Neckties on Physicians: The Way of Powdered Wigs
**Neckties on Physicians: Going the Way of Powdered Wigs**

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**Introduction**

Healthcare-associated infections afflict 722,000 hospitalized patients each year in the United States (US), and kill 75,000 of these patients.\(^1\,^2\) The US Center for Disease Control reported that on any given day, approximately 4% of all hospitalized patients have a healthcare-associated infection, and that these nosocomial infections exact an economic toll of about $40 billion annually.\(^1\,^3\)

Experts on the topic have concluded that white coats and neckties worn by healthcare providers are probable or definite vectors for pathogen transmission.\(^4\,^5\) Although white coats and neckties are standard clinical attire for American healthcare providers, they are nearly absent among Australian physicians as a result of measures taken to reduce nosocomial infections.\(^6\) Similarly, the Department of Health in the United Kingdom (UK) more than a decade ago adopted wide-ranging infection-control practices that mandate against neckties and long sleeved shirts and coats for physicians involved in patient care.\(^7\,^8\) Such a policy has not been formally proposed in the US, but evolving evidence suggests adopting such a regimen would likely be helpful in reducing the rate of nosocomial infections. For example, since the UK Department of Health implemented the new dress code which includes bare below the elbows (BBE) and no necktie in 2007, the rate of healthcare-associated infections has decreased from 8.2% in 2006 to 6.4% in 2011.\(^9\) Even though the impact of BBE is not well known, the Society for Healthcare Epidemiology of America suggests that health care facilities adopt BBE policy because it is supported by biological plausibility and studies in the laboratory and clinical settings as well as by biological plausibility; and barriers to implementation remain low as it is unlikely to cause harm.\(^5\)

**Neckties: More Trouble than They’re Worth**

The necktie is a decorative accessory that has no function, and is washed less frequently than other clothing items. In the early 20th century the necktie became fashionable, and evolved to become part of standard work attire for male professionals. Many male physicians in the US continue to wear neckties despite growing concerns about their possible role in transmitting infections.\(^4\,^6\)

A study completed in a New York hospital found that 25% of neckties worn by male healthcare providers carried *Staphylococcus aureus*, and another 12.5% of ties carried other pathological bacteria such as *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, and *Acinetobacter baumanii*.\(^10\) The same study reported that a physician's necktie was 800% more likely to be colonized with pathological microbes than the ties of hospital security staff members, who served as controls for the study.\(^10\) Other studies have also reported that neckties worn by physicians are commonly
contaminated with pathological microbes such as coagulase negative staphylococci, *Enterococcus faecalis*, methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus*, *Escherichia coli*, and *Pseudomonas aeruginosa*.

Another study conducted by Shabbir et al. on 50 surgeons’ neckties across 2 different hospitals found 1 neck tie with MRSA, 35 (70%) with methicillin-sensitive *Staphylococcus aureus* (MSSA), 10 (20%) with Enterococcus species, and 4 (8%) had gram-negative bacilli.

Webber et al. conducted a prospective controlled study where physicians wore 4 different outfit combinations: no tie and short sleeves, tie and short sleeves, long sleeves and no tie, and long sleeves and tie. Ties and sleeves were inoculated with Micrococcus luteus and then worn by physicians while examining 5 simulated patients (mannequins). In the group of long sleeves and ties, 24 colonies were obtained from the mannequins whereas 0 colonies were cultured from the short sleeve and no tie group. Ultimately, not a single mannequin was contaminated in the short sleeves and no tie group compared to 4 of 5 contaminated mannequins in the long sleeves and tie group.

Haun and colleagues conducted a systemic review of 72 studies evaluating personal attire and devices as fomites. They found that neckties had a contamination rate of up to 32% with MRSA and up to 23% with gram negative rods (GNR). A randomized crossover study involving gynecology and obstetrics physicians assessed bacterial contamination of doctors’ neckties and bowties. Contamination of both ties were common after only 3 days of use, and the levels of microbes were not different between neckties and bowties.

