demonstrated this similar finding, as one patient of 39 TJA patients (2.6%) developed an infection after a contaminated case and the organism *Cutibacterium acnes* was the same as the one isolated from the previous infected case [3]. Of note, the sample size was small in this study, although this study encompassed a 5-year study period, indicating that few TJAs were performed after infected cases. On the other hand, a previous study examining 85 TJAs performed immediately after an infected case demonstrated no difference in deep or superficial infection risk at 12 months when compared to a matched cohort of 354 TJAs that did not follow a contaminated case [4]. The pathogen from the TJA infection that followed a contaminated case was due to a different organism than the pathogen present in the preceding infected case. Further research is needed to determine whether infection risk is increased when a primary TJA is performed after a contaminated surgical case.

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# QUESTION 2: Does the use of sterile surgical vests decrease the risk of contamination or incidence of infection following total joint arthroplasty (TJA)?

**RECOMMENDATION:** The use of sterile surgical vests has no bearing on the incidence of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) following orthopaedic procedures.

**LEVEL OF EVIDENCE:** Consensus

**DELEGATE VOTE:** Agree: 85%, Disagree: 6%, Abstain: 9% (Super Majority, Strong Consensus)

## RATIONALE

The optimal choice of gown material, type of surgical attire and method of donning operating room personal protective equipment has long been debated. Despite the current era of evidence-based medicine, surgical clothing remains steeped in historic practices based on literature over 30 years old and the notion of "what we have always done." Overall, the evidence surrounding surgical gowning/vests is poor. On systematic review, using PubMed, Ovid-MEDLINE®, Embase, PEDro, Cochrane Library, Scopus, Web of Science, ERIC and CINAHL Plus, we identified 1,356 articles using search terms related to surgical vests, gowns or suits; orthopaedic vests, gowns, suits, exhaust, helmet and surgical textiles. Of these, only 25 were pertinent to our study and represented a heterogeneous group.

It is an issue of significant socioeconomic value given the risk of exposure to contaminants and SSI following TJA. Guidelines from various bodies (World Health Organization, Association of Perioperative Registered Nurses, National Institute for Health and Care Excellence) appear to be based more in "expert opinion" and pragmatic approach rather than scientific evidence. On occasion, these guidelines appear contradictory and incomplete [1,2]. Many papers had major methodological flaws in study design and severe observer bias such that they would not merit inclusion in the study. Of those studies included, several use unproven links such as the reduction of bacterial counts and skin squamous cells as a proxy for infection.

The part of the surgical gown below the level of the operating table and above the chest level appears to be more contaminated [3]. Gowning and gloving appear to generate air particles in an operating room environment, although this appears less so at the level of the operating table under laminar airflow [4].

Exhaust suits have been thought to contribute to reduction of SSI for many years [5]. In addition, it is advocated that they protect the surgical team from contamination during orthopaedic procedures [6]. In a randomly allocated study of different surgical attires used for total knee arthroplasty, body exhaust suits produced less air contamination than occlusive polyester gowns, but no difference was identified in wound contamination [7]. In a combination of hip and knee arthroplasty series, filtered exhaust helmets provided no increased protection against bacterial contamination in the area of the surgical field versus conventional hoods and masks [8]. In comparison to established occlusive polyester gowns, more modern liquid-proof fabric gowns have received criticism that they produce increased air contamination [9]. Disposable non-sterile hoods appear to be equally efficient to helmet systems in containing bacteria in air and surgical site surface [10]. In another study, space suits appear to cause more particle counts in the operating room with surgeon motion compared to standard surgical gowns [11]. Space suits do seem to offer protection in bacterial air contamination at the surgical site compared to conventional surgical suits [12]. Disposable polypropylene clean air suits with cuffs at the sleeves and legs appear to reduce air contamination compared to other suits [13,14]. Reusable surgical gowns show more bacterial penetration compared to disposable spun-bonded gowns [15,16]. Tightly woven special scrub suits do not seem to reduce air or wound contamination with methicillin-resistant *Staphylococcus epidermidis* (MRSE) and the most common source of MRSE remains the patient [17].

Modern positive-pressure surgical helmet systems differ from the earlier negative-pressure body exhaust systems, which were noted to reduce surgical site infection [18]. Furthermore, not all surgical helmet systems compare similarly as far as the contamination of the glove-gown interface is concerned. Specifically, positive pressure systems show more contamination in this area, even compared to conventional sterile gowns [19]. This has been attributed to contamination at the glove-gown interface [20,21]. A randomized study of standard surgical gowns and positive-pressure surgical helmet systems, with and without cuff/glove taping, found

more positive surgical site cultures with helmets and tape, but this was not statistically significant [22]. Direct contact with the sterile helmet is discouraged as a significant number may be contaminated during joint arthroplasty and sterility should not be presumed [11]. In a very large cohort of primary total hip arthroplasty, procedures where a body exhaust system was used showed a higher deep infection incidence, but this did not prove to be a risk factor in multivariate analysis [23].

Overall, the study quality on the subject of sterile surgical attire is low in most instances. Tangible conclusions on which type of attire, material, system and combinations leads to reduction of contamination or incidence of infection following TJA cannot be reached. There appear to be several reports of contamination using sterile helmet systems. Whether that leads to increased incidence of infection remains to be shown. In summary, a weak recommendation of sterile surgical gowns for TJA is put forward, as best "common sense" practice in the absence of robust evidence [24], but the use of modern helmet systems would not be recommended in preventing SSI.

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# QUESTION 3: Does the use of personal protection suits (space suits) influence the rate of surgical site infections/periprosthetic joint infections (SSIs/PJIs) in patients undergoing joint arthroplasty?

**RECOMMENDATION:** In the absence of strong evidence, we believe the use of personal protection suits does not reduce the rate of subsequent SSIs/PJIs in patients undergoing joint arthroplasty.

**LEVEL OF EVIDENCE:** Moderate

**DELEGATE VOTE:** Agree: 87%, Disagree: 11%, Abstain: 2% (Super Majority, Strong Consensus)

## RATIONALE

Initial personal protection suits, which aimed to protect the surgical site by reducing microbial contamination and subsequent infection from the operation staff, were negative pressure body exhaust suits with inflow and outflow tubing creating a negative pressure inside the suit. Shed particles were vented away from the surgical site by the tubing. Due to the cumbersome nature of the tubing, more port-