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Guidelines

Use of sterile gowns for single-shot spinal anaesthesia: consensus guidelines from the Association of Anaesthetists, Royal College of Anaesthetists, Obstetric Anaesthetists' Association, Regional Anaesthesia UK, College of Anaesthesiologists of Ireland and Australian and New Zealand College of Anaesthetists

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Summary

Introduction International guideline recommendations vary on the use of sterile gowns during spinal anaesthesia. There is limited evidence of benefit for their routine use and debate about environmental, financial and clinical costs and benefits. Updated, evidence-informed, consensus-based recommendations on the essential infection prevention measures for single-shot spinal anaesthesia are required to balance the need to maintain high standards of infection prevention with proportionate and sustainable practice.

Methods A comprehensive literature review was undertaken to explore: the risk of infective sequelae; time to establish anaesthesia; infection prevention recommendations for the clinician performing the procedure and the assistant; and attitudes to infection prevention. This formed the basis for the development of statements and recommendations, which were considered in a modified three-round Delphi process.

Results In total, 239 academic articles were identified, with 39 selected for full-text review. The review informed the development of 10 statements and 11 recommendations. Thirty-two professional experts and one patient representative completed all three rounds of the Delphi process. Consensus was reached on eight statements and 11 recommendations, including that the routine use of a sterile gown when performing single-shot spinal anaesthesia for uncomplicated adult patients (i.e. immunocompetent and/or for whom the procedure is expected to be neither difficult nor prolonged), should not be considered mandatory; two statements did not reach consensus.

Discussion This consensus statement defines the essential aseptic measures for single-shot spinal anaesthesia in uncomplicated adult patients. While the routine use of sterile gowns should not be considered mandatory, core aseptic practices such as effective hand hygiene and facemask use are essential. These recommendations support a proportionate, sustainable approach to infection prevention. Clinicians may use this guidance to inform safe, evidence-aligned and environmentally responsible anaesthetic practice.

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This is a consensus document produced by expert members of a Working Party established by the Association of Anaesthetists. It has been seen and approved by the Association Board of Trustees and has been endorsed by the Royal College of Anaesthetists, the College of Anaesthesiologists of Ireland, Regional Anaesthesia UK, the Obstetric Anaesthetists' Association and the Australian and New Zealand College of Anaesthetists.
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Recommendations

1. In uncomplicated adult patients (i.e. immunocompetent and/or for whom the procedure is expected to be neither difficult nor prolonged), the routine use of a sterile gown when performing single-shot spinal anaesthesia should not be considered mandatory.
2. Sterile gowns should be available for any clinician who feels they may be of benefit, and particularly where individual patient circumstances, ergonomics or experience of the anaesthetist performing the procedure may potentially influence asepsis.
3. The practice of meticulous skin decontamination for the clinician and the patient should be considered mandatory; for the clinician, this should include surgical scrubbing up to the elbow using the skin preparation solution recommended in local guidelines.
4. A head covering, sterile gloves, sterile drapes and a fresh surgical facemask should be considered mandatory in all cases. Clinicians should secure or remove any items that could potentially interfere with the aseptic field, such as lanyards or pens.
5. Sterile gown usage should be encouraged in the early stages of anaesthetic training while experience in performing the technique is being established.
6. In cases where a sterile gown is preferred, a reusable gown should be the first choice.

Why were these guidelines developed?

Spinal anaesthesia is performed commonly in global anaesthetic practice. Of the estimated 325,000 spinal blocks undertaken annually in UK NHS hospitals, an almost equal proportion are performed for obstetric and non-obstetric indications [1]. Guidance published over the last two decades in Australia, New Zealand, the UK and Ireland has generally recommended a sterile technique with ``*maximal barrier precautions*'' for single-shot spinal anaesthetics, including surgical scrub of the hands and forearms; sterile gloves; sterile gown; cap; facemask; and a large sterile drape [2, 3]. However, there is a significant variation in recommendations and practice globally [4]. For instance, while some guidelines advocate for the use of sterile gowns during single-shot spinal anaesthesia [3, 5, 6], others do not consider them mandatory [7, 8]. In addition, practices such as the use of caps, facemasks and the extent of sterile draping vary between countries and institutions [3].

The universal adoption of sterile gowns for single-shot spinal anaesthesia remains controversial, in part due to limited evidence supporting their routine use in preventing infectious complications, and because of their financial cost and contribution to healthcare waste. This guidance provides consensus recommendations on appropriate aseptic precautions for single-shot spinal anaesthesia, ensuring high infection prevention standards are maintained while reducing unnecessary environmental waste.

