



HHS Public Access

Author manuscript

Infect Control Hosp Epidemiol. Author manuscript; available in PMC 2016 April 04.

Published in final edited form as:

Infect Control Hosp Epidemiol. 2014 February ; 35(2): 107–121. doi:10.1086/675066.

Expert Guidance: Healthcare Personnel Attire in Non-Operating Room Settings

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Abstract

Healthcare personnel (HCP) attire is an aspect of the medical profession steeped in culture and tradition. The role of attire in cross-transmission remains poorly established and until more definitive information exists, priority should be placed on evidence-based measures to prevent hospital acquired infections (HAI).

This paper aims to provide a general guidance to the medical community regarding HCP attire outside the operating room. In addition to the initial guidance statement, the manuscript has three major components: 1. A review and interpretation of the medical literature regarding a) perceptions of HCP attire (from both HCP and patients) and b) evidence for contamination of attire and its potential contribution to cross-transmission; 2. A review of hospital policies related to HCP attire, as submitted by members of the SHEA Guidelines Committee; 3. A survey of SHEA and SHEA Research Network members, which assessed both institutional HCP attire policies and perceptions of HCP attire in the cross-transmission of pathogens.

Recommendations for HCP attire should attempt to balance professional appearance, comfort, and practicality with the potential role of apparel in the cross-transmission of pathogens. Although the optimal choice of HCP attire for inpatient care remains undefined, we provide recommendations on the use of white coats, neck ties, footwear, the bare-below-the-elbows strategy, and laundering. Institutions considering these optional measures should introduce them with a well-organized communication and education effort directed at both HCP and patients. Appropriately designed studies are needed to better define the relationship between HCP attire and HAIs.

Background

Healthcare personnel (HCP) attire is an aspect of the medical profession steeped in culture and tradition. From Hippocrates' admonition that physicians' dress is essential to their dignity, to the advent of nurses' uniforms under the leadership of Florence Nightingale, to the white coat ceremonies that continue to this day in medical schools, HCP apparel and appearance is associated with significant symbolism and professionalism. Recent years, however, have seen a rising awareness of the potential role of fomites in the hospital environment in the transmission of healthcare-associated microorganisms. Although studies have demonstrated contamination of HCP apparel with potential pathogens, the role of clothing in transmission of these microorganisms to patients has not been established. The paucity of evidence has stymied efforts to produce generalizable, evidence-based recommendations, resulting in widely disparate practices and requirements that vary by country, region, culture, facility, and discipline. This document is an effort to analyze the available data, issue reasonable recommendations, and describe the needs for future studies to close the gaps in knowledge on HCP attire.

Intended Use

This document is intended to help acute care hospitals develop or modify policies related to HCP attire. It does not address attire in the operating room (OR), perioperative areas, or other procedural areas, and is not intended to guide HCP attire in those settings, or in healthcare facilities other than acute care hospitals.

SHEA Writing Group

The writing group consists of volunteers among members of the SHEA Guidelines Committee, including those with research expertise on this topic.

Key Areas Addressed

We evaluated and summarized the literature around two aspects of HCP attire (details provided in the Methods section):

- I. Perception of both patients and HCP regarding HCP attire in relation to professionalism and potential risk for transmission of microorganisms.
- II. Evidence for contamination of HCP attire and the potential for HCP attire to contribute to the transmission of pathogenic microorganisms in hospitals.

In addition, we performed a survey of the SHEA membership and SHEA Research Network to learn more about the policies related to HCP attire that are currently in place in members' institutions.

Guidance and Recommendation Format

Because this topic lacks the level of evidence required for a more formal guideline using the GRADE system, no grading of the evidence level is provided for individual recommendations. Each guidance statement is based on synthesis of limited evidence, theoretical rationale, practical considerations, a survey of SHEA membership and the SHEA Research Network, author opinion, and consideration of potential harm where applicable. An accompanying "rationale" is listed alongside each recommendation.

Guidance Statement

There is a paucity of data on the optimal approach to HCP attire in clinical, non-surgical areas. Attire choices should attempt to balance professional appearance, comfort, and practicality with the potential role of apparel in the cross-transmission of pathogens resulting in healthcare-associated infections (HAIs).

As the SHEA workgroup on HCP attire, we recommend the following:

- I. Appropriately designed studies should be funded and performed to better define the relationship between HCP attire and HAIs.
- II. Until such studies are reported, priority should be placed on evidence-based measures to prevent HAIs (e.g. hand hygiene, appropriate device insertion and care, isolation of patients with communicable diseases, environmental disinfection).
- III. The following specific approaches to practice related to HCP attire may be considered by individual facilities; however, in institutions that wish to pursue these practices, measures should be voluntary and accompanied by a well-organized communication and education effort directed at both HCP and patients.
 - A. **"Bare below the elbows" (BBE)¹**: Facilities may consider adoption of a BBE approach to inpatient care as an infection prevention adjunct, although the optimal choice of alternate attire, such as scrub uniforms or other short sleeved personal attire remains undefined.
 1. Rationale: While the incremental infection prevention impact of a BBE approach to inpatient care is unknown, this practice is supported by biological plausibility and studies in laboratory and clinical settings, and is unlikely to cause harm.
 - B. **White Coats**: Facilities that mandate or strongly recommend use of a white coat for professional appearance should institute one or more of the following measures:

¹This paper defines BBE as HCP's wearing of short sleeves, no wristwatch, no jewelry, and no ties during clinical practice.

1. HCP engaged in direct patient care (including housestaff and students) should possess two or more white coats and have access to a convenient and economical means to launder white coats (e.g. on site institution provided laundering at no cost or low cost).
 - i. Rationale: These practical considerations may help achieve the desired professional appearance yet allow for HCP to maintain a higher frequency of laundering of white coats.
 2. Institutions should provide coat hooks that would allow HCP to remove their white coat (or other long-sleeved outerwear) prior to contact with patients or the patient's immediate environment.
 - i. Rationale: This practical consideration may help achieve the desired professional appearance yet limit patients' direct contact with potentially contaminated attire, and avoid potential contamination of white coats that may otherwise be hung on inappropriate objects in the hospital environment.
- C. Other HCP apparel:** Based on the current evidence, we cannot recommend limiting the use of other specific items of HCP apparel (such as neckties).
1. Rationale: The role of neckties and other specific items of HCP apparel on the horizontal transmission of pathogens remains undetermined. If neckties are worn, they should be secured by a white coat or other means to prevent them from coming into direct contact with the patient or near-patient environment.
- D. Laundering:**
1. **Frequency:** Optimally, any apparel worn at the bedside that comes in contact with the patient or patient environment should be laundered after daily use. In our opinion, white coats worn during patient care should be laundered no less frequently than once a week and when visibly soiled.
 - i. Rationale: White coats worn by HCP who care for very few patients or by HCP who are infrequently involved in direct patient care activities may need to be laundered less frequently than white coats worn by HCP involved with more frequent patient care. At least weekly laundering may help achieve a balance between microbial burden, visible cleanliness, professional appearance, and resource utilization.
 2. **Home laundering:** Whether HCP attire for non-surgical settings should be laundered at home or professionally remains unclear. If laundered at home, a hot water wash cycle (ideally with bleach) followed by a cycle in the dryer is preferable.
 - i. Rationale: A combination of washing at higher temperatures and tumble drying or ironing has been associated with

elimination of both pathogenic Gram-positive and Gram-negative bacteria.

