



"Vest Cozy": Protective Layer for Radiation Protective Equipment

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Abstract/Introduction

Hospitals are prime locations for the spread of germs and disease (i.e., nosocomial infections), and these types of infections are associated with significant morbidity, mortality, and hospital costs. As textiles are commonly used in healthcare facilities, it is important that they do not pose as a vehicle for the transfer of pathogens. Radiation protection gear in particular is not frequently washed between operations due to their fragile nature and lack of standard sanitation procedures. This means that they may contain high numbers of microorganisms from body fluids and substances such as blood or skin, which contributes to unsanitary working environments for healthcare radiation workers and patients. In order to address this problem, we explore the option of using an inexpensive, durable, antimicrobial, machine-washable coverslip to be placed on top of existing radiation protection garments to protect users from contamination and biological hazards.

Background



- Nosocomial Infections
 - Affect 1.4 million people worldwide
 - Cost our healthcare systems > \$35 billion per year [2]
 - Account for ~ 100,000 deaths per year in the US [1]



- Nosocomial infection are infections acquired by a patient whose origin comes from the healthcare setting itself and was absent at the time of admission [3].
- These infections cause extended stay, disability and additional financial burden to the patient and the healthcare center itself. Therefore, preventative measures must be taken.
- High traffic in hospitals spread pathogens from patient to patient increasing their risk for nosocomial infection. This is particularly true for interventional radiologists who perform surgical procedures wearing radiation protective gear necessary for their safety.
- Additionally, this gear is often not washed between procedures due to their construction and fragile nature, thereby posing an increased risk of infectious complications for the patients.
- If protective garment disinfection could be made easier, it would greatly reduce the chances of patients undergoing radiological procedure contracting healthcare associated infections.

Methods

This method was designed to evaluate the antibacterial activity of antimicrobial agents on treated textiles. It tests the ability of the textile to inhibit the growth of microorganisms.

Control: Antimicrobial fabric

Experimental: Dual-layered fabric (antimicrobial fabric & hospital-acquired vest fabric)

- Distribute equal amounts of *E. coli* culture onto sample of the antimicrobial fabric and antimicrobial-side of the dual-layered fabric consisting of a layer of antimicrobial fabric and a layer hospital-acquired vest fabric.
- Take a swab of the *E. coli* culture from control condition using a sterile loop and streak the solution in 5 consecutive streaks, spaced evenly apart, onto solidified growth agar. Repeat for the experimental condition.
- Using a new sterile loop, spread the suspension evenly around the surface of the agar by quickly skating the flat surface back and forth. Repeat for the experimental condition.
- Take the two plates, tape, label, and stack them. Place the stack upside down in the 37°C incubator for 24 hours.
- Observe the results the next day and image cells to quantify bacterial growth.

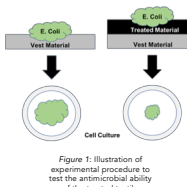


Figure 1: Illustration of experimental procedure to test the antimicrobial ability of the treated textile

Proposed Solution



Figure 2: Hospital-Acquired Radiation Protective Vest



Figure 3: Antimicrobial Moisture-Wicking Fabric (composition: 83% polyester, 17% spandex)

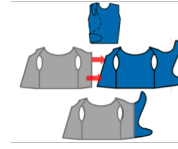
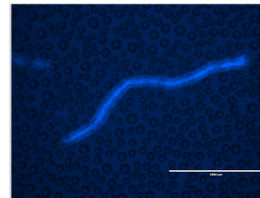
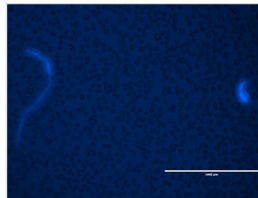


Figure 4: Vest Cozy Diagram to illustrate how the design will fit over existing radiation protective vests

- To combat the transmission of infection, we propose creating a cost effective, machine washable cover for radiation protective garments utilized by radiologists and imaging technicians.
- Hospitals can easily adopt this new product instead of having to replace expensive radiation protection garments.
- The "Vest Cozy" will:
 - serve as a shield for the radiation protective garments from bodily fluids and other pathogen-carrying substances present during surgery or checkups.
 - be removable and easily disinfected, conserving the radiation protection capabilities of typical protective gear.
 - be made from a moisture-wicking polyester-spandex blend that only retains 0.4% of moisture [5] to address excessive perspiration in users
- As a more active approach to infection reduction, the Vest Cozy will be coated in silver nanoparticles.
 - It has been found that concentrations 0.1 ppm of silver nanoparticles can inhibit the growth of streptococcal bacteria, a pathogen that commonly causes nosocomial infections, by 92.33% in total bacterial count measurements in a two-hour period [4].

Results



Figures 5 and 6: Representative images of *E. coli* growth after 24 hours of incubation at 4x magnification

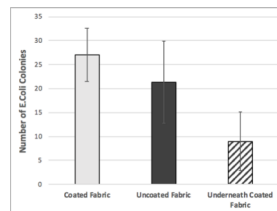


Figure 7: Results of our preliminary study of swabbing *E. coli* colonies onto three variables for growth.

Antimicrobial Properties:

- The "Underneath Coated Fabric" reduced the *E. coli* growth by roughly half, demonstrating the efficacy of using the layered fabric approach as a physical and chemical barrier.
- There are significant differences between the number of *E. coli* colonies in the conditions
 - "Underneath Coated Fabric" successfully prevented bacteria growth
- Unexpectedly higher growth on the "Coated Fabric" compared to the "Uncoated Fabric".
 - Future iterations are needed

Conclusions

- In recognition of the potential infectious agents and environmental risks for users and patients, the addition of "Vest Cozy" in hospitals is a rational move to improve hospital hygiene standards.
- Economically, adopting "Vest Cozy" will aid in reducing overall costs in healthcare associated with nosocomial infections.
- By manufacturing and distributing this product, the potential benefits gained from the healthcare, economic, and patient perspectives are valuable prospects.

Future Work

More Thorough Testing of "Vest Cozy":

Moisture-Wicking Properties:

- Test by soaking samples of fabric in water and measuring dehydration times in a fume hood.
- Effectiveness of weight distribution and ability to prevent overheating.

Bacterial Bath:

- Testing *E. coli* growth using bacterial baths as opposed to swabbing to procure more reliable results.

Integrity of Treated Fabric over Repeated Washes:

- Durability of fabric in an industrial setting is important for reducing costs.
- Clients would desire a product to have a long life cycle

Fabric blend:

- Future iterations of this product includes bamboo/polyester/spandex fabric blends due to their proven efficiency in retaining treated coatings over time

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