What guidelines currently exist?

The Association of Anaesthetists published guidelines in 2020, which recommend the use of an ``*aseptic technique*'' during central neuraxial blockade and proposed an audit standard of ``*aseptic techniques and full barrier precautions*'' for invasive procedures [5]. Similarly, the Australian and New Zealand College of Anaesthetists' (ANZCA) 2015 guidance advocated full aseptic technique and maximal barrier precautions when performing spinal or epidural blocks [3].

In contrast, recent consensus guidelines from the Canadian Anesthesiologists' Society and the American Society of Regional Anesthesia and Pain Medicine recommend a surgical cap, facemask and sterile gloves, but do not require sterile gowns for single-shot spinal anaesthesia [7, 9]. This reflects a long-established North American practice not to use gowns during spinal anaesthesia. Updated guidance from ANZCA, published in 2025 [10], no longer mandates the routine use of a sterile gown for spinal anaesthesia unless the anaesthetist

anticipates a technically difficult or prolonged procedure or is undergoing training.

How do these guidelines differ from existing guidelines?

The working party reviewed current literature and undertook a modified Delphi process to provide up-to-date guidance based on evidence and expert opinion. These consensus statements and recommendations, endorsed by multiple professional organisations, aim to help clinicians weigh the potential benefits of amending current practice regarding infection prevention during single-shot spinal anaesthesia while maintaining patient safety as a priority.

Introduction

Infective complications after spinal anaesthesia are rare. In the Third National Audit Project (NAP3) of the Royal College of Anaesthetists (RCoA) there were only two cases of vertebral canal abscess and one of infective meningitis among 325,000 spinal anaesthetics [1]. The incidence of bacterial meningitis following spinal anaesthesia in European studies ranges between 1 in 35,439 and 1 in 53,000 [11, 12]. The UK Confidential Enquiries into Maternal Deaths reported one maternal death from meningitis (between 1997 and 1999) and one death from spinal empyema with acute leucoencephalitis (between 2006 and 2008) following spinal anaesthesia for caesarean delivery [13, 14].

Whilst rare, infective complications following epidural insertion are more common than following spinal anaesthesia. In NAP3, the vast majority of vertebral canal abscesses [15–17] occurred in relation to epidural catheter insertion; risk factors included prolonged epidural catheterisation and patients with compromised immunity [1]. A French audit of complications of regional anaesthesia showed an incidence of meningitis six-fold higher following epidural insertion compared with spinal injection [11].

In 2008, the Association of Anaesthetists' consensus guideline on *infection control in Anaesthesia* recommended ``*maximal barrier precautions*´´ (comprising full hand washing, wearing of sterile gloves and sterile gown, cap, facemask and the use of a large sterile drape) for spinal and epidural procedures [2]. This was reiterated in joint guidance from the Association of Anaesthetists, the Obstetric Anaesthetists' Association (OAA), Regional Anaesthesia UK (RA-UK) and the Association of Paediatric Anaesthetists of Great Britain and Ireland (APAGBI) published in 2014 [15]. The updated Association of Anaesthetists' *Infection Prevention and Control* (2020) guidelines recommended the use of ``*an aseptic technique*´´ during central neuraxial blockade but proposed an audit standard of ``*aseptic techniques and full barrier precautions*´´ for invasive procedures [5]. Whilst the term, `full barrier precautions´ is not defined in the 2020 guidance, this is generally understood to be synonymous with the recommendation in the previous iteration. Of note, the initial recommendation was based on evidence presented in an article discussing intravenous catheter-related sepsis rather than single-shot spinal anaesthesia [16].

Although reporting systems are limited, infective complications due to spinal anaesthesia are found to be rare, and there is a paucity of evidence to support the routine use of sterile gowns for single-shot spinal anaesthesia. Guidelines from the USA, Canada and Brazil do not recommend routine gowning for single-shot spinal anaesthesia [7–9]. Guidance from South Africa notes that there are ``*insufficient data to make definitive recommendations with regards to routine gown use*´´ [6] and educational materials from the World Federation of Societies of Anaesthesiologists state ``*sterile gown optional*´´ in the context of spinal anaesthesia for caesarean delivery [17]. A multicentre study of 257,000 patients in the USA found an incidence of epidural abscess of 1:63,000 [18], which is in keeping with that found in studies in countries which use gowns routinely [1, 12–14].