- E. HCP footwear:** All footwear should have closed toes, low heels, and non-skid soles.
 - 1. Rationale: The choice of HCP footwear should be driven by a concern for HCP safety and should decrease the risk of exposure to blood or other potentially infectious material, sharps injuries, and slipping.
- F. Identification:** Name tags or identification badges should be clearly visible on all HCP attire for identification purposes.
 - 1. Rationale: Name tags have consistently been identified as a preferred component of HCP attire by patients in several studies, are associated with professional appearance, and are an important component of a hospital's security system.
- IV. Shared equipment including stethoscopes** should be cleaned between patients.
- V. No guidance can be made in general regarding prohibiting items like lanyards, identification tags and sleeves, cell phones, pagers, and jewelry, but those items that come into direct contact with the patient or environment should be disinfected, replaced, or eliminated.**

Methods

Using PubMed/Medline, between the months of January and May 2013 we searched the English literature for articles pertaining to HCP attire in clinical settings focusing on areas outside the OR. We included all studies dealing with either bacterial contamination and laundering of HCP attire, patients' and providers' perceptions based on the type of attire, and HCP footwear.

Additionally, we reviewed and compared the hospital policies related to HCP attire from seven large teaching hospitals, as submitted by members of the SHEA Guidelines Committee. Finally, between February and May 2013, we sent out a survey to all SHEA members to assess their institutional HCP attire policies (if any) and to determine their perceptions of HCP attire as a vehicle for potential transmission of pathogens.

Results

I. Patients' Perceptions of HCP Attire

We identified 26 studies (published from 1990 onwards) that examined patients' perceptions of HCP attire¹⁻²⁶(Table 1). Most (23/26) studies surveyed patient preference for different types of HCP attire^{1-6,8-18,20-25}using either pictures of models in various dress styles^{3,4,7-9,15-18,20,22-24} or descriptions of attire^{1,5,11,14,21,25}. Four studies^{6,10,12,13} asked patients to assess the attire of their actual physicians. Attire descriptions and terminology varied among studies (e.g. "formal", "business", "smart", "suit and tie", and "dress"), and

will be referred to hereafter as “formal attire”. We refer to “casual attire” as anything other than formal attire.

A. Formal Attire and White Coats

Most of the studies using pictures and models of HCP attire indicated patient preference for formal attire, which was favored over both scrubs^{1,3,7,9,18,22} and casual attire^{7,9,15,16,19,22}. However, several other studies revealed that physician attire was unlikely to influence patients’ levels of comfort^{4,20}, satisfaction, trust, or confidence in the physicians’ abilities^{2,4,9,19,20,25} even if patients previously had expressed preference for one type of attire^{4,9,20,25}.

Fifteen studies addressed white coats^{1,4,7-9,11-17,20-22}. In 10 of these 15 studies, patients preferred that physicians wear white coats^{1,7-10,12,15-17}, and in one study, patients reported feeling more confident in those physicians⁸. Similarly, two studies showed significant association between the presence of a white coat, especially on a female physician, and patients’ trust and willingness to share sensitive information²². Patients also indicated less comfort in dealing with an informally dressed physician¹⁶, describing a shirt and a tie as the most professional and desirable attire for physicians²³⁻²⁵ in addition to an overall well-groomed appearance^{5,15}. Moreover, the following items were deemed as inappropriate or undesirable: jeans^{5,14}, shorts¹⁵, clogs^{14,15}, and open-toed sandals¹⁵. In the remaining five studies, patients showed no clear predilection for one dress style over another or did not consider a white coat either necessary or expected^{4,11,13,20,21}.

Five studies assessed patient satisfaction, confidence, or trust based on their treating physicians’ dress^{2,6,10,12,13} showing little response variations regardless of apparel. A survey of patients seen by obstetricians/gynecologists who were randomly assigned formal attire, casual attire, or scrubs found high satisfaction with physicians regardless of the group allocation⁶. Similarly, in a before-and-after trial, emergency department (ED) physicians were asked to wear formal attire with a white coat one week, followed by scrubs the subsequent week. Using a visual analog scale, patients rated their physician’s appearance, professionalism, and satisfaction equally regardless of the week of observation¹³. Another ED study found no difference in patients’ satisfaction with the care provided when their physicians wore white coats combined with either scrubs or formal attire.² Similarly, two groups of patients who received preoperative care by the same anesthesiologist wearing either formal attire for one group of patients or casual attire for the other found no differences in patient satisfaction between the groups¹⁰. In contrast, one crossover trial involving physicians dressed in “respectable” or formal versus “retro” or casual attire found patient confidence and trust were higher with the “respectable” dress protocol¹⁹. Another study evaluating the attire of patients’ treating physicians indicated preference for polished shoes and short hair for men, with jeans, clogs, trainers, and earrings on men being rated as undesirable¹⁰. A survey among Japanese outpatients indicated preference for

white coats but no significant difference in satisfaction levels based on attire¹² when presented with physicians wearing white coats or “non-institutional clothes”.

B. Bare Below the Elbows (BBE)

Preference for BBE was assessed in six studies originating in the UK following implementation of the nationwide BBE policy^{1,3,23-25}, and in one U.S. study.¹¹ In these seven reports, patients did not prefer short sleeves. After informing patients of the BBE policy, older patients were more likely to prefer short-sleeved shirts without ties, while younger patients favored scrubs¹. After providing information about potential for cross-contamination from shirt sleeve cuffs and neckties, responses changed from a preference for formal or long-sleeved attire to a preference for short-sleeves or scrubs.^{11,18,23} In addition, Shelton et al. also found an association between physician gender and BBE attire: after a statement informing the participants of the potential cross transmission of microorganisms by attire, patients preferred scrubs for female physicians but did not differentiate between scrubs and short-sleeved shirts for male physicians.²³

C. Ties

Neckties were specifically addressed in several studies from the UK^{5,21,24}. In one study, patients reported that attire was important but that neckties were not expected²¹. Similarly, in a survey among individuals in the public concourse of a hospital, 93% had no objection to male physicians not wearing ties⁵. None of these studies evaluated neckties in the context of patients’ perceptions of infection prevention.

D. Laundering of Clothes

In one study, patients identified “daily laundered clothing” as the single most important aspect of physicians’ appearance⁸.

