet contamination from the operator's nasopharynx/oropharynx is not conclusive, and that the use of masks has not been proven to prevent contamination of the operative field with organisms from the operator's mouth or upper respiratory tract.[23] Black and Weinstein argued that in the absence of conclusive evidence, the emphasis should be on aseptic technique, with the use of masks reserved for higher-risk situations, which they define as: operator has an upper respiratory tract infection; during instruction of students when frequent talking is likely to take place; during a long procedure or introduction of a device likely to remain in place for a long time; or when the procedure is undertaken in a normally sterile environment such as an operating theatre.[23] Since then, however, the Healthcare Infection Control

Practices Advisory Committee (HICPAC) have undertaken a review of the evidence, and concluded that there is sufficient evidence to recommend the use of a mask for invasive spinal procedures as a Category IB recommendation.

Assessment and consideration of the evidence indicates that it is appropriate to recommend that operators wear a mask when performing invasive spinal procedures. Infection and prevention and control guidance in Scotland should include a recommendation that operators wear a mask when performing invasive spinal procedures. This recommendation is intended to protect patients from infection, and should be included as part of Standard Infection Control Precautions

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