Wearing sterile gowns for single-shot spinal anaesthesia incurs financial and environmental costs. Estimating this accurately across the NHS is challenging given the large range of suppliers and the variation in waste disposal contracts, though gowns would have made up a significant portion of the £146 million ($193,990 million, €167,330 million) spent on personal protective equipment in 2019–2020 [19]. Researchers have identified that the use of 1000 disposable gowns resulted in the generation of between 63 kg and 268 kg of solid (largely plastic-based) waste and between 310 kg and 1636 kg of carbon dioxide equivalent (CO_2e) emissions [20, 21]. Although single-shot spinal anaesthesia is therefore a relatively minor contributor to the NHS carbon footprint of 6.1 million tonnes CO_2e, considering the climate crisis (and its associated health impacts), it is important to identify multiple opportunities to move towards a `net zero´ system [22] while ensuring we deliver safe, high-quality healthcare.

In view of inconsistent guidance in high-income healthcare systems worldwide, the need to re-evaluate the evidence for sterile gown use in neuraxial anaesthesia has been highlighted in recent years [23, 24]. Therefore, to assist clinicians in making an informed decision about the use of sterile gowns for single-shot spinal anaesthesia, a working party was established to undertake a review of the

evidence and apply a structured consensus approach to produce best practice guidelines on barrier precautions for single-shot spinal anaesthesia in the UK and Ireland.

Methods

A working party was established consisting of representatives from the Association of Anaesthetists, RCoA, College of Anaesthesiologists of Ireland (CAI), RA-UK, OAA and ANZCA. All members were selected for their experience of neuraxial anaesthesia and a strong interest in maintaining clinically appropriate and up-to-date infection prevention recommendations for single-shot spinal anaesthesia in the UK and Ireland.

The PatientsVoices@RCoA group was consulted to provide patient and public involvement during the development of the study protocol; the work was presented by three members of the working group (PS, JB and CS), followed by an open discussion of the project. This helped establish the relevance and acceptability of the work to patients and indicated that (well-informed) patient representatives had few prior expectations about the aseptic precautions used during spinal anaesthesia.

In November 2024, a comprehensive literature search was conducted using MEDLINE (online Supporting Information Appendix S2). The details of all papers identified in the initial literature search were uploaded to a Microsoft Excel spreadsheet (Microsoft Corp., Redmond, WA, USA), and title and abstract screening was conducted by JB, CS, YM and CP. Following identification of relevant papers and removal of duplicates and incorrectly identified articles, full texts were shared with the whole working group and a narrative literature review was undertaken. The aim was not to grade the evidence but to provide a comprehensive overview of the literature as a foundation for expert opinion.

A series of candidate statements was developed by the core working group relating to the use of sterile surgical gowns in the practice of spinal anaesthesia. These statements were informed by a review of the relevant literature and the professional experience of group members. Statements were circulated to the wider working group and revised iteratively to enhance clarity and ensure alignment with the project's objectives. A modified Delphi process was used to reach consensus on the statements. Experts in patient safety in anaesthetic practice, regional anaesthesia, obstetric anaesthesia, sustainable anaesthesia and patient representation were invited to contribute to the Delphi panel. `Expertise´ was defined as having published or undertaken research on the topic, participation in relevant committees or organisations, public-facing engagement or advocacy in relevant topics or being identified as experts in practice by relevant national anaesthesia organisations. It was agreed a priori that members of the core working group would constitute < 50% of the Delphi panel.

Following development of the statements, these were uploaded to an electronic platform (Microsoft Forms, Microsoft Corp.) and piloted among the members of the core working group who were not participating in the Delphi panel. After incorporating any necessary revisions, the statements were then distributed to the Delphi panel. Respondents rated each statement on a four-point Likert scale tailored to the nature of the statement: level of agreement (`strongly disagree´, `disagree´, `agree´, `strongly agree´); perceived importance (`not at all important´, `not very important´, `slightly important´, `very important´); or perceived influence (`no influence´, `minimal influence´, `moderate influence´, `strong influence´).

The results of the literature review, together with existing guidance from the UK and Ireland, and other comparable health systems from high-income countries [3, 5, 7], were shared with Delphi participants, who were encouraged to familiarise themselves with the literature before submitting their responses. Participants were also invited to propose anonymously amendments or alternative phrasing for each statement. Panel members who did not participate in a Delphi round were excluded from all subsequent rounds.