E. Other Factors

Several additional variables may influence patient preference for physician attire, including age of either the patient or the managing physician, gender of the practitioner, time of day, setting, and the attire patients are accustomed to seeing. In Japan, older patients were more likely to prefer white coats¹². Similarly, older patients in England found scrubs less appealing when compared to younger patients⁸. Pediatric dental patients were more likely than their parents to favor casual attire¹⁷. Patients preferred formal attire for senior consultants but thought that junior physicians should be less formal¹. Patients identified female physicians’ attire as more important than the attire worn by male physicians²². Formal attire was less desirable by patients seen during the night shift⁹. Parents of children being seen in the ED favored surgical scrubs. Additionally, two trials evaluated the attire preference based on what patients often see their HCP wearing. In one trial, patients accustomed seeing their anesthesiologist in a suit were more likely to find suits and ties desirable¹⁰. Similarly, the practice to which a patient belonged was found as an independent factor in the patient’s choice of preferred attire¹⁶;

however, another study found poor agreement between patient preferences and their physicians' typical attire ¹¹.

In summary, patients express preferences for certain types of attire, with most studies indicating a predilection for formal attire, including a white coat, but these partialities had limited overall impact on patient satisfaction and confidence in practitioners. This is particularly true in trials that evaluated the effect of attire on patient satisfaction in real-world settings. Patients generally do not perceive white coats, formal attire, or neckties as posing infection risks; however, when informed of potential risks associated with certain types of attire, patients appear willing to change their preferences for physician attire.^{11,18}

HCP Perceptions Regarding Attire

Few studies evaluated HCP preferences with regards to attire ^{5,6,14,26}. While most studies addressed specific elements of HCP attire, one study looked at overall importance of attire and found that 93% of physicians and nurses versus 83% of patients thought that physician appearance was important for patient care ($P < .001$) ²⁶.

A. White Coats

In a survey exploring perceptions of surgeons' apparel performed among surgeons themselves, inpatients, and non-hospitalized public, all three groups were equally likely to consider a white coat necessary and blue jeans inappropriate. Surgeons were more prone to consider scrubs and clogs appropriate ¹⁴. In another survey among 15 obstetricians/gynecologists, 8 preferred casual attire while 7 preferred formal attire⁶. Three studies assessed HCP alongside patient perception of infection risk or lack of hygiene associated with white coat, formal attire, or neckties ^{3,24,26}, with one finding that HCP were more likely than patients to consider white coats unhygienic²⁶.

B. Ties

In a survey performed in a public concourse of a UK hospital, HCP were more likely than non-HCP to prefer physicians' wearing of neckties for reasons of professionalism ⁵.

C. Laundering of Clothes

A recent survey showed that non-surgical providers preferentially—and without prompting—laundered their scrubs every 1.7 ± 0.1 days (mean \pm standard error) compared to white coats, which were laundered every 12.4 ± 1.1 days ($p < 0.001$); however, the reasons for this divergent behavior remain unclear ²⁷.

III. Studies of Microbial Contamination of Apparel in Clinical and Laboratory Settings

No clinical studies have demonstrated cross-transmission of healthcare-associated pathogens from a HCP to a patient via apparel; however, a number of small prospective trials have demonstrated the contamination of HCP apparel with a variety of pathogens ^{5,28-37}.

A. White Coats/ Uniforms

The five studies we evaluated indicate that physician white coats and nursing uniforms may serve as potential sources of colonization and cross-transmission. Several studies described contamination of apparel with *S. aureus* in the range of 5% to 29%^{30,33-35,38}. Although Gram-negative bacilli have also been identified, these were for the most part of low pathogenicity^{30,35} however, actual pathogens such as *Acinetobacter* spp., *Enterobacteriaceae*, and *Pseudomonas* spp. have been reported³⁸.

A number of factors were found to influence the magnitude of contamination of white coats and uniforms. First, the degree of contamination was correlated with more frequent usage of the coat³⁵, recent work in the inpatient setting³⁴, and sampling certain parts of the uniform. Higher bacterial loads were found on areas of clothing that were more likely to come into contact with the patient, such as the sleeve³⁵. Additionally, the burden of resistant pathogens on apparel was inversely correlated with the frequency of lab coat change³⁸. Apparel contamination with pathogenic microorganisms increased over the course of a single patient care shift. Burden et al. demonstrated that clean uniforms become contaminated within only a few hours of donning them²⁸. Similarly, a study testing nurses' uniforms both at the beginning and end of their shifts described an increase in the number of uniforms contaminated with one or more microorganisms from 39% to 54%, respectively. The proportion of uniforms contaminated with VRE, MRSA and *C. difficile* was also noted to increase with shift work³³.

In the first report of a positive correlation between contamination of hands and contamination of white coats, Munoz-Price et al. cultured the hands, scrubs, and white coats of intensive care unit staff³⁹. The majority of bacteria isolated from hands were skin commensals, but HCP were also found to have contamination of hands, scrubs, and white coats with potentially pathogenic bacteria including *S. aureus*, *Enterococcus* spp., or *A. baumannii*. Among dominant hands, 17% of 119 hands were contaminated with one of these species, and staff members with contaminated hands were more likely to wear a white coat contaminated with the same pathogen. This association was not observed with scrubs.

B. Bare Below the Elbows (BBE)

Two observational trials evaluated the bacterial contamination of HCP's hands based on BBE attire versus controls, finding no difference in total bacterial counts or in the number of clinically significant pathogens^{40,41}. In contrast, using a fluorescent method, Farrington et al. examined the efficacy of an alcohol hand wash among BBE providers versus controls⁴². The authors found decreased efficacy of hand hygiene at the wrist-level in the non-BBE group, suggesting that the BBE approach may improve wrist disinfection during hand washing.

The United Kingdom (U.K.) has adopted a BBE approach, based on the theory that it will limit patient contact with contaminated HCP apparel and to promote better hand and wrist hygiene. However, a randomized trial comparing bacterial contamination of white coats against BBE found no difference in total bacterial or

MRSA counts (on either the apparel itself or from the volar surface of the wrist) at the end of an eight-hour workday²⁸.

C. Scrubs

The use of antimicrobial-impregnated scrubs has been evaluated as a possible solution to uniform contamination. In a prospective, randomized crossover trial of 30 HCP in the ICU setting³⁶, when compared to standard scrubs, antimicrobial impregnated scrubs were associated with a 4 to 7 mean log reduction in surface MRSA burden, though there was no difference in the MRSA load on HCP hands nor in the number of VRE or Gram-negative bacilli cultured from the scrubs. The study did not assess the HAI impact of the antimicrobial scrubs.

D. Ties

Several studies indicated that neckties may be colonized with pathogenic bacteria, including *S. aureus*. Lopez et al. reported significantly higher bacterial burden on neckties than on the front shirt pocket of the same subject. In three studies, up to 32% of physician neckties grew *S. aureus*^{5,31,37}. Steinlechner et al. identified additional potential pathogens and commensals from necktie cultures, including *Bacillus* species and Gram-negative bacilli³⁷. Two reports found up to 70% of physicians admitted having never cleaned their ties^{5,31}.