Curiously, ties have other health-related risks as well. A recently published randomized trial utilizing magnetic resonance imaging (MRI) found that wearing a necktie, tightened to the usual degree, reduced cerebral blood flow by

![Mean CBF Experimental Group](image)

*Figure 1. CBF (cerebral blood flow) as assessed by MRI of the brain was significantly lower in the group wearing a necktie, compared...*
7.5% (figure 1).\textsuperscript{16} Furthermore, other studies have shown that a standardly tightened necktie increased intraocular pressure among both normal subjects and glaucoma patients.\textsuperscript{17} The mean IOP increased by 2.6 mmHg (p=0.008) in normal subjects and increased by another 1.0 mmHg (p=0.02) following tightening. Also, after loosening the necktie mean IOP in normal subjects decreased by 3.3 mmHg (p<0.0001) and in glaucoma patients by 1.3 mmHg (p=0.02).\textsuperscript{17} Similarly, Bozic showed significant reductions in IOP after untying the necktie on patients with open angle glaucoma (1.05 mmHg, p=0.000) as well as on healthy controls (1.25 mmHg, p=0.016).\textsuperscript{18}

\textbf{Dirty White Coats}

As workplace apparel goes, few garments are imbued with more symbolism than a doctor’s white coat. Approximately 130 years ago near the end of 19\textsuperscript{th} century legitimately trained physicians and surgeons began wearing white lab coats to distinguish themselves from the charlatans and quacks who did not practice evidence-based medicine.\textsuperscript{19} In recent decades the donning of a white coat by medical students beginning their clinical years of schooling became a rite of passage analogous to the graduation cap and gown ceremony. According to the Association of American Medical Colleges, 97\% of medical schools as of 2018 have a white coat ceremony.\textsuperscript{19}

Although the white coat may connote credibility and stature for a healthcare provider, these garments frequently harbor potentially pathogenic microorganisms, many of which are drug-resistant, and thus can transmit nosocomial infections.\textsuperscript{20,21} Disturbingly, microorganisms can remain viable for between 10 and 100 days on white coats.\textsuperscript{22,23} A prospective study of 100 medical students and interns found that about 70\% of their white coats were contaminated.\textsuperscript{24} These doctors in training generally felt that their white coats were relatively clean, and indeed 71\% of them reported that they had washed their white coats within the past 2 weeks; yet most of them carried potentially dangerous microbes.\textsuperscript{24} Studies have found that the microbial counts on the white coats of health care providers reach a steady state of within about 1 week of daily use of the garment, and this does not change significantly thereafter.\textsuperscript{20,24}

An earlier study of 100 physicians showed a high level of contamination of white coats, more so on the cuffs and the pockets than the backs of coats.\textsuperscript{20} In another study of 149 physicians at a teaching hospital, 23\% of their white coats were found to be contaminated with \textit{Staphylococcus aureus}, which was MRSA in three-quarters of the contaminated coats.\textsuperscript{25} Training physicians more commonly had contaminated white coats compared to the staff physicians.\textsuperscript{25}

Recent studies show that the long-sleeves of the doctors’ white coats have been shown to transfer bacteria from one patient to another, thereby serving as fomites that could transmit infectious diseases.\textsuperscript{4,26} Again, in the systemic review conducted by Haun and colleagues found that white coats had a contamination rate of up to 16\% with MRSA and up to 42\% with GNR.\textsuperscript{4} It is important to highlight, that whitecoats in some instances had higher GNR prevalence than stethoscopes that were being used to examine patients.\textsuperscript{4,26}

John et al. randomized practitioners to long and short sleeves while examining a mannequin contaminated with viral DNA followed by examination of uncontaminated mannequin. The cuffs of long sleeve white coats touched the contaminated mannequin 77\% of simulations and contacted the uncontaminated mannequin 68\% of the simulations Also they found significantly more transfer of viruses to clean sites when wearing long sleeve white coats (figure 2).\textsuperscript{26}

Qaday et al. conducted a cross-sectional study sampling for bacterial contamination of
white coats. 73% of all sampled white coats were contaminated with pathogens. *S. aureus* was present in 92% of the isolates, *Pseudomonas aeruginosa* in 7% and *E. coli* in 2%.

Munoz-Price et al conducted a quality improvement project across 5 ICUs where they tested the hands and uniforms of personnel. They found 13% of health care workers did not grow any bacteria from their hands, all of which were not wearing white coats. They found that the presence of pathogens on the hands was associated with an increased likelihood of the presence of pathogens on white coats (*k* = 0.81; *P* < .001), but not on scrubs (*k* = 0.31; *p* = .036). Similarly, the presence of *Acinetobacter baumannii* on the hands was associated with a greater likelihood of *A. baumannii* contamination in white coats (*k* = 0.70; *P* < .001), but not on scrubs (*k* = 0.36; *P* = .024).