Consensus was defined as at least 75% of respondents providing a positive response (`agree´ or `strongly agree´; `slightly important´ or `very important´; or `moderate influence´ or `strong influence´) or a negative response (`disagree´ or `strongly disagree´; `not very important´ or `not at all important´; and `minimal influence´ or `no influence´). Statements reaching consensus were removed from subsequent rounds of the Delphi process.

Three rounds of the Delphi process were undertaken. Between rounds, statements were revised by consensus of the core working group in response to participant feedback. In the second and third rounds participants were shown the level of agreement or disagreement from the preceding round, and any new or amended statements were highlighted.

A draft of this guidance was then circulated to all Delphi panel members, who were invited to comment on the structure, content and important references. Following revision, the document was shared with all members of the working party and with relevant boards and Councils of the Association of Anaesthetists, RA-UK, RCoA, OAA, CAI and ANZCA for approval. The Association of Anaesthetists shared a draft of the document with its members and invited comments; minor changes were made in response to feedback received via these channels.

Results

The initial literature search identified 239 articles. After title and abstract screening and removal of duplicates, 39 full-text articles of potential relevance were identified. Full-text versions of these were shared with the entire working group.

Thirty-two potential participants with relevant expertise and experience were identified by the working group, representing a balance of subspecialty fields relevant to the use of sterile gowns in single-shot spinal anaesthesia. All 32 agreed to participate and responded to all three rounds of the Delphi process. A patient representative also participated in the process (see online Supporting Information Appendix S1 for details of Delphi participants). Following the three rounds, consensus was reached on eight statements and 11 recommendations; two statements did not reach consensus (online Supporting Information Appendix S3). The results are presented below alongside a structured narrative literature review, to address: the impact of gowning on the risk of infective sequelae; the impact of gowning on time to establish anaesthesia; preprocedural recommendations for the clinician and the assistant; and attitudes to infection prevention measures, including the use of sterile gowns, for single-shot spinal anaesthesia. In this consensus statement, `uncomplicated´ refers to patients who are immunocompetent and/or for whom the procedure is expected to be neither difficult nor prolonged.

Impact of gowning on the risk of infective sequelae

The use of a sterile gown for spinal anaesthesia has been recommended since guidelines were published in the UK and Ireland in 2008 [2], and in Australia and New Zealand between 2015 and 2025 [3, 10]. However, evidence supporting this recommendation is lacking.

The original recommendation for sterile gown use during spinal and epidural procedures was based on the maximal barrier precautions recommended to reduce the risk of infective sequelae associated with central venous cannulation [16, 25, 26]. However, there are notable limitations comparing central venous catheter insertion with single-shot spinal anaesthesia. Central venous catheters remain in situ far longer, and their infection rates – whether or not maximal barrier precautions are used – are substantially higher than those following a single-shot spinal injection [27].

Literature and evidence specifically evaluating the impact of gowning on infection risk in neuraxial anaesthesia is sparse and largely limited to studies examining bacterial colonisation of epidural catheters [28]. No randomised controlled trials or cohort studies have assessed the impact of gowning on infective sequelae following single-shot spinal anaesthesia.

Obstetrics

Only one randomised controlled trial has investigated whether an anaesthetist wearing a sterile gown affects bacterial colonisation of epidural catheters inserted during obstetric analgesia [29]. All procedures were performed by anaesthetists wearing sterile gloves, facemask and cap and using sterile drapes, with patients allocated to groups with and without the use of sterile gowns. There was no significant difference in catheter-tip colonisation rates between the gowned and ungowned groups (7.6% vs. 9.2%, respectively).

Elective and emergency surgical procedures

Where epidurals were used for postoperative analgesia, the highest epidural catheter colonisation rate (12.2%) was reported by Yuan et al. when sterile gowns were not worn during epidural insertion [30]. Colonisation rates of 5.2–6.0% have been reported when the clinician used a sterile gown at the time of epidural catheter insertion [31, 32].

A closed claims analysis from the USA and the Netherlands identified that patients who developed a spinal abscess following neuraxial intervention were more likely to have undergone emergency surgery [33]. This was attributed either to an inherently higher infection risk in this patient group or to breaches of sterility associated with the urgent nature of the procedure, such as failure to wear a facemask during spinal anaesthesia. However, gown use was not addressed specifically.