E. Laundering of Clothes

Numerous manuscripts published during the past 25 years describe the efficacy of laundering hospital linens and HCP clothing⁴⁴, but most experiences on the laundering of HCP attire have employed *in vitro* experimental designs that may or may not reflect real life conditions. A 2006 study⁴⁵ demonstrated that while clothes lost their burden of *S. aureus*, they concomitantly acquired oxidase-positive Gram-negative bacilli in the home washing machine. These bacteria were nearly eliminated by tumble drying or ironing. Similarly, investigators found that recently laundered clothing material acquired Gram-negative bacteria from the washing machine, which were subsequently eliminated by ironing. Another *in vitro* study in the U.K. compared the reduction of microorganisms on artificially inoculated nurses' uniform material after washing at various temperatures, as well as with and without detergents. Washing uniforms contaminated with MRSA and *Acinetobacter* spp. at a temperature of 60 degrees Celsius, with or without detergent, achieved at least a 7-log reduction in bacterial burden of both microorganisms.⁴⁶ There is no robust evidence that centralized industrial laundering decontaminates clothing more effectively than home laundering⁴³.

F. Footwear

Although restrictions on HCP footwear are influenced by a desire to meet patients' preferences for appropriate attire^{10,14,15}, most are driven by concerns for HCP safety⁴⁷⁻⁵⁰. Studies have found that wearing of shoes with closed toes, low heels, and non-skid soles can decrease the risk of exposure to blood or other potentially infectious material^{47,48,50,51}, sharps injuries^{48,50,52}, slipping, and musculoskeletal disorders⁴⁹.

Casual, open footwear such as sandals, clogs, and foam clogs potentially expose feet to injury from dropped contaminated sharps and exposure to chemicals in healthcare facilities. A comparison of needle stick injury surveillance data from the standardized Exposure Prevention Information Network [EPINet] program revealed a higher proportion of hollow-bore needle injuries to feet of Japanese HCP with 1.5% of 16,154 total injuries compared with 0.6% of 9,457 total injuries for U.S.HCP (2.5 times higher; $p < .001$)⁴⁸. Although multiple factors were linked to these injuries, one included the common practice in Japan to remove outdoor shoes and replace them with open-toed slippers upon hospital entry.

Footwear is an area of increased concern in the operative room. The Association of periOperative Registered Nurses (AORN) recommends that OR footwear have closed toes as well as backs, low heels and non-skid soles to prevent slipping⁵⁰. The U.S. Occupational Safety and Health Administration (OSHA) requires the use of protective shoes in areas where there is a danger of foot injuries from falling objects or objects piercing the soles⁴⁷. One study that measured the resistance of shoes to penetration by scalpels showed that of the 15 pairs of shoes studied, only six were made of material that was sharp-resistant including sneaker suede, suede with inner mesh lining, leather with inner canvas lining, non-pliable leather, rubber with inner leather lining, and thickerrubber⁵². The OSHA bloodborne pathogens standard mandates that employers determine the workplace settings in which gross contamination with blood or body fluids is expected, such as the OR, and to provide protective shoe coverings in those settings^{47,48,50,51}. Shoe covers are not meant to prevent transmission of bacteria from the OR floor; in fact, preliminary data show that the OR floor may play a dynamic role in the horizontal transmission of bacteria due to frequent floor contact of objects that then directly touch the patient's body (e.g. intravenous tubing, electrocardiogram (EKG) leads)⁵³.

When HCP safety concerns or patient preference conflict with a HCP's desire for fashion, a facility's dress code can be the arbiter of footwear. OSHA allows employers to make such dress code determinations without regard to a worker's potential exposure to blood, other potentially infectious materials, or other recognized hazards.

IV. Outbreaks linked to HCP Apparel

Wright et al. reported an outbreak of *Gordonia* potentially linked to HCP apparel⁵⁴. In this report, post-operative sternal wound infections with *Gordoniabronchialis* in three patients were linked to a nurse anesthetist. *Gordonia* was isolated from the HCP's scrubs, axillae, hands, and purse and from multiple sites on the HCP's roommate.

V. Studies from Developing Countries

In Nigeria, factors identified increasing the likelihood of bacterial contamination of white coats included daily laundering and use limited to patient care rather than non-clinical duties.⁵⁵ In India⁵⁶ medical students' white coats were assessed for bacterial contamination, paired with surveys about laundering habits and attitudes toward white coats. Coats were contaminated most frequently with *S. aureus*, followed by *Pseudomonas* spp. and coagulase-

negative Staphylococci. A similar trial of white coats used by staff in a rural dental clinic also revealed predominantly Gram-positive contamination⁵⁷.

VI. Hospital Policies Addressing HCP Attire

We reviewed and compared policies related to HCP attire from seven large teaching hospitals or health systems. In general, policies could be categorized into two groups:

- A. General appearance and dress of all employees
- B. Standards for healthcare personnel working in sterile or procedure-based environments (OR, central processing, procedure areas, etc.).

Policies were evaluated for the following elements:

- A. Recommended clothing (e.g. requirement for white coats, designated uniforms) or other options (e.g. BBE)
- B. Guidance regarding scrubs
- C. Use of nametags
- D. Wearing of ties
- E. Requirements for laundering or change of clothing
- F. Footwear, and non-apparel items worn or carried by HCP
- G. Personal protective equipment.

All institutions' human resources (HR) policies outlined general appearance or dress code requirements for professional standards of business attire; however, institutions varied in job-specific policies and for the most part did not address more specific attire requirements except for OR related activities. Few institutional policies included enforcement provisions. The institutions that required accountability varied from detailing the supervisor's administrative responsibilities to more specific consequences for employee noncompliance.

Three institutions recommended clothing (such as color-coded attire) for specific types of caregivers (e.g. nurses, nurses' assistants, etc.). Policies specific to clinical personnel were most frequently related to surgical attire, including scrubs, use of masks, head covers, and footwear in restricted and semi-restricted areas and surgical suites, and central processing, as consistent with AORN standards. Scrubs were universally provided by the hospital in these settings. Laundering policies clearly indicated that laundering of hospital-provided scrubs was to be performed by the hospital or at a hospital-accredited facility. Use of masks, head covers, footwear, and jewelry were generally consistent with AORN standards.

Excluding surgical attire, only one institution provided guidance specific to physicians, outlining a recommendation for BBE attire during patient care. This policy specified not to use white coats, neckties, long sleeves, wristwatches, or bracelets. Institutional policies also varied in recommendations for laundering and change of clothing other than for surgical attire. No specific guidance was issued for other uniforms, other than cleanliness and absence of visible soiling; however, one institution referred to infection control specifications for maintenance of clothing. Guidance regarding frequency of clothing change

was variable for scrubs, from nonspecific requirements (e.g., wearing freshly laundered surgical attire on entry to restricted/semi-restricted areas) to specific requirements (clean scrubs once per shift to once daily, and if visibly soiled). In addition, most policies included instructions for HCP to remove scrubs and change into street clothes either at the end of the shift, or when leaving the hospital or connected buildings.