This study lead to the adoption of BBE policy at one of the largest public hospitals in the US. Predictably, studies show that the levels of contamination drop dramatically with frequent washing/laundering of white coats (figure 3). Yet even today most medical students and physicians launder their white coats infrequently.

In summary, the white coats and neckties worn by healthcare providers are often contaminated with potentially pathogenic and drug-resistant microbes, making these garments potential fomites for the transmission of nosocomial infections.

**Proposed Solution**

Wearing potentially contaminated clothes to work, such as ties and white coats, presents a small but real risk of transmitting nosocomial infections. Adopting a routine of donning hygienic attire that is laundered daily is a low-cost, low-effort, common sense approach to

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**Figure 2.** Frequency of transfer of a viral DNA surrogate marker to clean sites during simulated physical examinations when wearing long-sleeved versus short-sleeved white coats.
reducing the risk of nosocomial infections, and complies with the *primum non nocere* (first do no harm) maxim of the Hippocratic oath. Approximately 10 years ago, the National Health Service of the United Kingdom adopted a BBE policy, which mandated no long-sleeved lab coats, no neckties, no wristwatches, and no jewelry. More recently, a 2014 statement from the Society for Healthcare Epidemiology of America advised that physicians alter their work attire to help reduce risk of healthcare-acquired infections. These guidelines called for healthcare providers including physicians to follow a BBE practice, along with no neckties, and frequent laundering of white coats and other work clothes.

These experts also concluded that these guidelines would be, “probably or definitely effective at reducing transmission of hospital pathogens”. Yet, many physicians continue to wear neckties and/or a white coat. They cite many reasons for preferring this attire, such as professionalism, tradition, sense of identity, style, warmth, etc. Medical students and training physicians generally follow the lead of their supervising physicians, and thus often feel obligated to wear neckties and white coats.

In a survey conducted 160 healthcare providers there were great differences in the laundering practices of whitecoats versus scrubs. Scrubs were washed much more frequently than white coats (mean of 1.7 versus 12.4 days). The fact that scrubs are worn for shorter durations likely accounts at least in part for the finding that they typically harbor a lower pathogen load than white coats. As mentioned before, the pathogen load increases by the end of a single 8-hour shift so it would be ideal to launder clothing after every shift.

Moreover, Nordstrom and colleagues showed that hospital-laundered scrubs had lower bacterial load than home-laundered scrubs. They found scrubs after one shift had a mean bacterial count of 85 CFU/cm² compared to new scrubs that had a bacterial count of 5 CFU/cm². Home-laundered scrubs had a
bacterial count of 16 CFU/cm² compared to hospital-laundered scrubs with a bacterial count of 2 CFU/cm². Also, 69% of the unwashed hospital scrubs were positive to coliform bacteria compared to none of new scrubs. Home-laundered scrubs were positive in 44% of the samples to coliform bacteria compared to 0% of the hospital-laundered scrubs. Thus, the practice of wearing clean hospital-laundered scrubs, never worn for more than one day, would be one logical solution to decrease the risk of nosocomial infections.

**Patient's Preferences**

Importantly, a recent study found that scrubs inspire as much confidence in the patient as does a white coat, and both outperform business attire for patient preference. Furthermore, a randomized study evaluated the effects of physicians’ attire on patient satisfaction with their medical encounter. The 1116 subjects in the study reported perceiving no differences in level of professionalism whether the physician was wearing traditional medical professional attire (including a tie and white coat), a white coat without a tie, or scrubs. Additionally, all 3 uniforms led to similar levels of overall patient satisfaction with their caregiver. In contrast, a large recent survey reported that physicians who wore a white coat were deemed to be more knowledgeable and trustworthy by their patients, especially among patients 65 and older.

**Summary**

Physicians and other healthcare providers who are personally examining and treating patients, particularly in the hospital setting, but even in an outpatient clinic, should consider the necktie as something that has gone the way of the powdered wig—permanently out of style. Ideal workplace attire consists of clean scrubs laundered daily. If a white coat is worn, it should be also laundered frequently, ideally on a daily basis, but certainly after being worn for 2 days or 3 days at most.

**REFERENCES**

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