Consensus statements relating to the impact of gowning on the risk of infective sequelae:

- **In uncomplicated adult patients undergoing elective obstetric procedures, performing a spinal without a gown does not increase the risk of infective sequelae (78% consensus)**.
- **In uncomplicated adult patients undergoing emergency obstetric procedures, performing a spinal without a gown does not increase the risk of infective sequelae (79% consensus)**.
- **In uncomplicated adult patients undergoing elective surgical procedures, performing a spinal without a gown does not increase the risk of infective sequelae (78% consensus)**.
- **In uncomplicated adult patients undergoing emergency surgical procedures, performing a spinal without a gown does not increase the risk of infective sequelae (78% consensus)**.

Impact of gowning on time to establish anaesthesia

Obstetrics

Time pressure in time-critical situations, such as category 1 caesarean birth (i.e. when there is ``*immediate threat to the life of the woman or fetus*''), has been cited as a reason for not wearing a gown when performing single-shot spinal anaesthesia [4, 34]. In 2010, Kinsella et al. described the ``*rapid sequence spinal*'' which aimed to minimise the time to establish neuraxial anaesthesia [34], and involved a no-touch technique with sterile gloves, but no gown. Although it is acknowledged that gowning adds a small amount of time to the procedure and that any delay in a time-critical obstetric emergency must be avoided, there have been no studies looking at the impact of gowning on time to establish anaesthesia or whether this small delay translates into clinically significant harm. The assumption that gowning contributes meaningfully to adverse maternal or neonatal outcomes therefore remains unproven and appears more a matter of perceived, rather than established, risk. It should be acknowledged that adequate surgical scrubbing will also take time.

Emergency surgery

In the general surgical population, the issue of gowning is unlikely to impact urgency, as neuraxial anaesthesia is rarely established under extreme time pressures in the non-obstetric setting. Nevertheless, even in this setting there is no evidence that gown use influences the time taken to establish single-shot spinal anaesthesia in a way that impacts patient care.

Consensus statement relating to the impact of gowning on time to establish anaesthesia:

- **In uncomplicated adult patients, for emergency surgical procedures, performing a spinal with a gown does not significantly increase the time to establish anaesthesia to a degree that is potentially detrimental to patient care (84% consensus)**.

Preprocedural recommendations for the clinician and their assistant

Hand hygiene

Handwashing is acknowledged universally as an essential component of aseptic practice for neuraxial anaesthesia [35–37]. However, there is variation in practice [35] and a lack of best practice guidelines regarding hand sanitising measures for these procedures [36]. A recent evidence review of surgical hand antisepsis techniques recommended that for clean hands (i.e. previously washed in water using soap or antimicrobial agent), either skin decontamination with surgical scrubbing (skin wetted in flowing warm water scrubbed with an antimicrobial agent) or surgical rubbing (clean dry skin first wetted then rubbed with an alcohol-based gel) with skin scrubbing or rubbing up to but below the elbows should be performed. Surgical scrubbing or rubbing should take at least 2 min to complete. For surgical scrubbing the skin should be dried by patting with a separate sterile single-use towel for each hand and forearm; after surgical rubbing, the alcohol should be allowed to evaporate fully [38].

Evidence specific to neuraxial anaesthesia is limited. One randomised controlled trial compared microbial colonisation on the forearms of operators following different hand antisepsis techniques [36]. In this study, the incidence of colonisation was lowest in the group that used alcohol gel only up to the elbows (2%), compared with the group who washed their hands with antimicrobial soap containing 0.3% Triclosan (Bacti-stat Antimicrobial Hand Soap, Ecolab, St Paul, MN, USA) and used a sterile towel to dry (15%). Hand washing followed by drying with a sterile towel and applying alcohol gel was less effective than the use of alcohol gel alone (3%), which may have been due to a less meticulous application and/or residual moisture on the skin.

Head coverings, sterile gloves and sterile drapes

Head coverings are deemed essential in the operating theatre and should be well-fitting and cover the hair fully [39]. The evidence base, however, is limited. Available data support their use for those in close proximity to the surgical field [40]; there are no studies evaluating the role of head coverings in neuraxial anaesthesia. With numerous infection prevention guidelines for neuraxial procedures emphasising the use of head coverings [5, 7, 41], it is unsurprising that their adoption is the subject of national surveys [35, 37]. In a survey of 1047 Canadian anaesthetists, 91% reported wearing a surgical cap and fresh facemask before inserting a labour epidural [35]. Similarly, a UK survey of obstetric anaesthetic units found that 87% of anaesthetists wore a surgical cap to insert an epidural catheter, whilst 90% required their assistant to also wear a cap and facemask [37].