VII. Survey Results

A total of 337 SHEA members and members of the SHEA Research Network (20%)² responded to the survey regarding their institutions' policies for HCP attire. The majority of respondents worked at hospitals (91%); additional facilities included 4% free-standing children's hospitals, 1% free-standing clinics, and 5% other facility types, such as long-term acute care hospitals, multi-hospital systems, short-term nursing facilities, and rehabilitation hospitals (rounding of numbers accounting for % greater than 100). The majority of responses were from either university/teaching hospitals (39%) or university/teaching affiliated hospitals (28%). We received additional responses from non-teaching hospitals (24%), VA hospitals (3%), specialty hospitals (2%), and miscellaneous facilities (4%).

Enforcement of HCP attire policies was low at 11%. A majority of respondents (65%) felt that the role of HCP attire in the transmission of pathogens within the healthcare setting was very important or somewhat important.

Only 12% of facilities encouraged short sleeves, and 7% enforced or monitored this policy. Pertaining to white coats, only 5% discouraged their use and, of those that did, 13% enforced or monitored this policy. For watches and jewelry, 20% of facilities had a policy encouraging their removal. A majority of respondents, 61%, stated that their facility did not have policies regarding scrub, scrub-like uniforms, or white coats in non-clinical areas. Thirty-one percent responded that their hospital policy stated that scrubs must be removed before leaving the hospital, while 13% stated that scrubs should not be worn in non-clinical areas. Neckties were discouraged in 8% of facilities but none monitored or enforced this policy.

Although 43% of respondents stated that their hospitals issued scrubs or uniforms, only 36% of facilities actually laundered scrubs or uniforms. A small number of hospitals provided any type of guidance on home laundering: 13% provided specific policies regarding home laundering while 38% did not.

In contrast to other items of HCP attire, half of facilities required specific types of footwear, and 63% enforced and/or monitored this policy.

Discussion

Overall, patients express preferences for certain types of attire, with most surveys indicating a preference for formal attire, including a preference for a white coat. However, patient comfort, satisfaction, trust, and confidence in their physicians is unlikely to be affected by

²337 respondents of 1550 SHEA and SHEA Research Network Members (21.7%)

the practitioner's attire choice. The ability to identify a HCP was consistently reported as one of the most important attributes of HCP attire in studies. This was particularly true in studies that evaluated the effect of attire of actual physicians on patient satisfaction in a real-world setting rather than those assessing the influence of physician attire on patient satisfaction in the abstract. Patients generally did not perceive white coats, formal attire, or ties as posing infection risks; however, when informed of potential risks associated with certain types of attire, patients were willing to change their preferences for physician attire^{11,18}.

Data from convenience sample surveys and prospective studies confirm that contamination occurs for all types of HCP apparel, including scrubs, neckties, and white coats, with pathogens such as *S. aureus*, MRSA, VRE, and Gram-negative bacilli. HCP apparel can hypothetically serve as a vector for pathogen cross-transmission in healthcare settings; however, no clinical data yet exist to define the impact of HCP apparel on transmission. The benefit of institutional laundering of HCP scrubs versus home laundering for non-OR use remains unproven. A BBE approach is in effect in the U.K. for inpatient care; this strategy may enhance hand hygiene to the level of the wrist, but its impact on HAI rates remains unknown.

Hospital policies regarding HCP attire were generally consistent in their approach to surgical attire; however, general dress code policies varied from guidance regarding formal attire to use of job-specific uniforms. Laundering and change of clothing was also not consistently addressed other than for surgical attire. Finally, accountability for compliance with the attire policies by HCP and supervisors was not routinely included in the policies.

Areas for Future Research

- I. Determine the role of HCP attire on the horizontal transmission of nosocomial pathogens and its impact on the burden of HAIs.
- II. Evaluate the impact of antimicrobial fabrics on the bacterial burden of HCP attire, horizontal transmission of pathogens and HAIs. Concomitantly, a cost-benefit analysis should be conducted in order to determine the financial merit of this approach.
- III. Establish the effect of a BBE policy on both the horizontal transmission of nosocomial pathogens and incidence of HAIs.
- IV. Explore the behavioral determinants of laundering practices among HCP regarding different apparel and examine potential interventions to decrease barriers and improve compliance with laundering.
- V. Examine the impact of not wearing white coats on patients' and colleagues' perceptions of professionalism based on the HCP's variables (e.g. gender, age).
- VI. Evaluate the impact of compliance with hand hygiene and standard precautions on contamination of HCP apparel.

Acknowledgements

This study was supported in part by the SHEA Research Network.

G.B., Grants: Pfizer, Cardinal Health, BioVigil LLC, and Vestagen Technical Textiles; M.E.R., Research Grants/Contracts: 3M. Advisory/Consultant Role: 3M, Ariste, Care Fusion, Mölnlycke; K.B., S.L, J.M., L.S.M.P, R.M., T.P., J.W. *have no conflicts to disclose*

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Table 1

Studies of Patient and Healthcare Worker Perception of Healthcare Worker Attire (1990-2012)

Lead Author, Year (Country)[Ref]	Methodology	Findings
Ardolino, 2009 (UK) ¹	Survey (n, 100): Pts Re: Preference for MD attire pre/post aware of BBE policy	<ul style="list-style-type: none"> Pre BBE policy: Prefer suit >WC but WC preferred for junior MD, scrubs not preferred as unprofessional & difficult to distinguish MDs Post BBE policy: Prefer short-sleeve shirt without tie (older Pts); Prefer scrubs (younger Pts)
Baevsky, 1998 (US) ²	Survey (n, 596): Urgent care Pts seen by MD in WC and on alternating days, scrubs vs. formal attire Re: Satisfaction for courtesy, concern, skill, and likelihood Pt would return/recommend ED	<ul style="list-style-type: none"> No difference in satisfaction elements for scrubs vs. formal attire WC ranked higher when MD broke protocol and did not wear, though when stratified by scrubs vs. formal, higher mean ranks for WC noted only when MDs wore scrubs. Attitude, mannerism, and professionalism likely more important than attire
Bond, 2010 (UK) ³	Survey (n, 160): ENT InPts, OutPts Re: Attitudes towards MD attire with photos of male MD in scrubs, formal, and BBE	<ul style="list-style-type: none"> Most professional: Formal 72%, Scrubs 23%, BBE 5% Most hygienic: Formal 10%, Scrubs 87%, BBE 3% Ease to identify as MD: Formal 59%, Scrubs 35%, BBE 6% Overall preference: Formal 48%, Scrubs 41%, BBE 11%
Cha, 2004 (US) ⁴	Survey (n, 184): OutPts in predominantly resident run OB GYN clinic Re: Preference for MD attire and confidence and comfort with photos of MD in various attire	<ul style="list-style-type: none"> Attire preference: No preference 60%, WC 38% Pt comfort level: Attire no affect 63% vs. does affect 28% Confidence level in MD: Attire does not affect 62% vs. does affect 24% Mean scores for comfort and confidence levels decreased as attire moved from clinical/formal (scrubs/WC) to casual
Ditchburne, 2006 (UK) ⁵	Survey (n, 100): Public in hospital concourse Re: Attitudes to MD not wearing ties	<ul style="list-style-type: none"> 93% did not object to tie-less MD, but for staff more likely considered as professionalism factor Most important: Wearing shirt and dress trousers (vs. denim), being clean, tidy, formal, wearing clear identifications
Fischer, 2007 (US) ⁶	Survey (n, 1136): Pts and OB/GYN MD pre/post randomization of MD attire type Re: Pt satisfaction with MD attire; MDs asked for their preference	<ul style="list-style-type: none"> Pt satisfaction overall high and did not change with different MD attire No difference for perceived MD competency and professionalism MD preference: 8 casual, 7 business, 5 scrubs
Gallagher, 2008 (Ireland) ⁷	Survey (n, 124) : OutPts Re: Preference and ranking of MD attire with photos (formal, casual, WC, scrubs)	<ul style="list-style-type: none"> Prefer WC, formal, and semi-formal vs. scrubs and casual WC most preferred; scrubs and casual least preferred
Gherardi, 2009 (UK) ⁸	Survey (511): InPts Re: Rated photos of MD in various attire to inspire confidence	<ul style="list-style-type: none"> WCs ranked highest and most confidence-inspiring All dress styles rated above neutral except casual (rated lower) Older Pts found scrubs less appealing
Gonzalez Del Ray, 1995 (US) ⁹	Survey (n, 360): Parents of pediatric ED Pts shown pictures of MD dressed in various types of attire Re: Which doctor would they prefer for their child,	<ul style="list-style-type: none"> Most preferred attire: formal 44% (P<0.001) selected for all shifts but less likely selected for Pt seen by night shift Least preferred attire: casual without WC 64% (P<0.001) Overall, 69% of "most liked" pictures had WC and 89% of "least liked" pictures did not have WC