There is a similar lack of research evaluating the use of sterile gloves and drapes for neuraxial anaesthesia. Given the clinician's hands come into contact with equipment and the patient's back following skin preparation, sterile gloves and drapes are recommended as key components of the aseptic technique [3, 5, 7, 41].

Sterile gowns

There is substantial international variation in gowning for spinal anaesthesia. Since 2008, guidance in the UK and Ireland has recommended the use of a sterile gown, as part of maximal/full barrier precautions [2]. Guidance from ANZCA aligned with this until 2025, when updated recommendations no longer mandated gown use [3, 10]. In contrast, American, Canadian and Brazilian guidelines do not recommend sterile gowns as part of infection control measures for single-shot spinal injections [7–9]. This variation was reflected in a 2018 survey of worldwide practice. All respondents in Canada, 94% of respondents in the USA and 91% of respondents in China reported `never´ gowning. In comparison, all respondents from the UK, Australia, Japan, New Zealand and Sweden reported `always´ gowning [4].

There is little evidence for the use of sterile gowns for single-shot spinal anaesthesia. Furthermore, details of gown-wearing are limited in case reports of bacterial meningitis following spinal anaesthesia. In one case report of *Escherichia coli* meningitis after spinal anaesthesia in Ethiopia, it was stated explicitly that the anaesthetist did not wear a gown [42]. However, other factors related to a breach of sterility must also be considered, including the use of povidone iodine from a multi-use container.

Surgical facemasks

Facemasks have long been a key component of national infection prevention guidelines for neuraxial procedures [2, 3, 7, 43, 44]. Despite this, international surveys of practice reveal considerable variation in facemask use for central neuraxial blockade. Before the publication of the Association of Anaesthetists' *Infection Control in Anaesthesia* guidance in 2008, 50.6% of respondents to an OAA survey reported not wearing facemasks for spinals or epidurals, and 20.1% of those who routinely wore facemasks did not believe that facemask-wearing reduced the risk of infection [45]. By 2009, a further UK survey showed 91% of respondents wearing a facemask for obstetric neuraxial blockade [37]. Comparatively, in an international survey of infection prevention in neuraxial catheterisation in labour, 96.7% of respondents reported always wearing a facemask, although in some countries this was as low as 66.7% [4].

Iatrogenic bacterial meningitis following spinal anaesthesia is most commonly caused by viridans group streptococci, particularly *Streptococcus salivarius* [46, 47]. Transmission from the mouth or upper airway of the anaesthetist or the assistant is the most likely origin of this organism, with pulsed field gel electrophoresis and polymerase chain reaction confirming links between respiratory and cerebrospinal fluid isolates [46–50].

Lee et al. reported a case of bacterial meningitis following spinal anaesthesia for caesarean delivery, presumed to be caused by inadequate aseptic technique [51]. Sterile gown and gloves were worn, but not a facemask, which the authors deemed to be of insignificant value except to protect patients from upper respiratory organisms dispersed by staff. However, more recently, understanding around the benefits of facemask wearing have changed and multiple case reports have been published highlighting their role in preventing iatrogenic bacterial meningitis [49–53].

Trautmann et al. presented three cases of bacterial meningitis after spinal and epidural anaesthesia. In two cases this was presumed secondary to contamination of the needle by oropharyngeal flora of the anaesthetist or the assistant; in the third case, the genotypic profile of the *Staphylococcus aureus* strain isolated from the anaesthetist's nasal swab was identical to the strain isolated from the patient [49]. Although facemasks were reportedly worn in all three cases, there was uncertainty about the fit and appropriateness of the facemask selected for the procedure.

Five cases of bacterial meningitis following intrapartum spinal anaesthesia were reported in New York and Ohio in September 2008 and May 2009, respectively [53]. *Streptococcus salivarius* was isolated in four of these patients, one of whom subsequently died. The three cases in New York were associated with a single anaesthetist, and the two in Ohio with another single anaesthetist, who notably did not wear a facemask and had the causative organism identified in a nasal swab.

Several other case reports highlight breaches in facemask use as a potential source of infection. Schneeberger et al. described four cases of streptococcal meningitis following spinal anaesthesia in the Netherlands, two involving unmasked anaesthetists and others linked to clinicians with recurrent pharyngitis; in all cases, assistants wore neither gloves nor facemasks [51]. Bouhemad et al. reported *Streptococcus salivarius* meningitis following combined spinal–epidural for labour where the anaesthetist was masked, but the assistant was not [52]. Barnwell and Ball described a case of *Streptococcus viridans* meningitis following spinal anaesthesia, noting oral droplet transmission as the likely source of infection, despite no reported issue with facemask wearing [48].