Lead Author, Year (Country)[Ref]	Methodology	Findings
	does attire matter, do clothes affect trust in MD?	<ul style="list-style-type: none"> • Pictures with scrubs favored by parents with children seen for surgical emergencies • Majority didn't consider most formally attired as most capable, didn't matter how MD dressed and didn't influence trust
Hennessy, 1993 (UK) ¹⁰	Survey (n, 110): 2 groups pre-op Pts, seen by same anesthetist, dressed formal vs. casual Re: Select adjectives to describe anesthetist/visit, graded 15 dress items as desirable, neutral, or undesirable	<ul style="list-style-type: none"> • No difference between adjective choices (professionalism, approachability) of anesthetist in formal vs. casual dress • Desirability (%): Name tag (90%), WC (66%), Polished shoes (62%), Short hair (57%), Suit (36%) (suit and tie selected more likely desirable if viewed) • Undesirability (%): Clogs (84%), Jeans (70%), Trainers (67%), Earrings (64%), Long hair (62%), Open-necked shirt (36%)
Hueston, 2011 (US) ¹¹	Survey (n, 423): OutPts Re: Preference for MD attire pre/post informed of possible microbial contamination	<ul style="list-style-type: none"> • Pre-education: No clear attire preference but didn't favor scrubs (6%), poor agreement withPt preference and what their MD wears • Post-education: Decrease preference for WC/tie/formal attire • Conclusion: Attire preferences may change with awareness for contamination
Ikusaka, 1999 (Japan) ¹²	Survey: OutPts seen by groups of MD in WC or private clothes Re: Pt tension/satisfaction, preference for MD attire	<ul style="list-style-type: none"> • Tension: WC group 42%, Private clothes group 33% • Satisfaction: No significant difference between attire groups • WC Preference: WC group (Older Pts more likely to prefer WC) 71%, Private clothes group: 39% (P<0.001)
Li, 2005 (US) ¹³	Pre/post trial (n, 111) of Pt opinion in ED Re: ED MDs wore WC/formal vs. scrubs	<ul style="list-style-type: none"> • No significant difference in scores between 2 dress styles in appearance, satisfaction, or professionalism
Major, 2005 (US) ¹⁴	Survey (n, 410):InPts, surgeons, and public Re: Surgeons' attire	<ul style="list-style-type: none"> • WC necessary: Surgeons 72%, InPts 69%, Public 42% • Scrubs appropriate: Surgeons 73%, InPts 41%, Public 33% [P<0.05] • Clogs appropriate: Surgeons 63%, InPts 27%, Public 18% [P<0.05] • Denim appropriate: Surgeons 10%, InPts 22%, Public 31%
Matsui, 1998 (Canada) ¹⁵	Survey (n, 220): OutPt pediatric children/parents Re: Asked who they would like as their MD from photos of MD with and without WC. Parents also rated attire appropriateness	<ul style="list-style-type: none"> • Selected MD in WC: Children 69%, Parents 66% • Most appropriate and favored: Name tag, WC, well-groomed • Neutral: Scrubs, formal dress • Not favored: Open toed sandals, clogs, shorts
McKinstry, 1991 (UK) ¹⁶	Survey (n, 475): OutPts in 5 practices Re: Pt acceptability for different styles of attire (photos of male and female MDs) for different attire and whether attire influenced their respect for MD	<ul style="list-style-type: none"> • Formal dress favored (suit/tie or WC) • 28% would be unhappy seeing one of MD shown, more likely those dressed informally • 64% thought how their MD dressed was important • Practice to which a Pt belonged was an independent factor in Pt choice of dress
Mistry, 2009 (UK) ¹⁷	Survey (n, 200): Pediatric dental parents /children Re: Attitudes on MD attire using photos	<ul style="list-style-type: none"> • WC and mask most popular overall but children favor casual attire • Formal WC preferred over pediatric coat by parents and children

Lead Author, Year (Country)[Ref]	Methodology	Findings
		<ul style="list-style-type: none"> Mask preferred over visor (eye contact potentially important)
Monkhouse, 2008 (UK) ¹⁸	Survey (n, 50): Surgical Pts Random survey (ER and elective admits) re: attitudes toward dress (formal vs. scrubs) pre/post educational intervention on transmission of microorganisms on ties	<ul style="list-style-type: none"> Pre- education: prefer formal for professionalism and approachability; prefer scrubs for hygiene, equal for identifiability; prefer formal dress overall Post- education: prefer scrubs (24% pre to 62% post); formal preference decreased (52% pre to 22% post) Authors' conclusions: if rationale behind modes of surgical dress are explained, Pts are more likely to prefer scrubs to formal clothes.
Nair, 2002 (Australia) ¹⁹	Survey(n, 1680):InPts post discharge with crossover trial of MDs in varying attire Re: Pt confidence/trust in MD in informal vs. "respectable" attire	<ul style="list-style-type: none"> Pt confidence highest with "respectable" dress Loss of WC or tie did not deteriorate confidence significantly Informal dress protocol "affront to sensitivities" and presence of nose ring most deleterious
Niederhauser, 2009 (US) ²⁰	Survey (n, 328): Pts at Naval OB/GYN clinic Re: Preference for MD attire and effect on comfort or confidence using pictures	<ul style="list-style-type: none"> 86% neutral whether MD wore a WC 88% said attire did not impact confidence in MD ability Active duty women were more likely than dependent wives to say MD attire influenced their comfort discussing general/sexual/psych/personal topics Authors conclude active duty women may withhold pertinent medical info (e.g. personal, sexual history) due to intimidation from military uniform of officer MD Aspect of military uniform unique to this study
Palazzo, 2010 (UK) ²¹	Survey (n, 75):InPts Re: Attitudes of MD attire Randomly chosen medical/surgical InPts rated 6 statements (modal responses provided) and provided reasons for importance of MD dress code. Opinions solicited after education of new dress code policy.	<ul style="list-style-type: none"> "MD dress important" - Strongly agree (reason: dress code instills confidence) "Your MD this admission dressed professionally." - Strongly agree "Scrubs are acceptable form of dress" - Strongly agree (reason: appears clean) "MD should wear WC" - Strongly disagree (reason: sleeves might encourage infection spread, might induce fear and anxiety in Pts) "MD should wear ties" - Strongly disagree (reason: unnecessary, uncomfortable) "Is it easy to distinguish between different grades of doctor based on their dress?" - Strongly disagree (hard to differentiate MD vs. the public) No Pts noticed dress code change prior to being informed of the change All Pts favored dress code change when the suggested impact on infection was explained Conclusions: MD attire important but necktie and WC not expected
Rehman, 2005 (US) ²²	Survey (n, 400): Pts/visitors in OutPt clinic Re: Preference, trust, willing to discuss sensitive issues with photos of MD in various attire	<ul style="list-style-type: none"> Preferences: Professional attire with WC 76%, Scrubs 10%, Business Dress 9%, Casual 5% Trust and willing to share sensitive information significantly associated with professional attire (P<0.001) Female MD dress significantly more important than male MD

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Lead Author, Year (Country)[Ref]	Methodology	Findings
Shelton, 2010 (UK) ²³	Survey (n, 100): InPts Re: Rate MD attire with photos of male and female MDs pre/post informed of microbial contamination	<ul style="list-style-type: none"> • Pre-info: no significant difference between most attire except casual dress and short sleeves (considered less appropriate) • Post-info: Scrubs and short-sleeves considered most appropriate, scrubs preferred for females
Baxter, 2010 (UK) ²⁴	Survey (n, 480): InPts Re: Attitudes towards MD attire using photos of male MD in long-sleeves/tie, scrubs, short-sleeves	<ul style="list-style-type: none"> • Most professional: Long-sleeves/Tie 77%, Scrubs 22%, BBE 1% • Greatest transmission risk: Long-sleeves/Tie 30%, Scrubs 33%, BBE 37% • Preference for MD attire: Long-sleeves/Tie 63%, Scrubs 33%, BBE 4%
Toquero, 2011 (UK) ²⁵	Survey (n, NA):Orthopedic InPts Re: Awareness/preference for recent BBE policy	<ul style="list-style-type: none"> • Unaware of policy: 86% • Attire preference: shirt/tie 63%, suits 22%, short sleeve shirt 6%, Pt trust high despite change to less preferred attire
Garvin, 2012 (US) ²⁶	Survey (n, 1494): InPts, MDs, RNs Re: Attitudes towards MD attire	<ul style="list-style-type: none"> • MD appearance important for Pt Care: MDs/RNs 93%, InPts 83% (P<0.001) • WC unhygienic: MDs/RNs 50%, InPts 6% (P<0.001) • Concerned with appearance of other provider but did not engage them: MDs 39%, RNs 43%, Pts 16% (P<0.001)

Abbreviations: (RN), white coat below elbows (BBE), inpatient (InP at (WC) t), physician (MD), not provided (NA), outpatient (OutPt), patient (Pt), nurse

Table 2

Apparel and microbial burden: review of studies in laboratory and clinical settings

Lead Author, Year (Country)[Ref]	Methodology	Findings
Bearman, 2012 ³⁶	Prospective, crossover trial of HCWs in ICU (n, 30) Randomized to antimicrobial vs. control scrubs Samples obtained from scrub abdominal area, pocket, and hands weekly	<ul style="list-style-type: none"> • HCW scrubs colonized during course of Pt care with MRSA • Antimicrobial scrubs associated with a 4-7 mean log reduction in MRSA but not VRE or GNR • No differences in bacterial hand burden or in HCWs with unique positive scrub cultures • No data reported on cross transmission to Pts
Burden, 2011 ²⁸	Randomized trial comparing contamination on regular (dirty) WC vs. short-sleeved UK-style MD uniform laundered daily	<ul style="list-style-type: none"> • No significant difference in bacterial burden between dirty WC and recently washed uniforms. Clean uniforms contaminated within few hours of donning. • No info on frequency WC washed nor hand hygiene rates • Suggests no microbiological advantage of BBE
Burger, 2011 ⁴⁰	Prospective observational study (n, 66) MDs from multiple specialties (38 BBE, 28 were not) volunteered without notice during normal work day Agar imprints of fingers, palms, wrists, forearms, and repeated post hand hygiene. Imprints of cuffs of those not BBE.	<ul style="list-style-type: none"> • No sig difference in bacterial counts (many skin commensals, no MRSA) between groups • Some MDs had higher counts post HH • Large variation in number of colonies cultured • Authors conclude "no difference in density or type of baseline flora on hands and forearms irrespective of dress code" • HH reduced colony counts from fingertips, palms, wrists in all groups
Ditchburne, 2006 ⁵	MD ties cultured (n, 40)	<ul style="list-style-type: none"> • MD ties capable of carrying bacteria, including MRSA: 40% of ties grew MSSA (1 with MRSA) • 70% had never laundered tie • 93% had no objection to NOT wearing ties • Authors suggest substitute other attire for ties to preserve professional image • No data reported on cross transmission to Pts
Farrington, 2009 ⁴²	BBE vs. non-BBE randomized trial of MD (n, 58) and medical students(n, 61) at a 900 bed teaching hospital. Participants cleaned hands using alcohol, with areas fluorescing by UV light considered "missed" and recorded on a standard hand diagram.	<ul style="list-style-type: none"> • No significant difference found between two groups in percentage area of hands missed • The non-BBE group missed more wrist vs. BBE group (P<0.002) • Mean percent area missed on wrists significantly higher than hands in both groups (P<0.001) • Strengths: high participation rate without drop-outs, single investigator created hand diagrams • Weaknesses: Hawthorne effect • Author Conclusions: BBE did not affect quality of HH, and though BBE improved wrist washing, the clinical • significance is uncertain
Gaspard, 2008 ²⁹	Descriptive study of staff clothing in 3 LTCFs Uniforms (n, 256) from 90 RNs, 166 care partners sampled from waist zone pocket and between pockets	<ul style="list-style-type: none"> • HCW apparel frequently contaminated with MRSA • 27%-80% MRSA recovery from 'waist zone'; 18%-60% MRSA recovery from 'pocket zone'