Experimental evidence supports these findings. Philips et al. showed the effectiveness of surgical facemasks in reducing bacterial contamination of a surface [54]. A freshly

applied facemask almost completely abolished bacterial contamination of agar plates 30 cm from the mouth. There was an increase in the level of contamination after 15 min, although this was statistically insignificant.

Consensus recommendations regarding preprocedural preparation for the clinician:

- **The use of sterile gowns is not important when undertaking spinal anaesthesia (78% consensus)**.
- **Head coverings are important when undertaking spinal anaesthesia (81% consensus)**.
- **Surgical hand antisepsis is important for the clinician undertaking spinal anaesthesia (97% consensus)**.
- **Surgical aseptic non-touch technique is important for the clinician undertaking spinal anaesthesia (97% consensus)**.
- **Surgical facemasks (Type 2 or 2R, covering the nose and extending to cover the mouth and chin) are important when undertaking spinal anaesthesia (97% consensus)**.
- **The use of sterile gloves is important when undertaking spinal anaesthesia (97% consensus)**.

Consensus recommendations regarding preprocedural preparation for the assistant (providing that assistants are not required to touch sterile equipment or the prepared field):

- **Sterile gloves are not important for the person assisting the clinician with spinal anaesthesia (85% consensus)**.
- **Surgical hand antisepsis is not important for when assisting with spinal anaesthesia (79% consensus)**.
- **Sterile gowns are not important for the person assisting the clinician with spinal anaesthesia (97% consensus)**.
- **Head coverings are important when assisting with spinal anaesthesia (79% consensus)**.
- **Surgical facemasks (Type 2 or 2R, covering the nose and extending to cover the mouth and chin) are important when assisting with spinal anaesthesia (84% consensus)**.

Attitudes to infection prevention measures

The American Society of Anesthesiologists and American Society of Regional Anesthesia and Pain Medicine emphasise the importance of aseptic technique for single-shot spinal anaesthesia, including hand washing, sterile gloves, caps, facemasks covering both mouth and nose, and sterile draping of the patient [7, 43]. This approach is supported by case reports and observational studies showing that infectious complications can occur when aseptic technique is not appropriately observed and that minimising risk is critical, recognising that infections may still occur despite full aseptic technique [43, 46–54].

Building on these society guidelines, recent Delphi consensus studies and national and international surveys have explored the prevailing attitudes among clinicians toward infection control for single-shot spinal anaesthesia [4, 7, 9, 35, 37]. A Delphi consensus process by the Canadian Anesthesiologists' Society concluded that sterile gowns should not be considered essential for single-injection regional anaesthesia techniques, with strong agreement among expert participants [9]. Instead, the focus should be on rigorous hand hygiene (preferably alcohol-based), sterile gloves and skin antisepsis as the essential components of aseptic technique.

While the importance of aseptic technique and minimising infection risk is acknowledged widely, there is significant variability in the adoption of specific measures [4]. One survey of practices during paediatric caudal blocks found that only 12% of respondents wore sterile gowns routinely [55]. Furthermore, participants of our Delphi process reported that they would be comfortable to change their practice to not wearing a gown for single-shot spinal anaesthesia. These findings suggest that many practitioners would be comfortable omitting a gown for single-shot spinal anaesthesia, provided other core aseptic precautions are maintained.

Randomised controlled trial data support this approach, showing no significant difference in catheter colonisation rates with or without gowning during neuraxial procedures [29]. The medical literature underscores that the critical elements for infection prevention are hand hygiene, sterile gloves and skin antisepsis, while the omission of a sterile gown for single-shot spinal anaesthesia is accepted increasingly among experts and reflected in current practice patterns [7–10].

The belief that the clinician's use of a sterile gown influences the assistant's adherence to infection control appears to be largely cultural rather than evidence based. In many institutions, the gown is viewed as a visual signal of sterility and a cue for the assistant to follow strict aseptic technique, reinforcing a `ritualised´ perception of safe practice. There is no published research that has investigated whether the presence or absence of a gown on the clinician measurably affects the assistant's behaviour or patient outcomes. However, behavioural studies have reported that adherence by senior staff to aseptic protocols and best practice reinforces a culture of compliance within the team. Operating theatre teams often mirror behaviour

of more experienced or authoritative team members [56, 57]. Infection control adherence depends primarily on core practices such as hand hygiene, use of gloves, draping and antiseptic skin preparation, rather than the gown itself. Thus, while wearing a gown may provide psychological reassurance or act as a social cue in the operating theatre, it does not appear to be a determinative factor in ensuring effective infection control.