Lead Author, Year (Country)[Ref]	Methodology	Findings
		<ul style="list-style-type: none"> • Authors stressed HH to limit cross transmission from apparel to Pts via HCW hands • No data reported on cross transmission to Pts
Jacob, 2007 ⁴³	Dept. of Health Working Group on Uniforms and Laundry: Evidence-based document on wearing and laundering uniforms from 2 literature reviews (Thames Valley University and University College London Hospital NHS Trust) Examined role of uniforms in infection transfer, efficacy of laundry practices in removing contamination, how uniforms affect image of individual and organizations	<ul style="list-style-type: none"> • No conclusive evidence that uniforms pose a significant hazard to spread infection • Public does not like seeing hospital staff in uniform outside workplace • All components of properly designed and operated laundering help to remove/kill microorganisms on fabric • 10 min wash at 60C sufficient to remove most microorganisms • Detergents can remove many microorganisms from fabrics at lower temp (e.g.; MRSA removed at 30°C) • No conclusive evidence for difference between commercial or domestic laundering to remove microorganisms • Authors provide list of good (and poor) practice examples with reasons: <ul style="list-style-type: none"> ○ Good practice example: “Dress in a manner which is likely to inspire public confidence.” • Poor practice example: “Wear false nails for Pt care.”
Loh, 2000 ³⁰	Random sample (n, 100) Cultured medical students’ WCs	<ul style="list-style-type: none"> • MSSA recovered from back, pocket, sleeves • Students report occasional or infrequent WC laundering • Authors suggest hospitals provide laundered WC for students • No data reported on cross transmission to Pts
Lopez, 2009 ³¹	Sampled shirts/ties from internists/surgeons (n, 25/25) for paired bacterial counts	<ul style="list-style-type: none"> • 16 participants had never cleaned their tie; 20 participants could not remember when tie last cleaned • Bacterial counts of ties significantly higher than those paired from shirts • Significant fraction of physicians (16) had <i>S. aureus</i> isolated from clothes • Apparel infrequently laundered (ties) associated with higher bacterial burden <ul style="list-style-type: none"> ○ No data reported on cross transmission to Pts
Morgan, 2012 ³²	Cohort study of sequential HCW interaction with Pts with culture of gowns/ hands linked to environmental cultures	<ul style="list-style-type: none"> • Study with PFGE linking environmental isolates, gowns/gloves and Pt in > 80% of cases (<i>Acinetobacter</i>, MDR <i>Pseudomonas</i>, MRSA) • Contamination of gowns/gloves during care of MDRO Pt most frequent with <i>A. baumannii</i>. • Environmental contamination major determinant of transmission to HCW gloves/gowns • Environmental cultures related to gowns/gloves > clothing
Perry, 2001 ³³	Cross-sectional sample (n, 57) Bacterial contamination across 5 services Sampled belt area-hem at start vs. end of shift	<ul style="list-style-type: none"> • MRSA, VRE and <i>C. difficile</i> recovered • Bacterial contamination of hospital-supplied apparel present at start of shift and increased by end of shift <ul style="list-style-type: none"> ○ Start shift: 39% uniforms positive 1 microorganisms ○ End shift: 54% uniforms positive 1 microorganisms • All uniforms laundered at home

Lead Author, Year (Country)[Ref]	Methodology	Findings
		<ul style="list-style-type: none"> No data reported on cross transmission to Pts
Scott, 1990 ⁵⁸	In vitro experiment: Bacterial transfer from laminate surfaces and cloths to hands	<ul style="list-style-type: none"> Contaminated inanimate surfaces (e.g.; laminates, textiles) associated with bacterial transfer to fingers: <i>E. coli</i>, <i>Salmonella</i> spp., MSSA
Steinlechner, 2002 ³⁷	Cohort of orthopedic surgeons (n, 26) Sampled ties for bacterial growth	<ul style="list-style-type: none"> Ties of orthopedic surgeons heavily colonized with pathogens 295 bacterial isolates: 45% were <i>B. cereus</i>, CNS, Gram negative rods, <i>S. aureus</i> No data reported on cross transmission to Pts
Treacle, 2009 ³⁴	Cross-sectional study Attendees (n, 149) of medical and surgical grand rounds at large teaching hospital Sampled WC for growth	<ul style="list-style-type: none"> 34 (23%) WCs grew <i>S. aureus</i>; 6 (18%) were MRSA No VRE recovered Large fraction of HCP WCs contaminated with <i>S. aureus</i>, including MRSA WC may be vectors of <i>S. aureus</i> transmission No data reported on cross transmission to Pts
Wiener-Well, 2011 ³⁸	Cross-sectional convenience sample of MD/RN (n, 135) with survey and cultures of uniform/WC	<ul style="list-style-type: none"> Nearly all HCW clothing heavily contaminated with skin flora and 63% with potential pathogens (<i>Acinetobacter</i> spp., <i>S. aureus</i>, <i>Enterobacteriaceae</i>) No data reported on cross transmission to Pts
Willis-Owen, 2010 ⁴¹	Prospective, cross-sectional observational study (n, 92) Agar imprints of MD hands from multiple specialties during normal work day (49 BBE, 43 not) No. cfu graded light (<10 cfus), mod (10-20), heavy (>20) with presence of pathogens recorded	<ul style="list-style-type: none"> No sig difference in either CFU or pathogens in BBE vs. no BBE No MDRO cultured from MD hands Participants not given an opportunity for hand hygiene prior to enrollment Study does not identify group for the 50% of MDs who wore uniforms with antibacterial properties Authors concluded: "BBE per se does not have impact on degree of contamination on MD hands" and BBE initiative should not divert from other important measures as hand hygiene, appropriate Pt:RN ratios...."
Wilson, 2007 ⁵⁹	Systematic review of published literature	<ul style="list-style-type: none"> HCW uniforms and WC can become progressively contaminated with bacteria of low pathogenicity (from HCW) and mixed pathogenicity (from environment) Data do not support role of apparel as vehicles for cross transmission
Wong, 1991 ³⁵	Cross sectional survey: Bacterial contamination of WC in a British hospital	<ul style="list-style-type: none"> 25% MSSA contamination of WC in both physicians and surgeons (cuffs, pockets) Degree of contamination associated with increased frequency of WC usage No data reported on cross transmission to Pts
Wright, 2012 ⁵⁴	Outbreak report Cluster of 3 Pts with deep sternal wound infections due to <i>Gordonea</i> spp.	<ul style="list-style-type: none"> Same species in RN anesthetist, her clothing, her roommate and roommate's clothing. Home laundering of scrubs implicated (but not confirmed) as origin of staff clothing colonization Reminder that home laundering scrubs can be problematic

Abbreviations: bare elbows (BBE), hand hygiene (HH), healthcare associated infection (HAI), healthcare personnel (HCP), inpatient (InPt), physician (MD), outpatient (OutPt), patient (Pt), nurse (RN), white coat (WC)