Consensus statements regarding attitudes to infection control measures:

- **The observance of asepsis for undertaking single-shot spinal anaesthesia is important (97% consensus)**.
- **It is important to minimise the risk of infection from spinal cannulation for spinal anaesthesia (94% consensus)**.
- **Most participants of the Delphi process would be comfortable to change their practice to not wearing a gown for single-shot spinal anaesthesia (75% consensus)**.

Discussion

This consensus process provides important clarification regarding the role of the sterile gown in the performance of single-shot spinal anaesthesia for uncomplicated adult patients. The principal finding is that, in this context, the routine use of a sterile gown should not be considered mandatory. The evidence base underpinning gown use remains limited and inconclusive [6, 29, 43], and this lack of proven benefit has likely contributed to the wide international variation in practice, with gown use determined more by previous national recommendations and cultural practice than by strong evidence. By contrast, the group agreed that core aseptic practices, such as surgical hand and forearm skin decontamination, patient skin antisepsis and the use of sterile gloves, surgical facemasks and head coverings, should be undertaken thoroughly and meticulously.

One potential limitation of this work is that we chose not to specify in detail which patients should be perceived as `uncomplicated´. Whilst we discussed this at length among the working group and agreed that, in broad terms, it refers to a patient who is not immunosuppressed due to pathological or pharmacological causes, we opted not to attempt to define a specific list of circumstances in which this definition would or would not apply, to avoid the risk of a `tick box´ approach to decision-making. This is consistent with the approach taken by other guidance and emphasises the role of professional judgment in regional anaesthesia practice [58].

These guidelines have important implications for clinical practice. They support anaesthetists and institutions to adopt a more proportionate approach to infection prevention and focus attention and resources on the measures associated most strongly with reduced infection risk. At the same time, the recommendations respect the importance of clinical judgement, acknowledging that sterile gowns may be appropriate in some circumstances, such as when ergonomics, comorbidity or operator experience may increase the likelihood of infection. With this in mind, we recognise that using a gown may be appropriate during the early stages of anaesthetic training, where it may support the maintenance of asepsis during the acquisition of technical skills.

Potential benefits of this approach extend beyond direct patient safety. By avoiding the universal recommendation for sterile gowns, especially where reusable options are not available, unnecessary use of disposable materials may be reduced, contributing to improved cost-effectiveness, more resilient stock management and a smaller environmental footprint. In cases where a sterile gown is used, making the switch from single-use to reusable gowns can result in up to 45% cost savings and 69% carbon emissions savings [59]. Importantly, the recommendations were informed not only by professional consensus but also by patient perspectives, ensuring that infection-prevention strategies remain evidence-based and responsive to patient expectations.

It is important, however, to acknowledge potential risks. A relaxation of mandatory gown use may be misinterpreted as a reduction in the importance of infection prevention measures or lead to concern among patients or staff regarding procedural safety. These risks can be mitigated through clear communication of the rationale supporting the recommendations, reinforcement of the central role of core aseptic practices and ongoing surveillance of infection outcomes at institutional and national levels.

Although gown-wearing for spinal anaesthesia is a relatively recent practice in the UK, we recognise that any move away from universal gown use for single-shot spinal anaesthesia may be challenging. Such a transition would need to be implemented systematically, with regular audit and evaluation to ensure the observance of safe and standardised asepsis practice.

As these guidelines are based on expert opinion, drawing on a limited body of evidence, they should not be construed as an objection to individual, departmental or institutional decisions to continue the routine use of sterile gowns for single-shot spinal anaesthesia procedures for precautionary reasons. If further evidence is produced in the

future, these guidelines should be reviewed and updated accordingly.

In summary, this consensus statement establishes a balanced, evidence-aligned framework for aseptic practice in single-shot spinal anaesthesia. It provides clarity where practice has historically been heterogeneous, promotes consistency across healthcare systems and supports patient safety and environmental sustainability.

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Supporting Information

Additional supporting information may be found online via the journal website.

Appendix S1. List of Delphi Collaborators.

Appendix S2. Literature review search terms and strategy.

Appendix S3. Statements not reaching consensus during the Delphi process.