INTERNATIONAL SAFETY CENTER

Improving Work Wear for Workers at Risk of Exposure to Blood, Body Fluids, and Other Biologic Hazards:
A Consensus Statement and Call to Action

Background:

The vitality of the healthcare sector relies on its ability to improve the safety of both its patients and workers. The risks associated with exposure to biologic hazards and infectious microorganisms from blood, body fluids, or the skin and the potential transfer of those pathogens to patients or workers may result in infection or illness. The International Safety Center's Exposure Prevention Information Network (EPINet®) surveillance data from U.S. hospitals indicates that there are thousands of these types of exposure incidents every year and personal protective equipment (PPE) and barrier garment use and compliance is at a decade low.

These occupational exposures, as well as other health hazards including hazardous drugs, chemicals, cleaners, environmental toxins, and physical hazards like patient handling, workplace violence, and slips, trips, and falls make healthcare the most dangerous place to work in the U.S.. Workers are continually exposed to hazards and remain unprotected. The Occupational Safety and Health Administration's (OSHA's) Assistant Secretary the Honorable David Michaels states that *"(w)orkers who take care of us when we are sick or hurt should not be at such high risk for injuries — that simply is not right. Workers in hospitals, nursing homes and long-term care facilities have work injury and illness rates that are among the highest in the country, and virtually all of these injuries and illnesses are preventable*."

Today, with growing focus on preparing healthcare systems for globally emerging and re-emerging infectious diseases and increased patient load due to improved access to health insurance, our industry is faced with an urgent need to address preventable conditions before they become a public health emergency. Controls are in place to protect both patient and worker, including the use of diagnostics, standard precautions, engineering controls, and personal protective equipment (PPE) - however, growing evidence in the peer-reviewed literature and consensus from agencies like OSHA tells us that current controls are not adequately preventing the spread of pathogens on surfaces and affiliated with textiles or garments, therefore we must explore new and innovative approaches.

Exposure Incident Surveillance

EPINet data from the last 5 years (2010-2014) indicate that of all reported occupational splash or splatter exposures involving blood and body fluids (70.5% of body fluids were contaminated with blood e.g. bloody urine), that less than 17% were wearing a protective gown (surgical or isolation) during the incident. When PPE is worn, data indicate that in a small percentage of cases (1.4%) the blood or body fluid soaks through the protective

garment. In addition, more than 40% indicate that they were just wearing normal clothes, scrubs, or a uniform during the exposure and of those more than 80% of exposures were to unprotected skin (EPINet Blood and Body Fluid Summary Report, 2014). This leaves a great deal of room for innovative approaches to reduce harm and exposure.

Since EPINet is the only surveillance system used in the US that publicly reports exposure incident data for blood and body fluid splashes and splatters, it currently serves as the only available benchmark measure. It is clear that there is a good deal of work to be done measuring exposures, reporting them publicly, and subsequently creating innovative products and systems that protect workers from exposure to blood, body fluids, and biological hazards.

Impact of Current PPE Use

According to EPINet data, compliance with PPE use when an exposure to blood, body fluid, or biologic hazard occurs is lower than ideal. It can range from more than 70% (glove use) to less than 2% (goggle use), depending on the body location and type of incident.

Table: *PPE or Barrier Garment Use during Blood or Body Fluid Exposure, EPINet 2014*

PPE or Barrier Garment Worn During Incident Report	Percent%
Gloves	76.4
Goggles	1.4
Faceshield	1.4
Mask/Respirator	11.1
Gowns	14.8
Apron	0.5
Labcoat	2.8
Other	16.7

*Total percent greater than 100 because multiple items are indicated as worn during a single incident report (e.g. gloves and goggles)

Even when PPE is worn to protect a worker from an exposure or contamination, studies indicate that upon removal a worker contaminates him/herself almost half of the time (46%). The most frequent self-contamination occurs on the hands, forearms, neck, and face, as well as in hair and on clothing (Tomas, *JAMA Intern Med* 2015).

Recent data published from the National Institute for Occupational Safety and Health (NIOSH) indicates that 40% of disposable isolation gowns intended to be worn to protect healthcare workers from emerging infectious disease threats like Ebola Virus do not meet manufacturing and testing performance parameters required to be followed by gown and other PPE manufacturers (Balci, *Am J Inf Cont* 2015).

These performance testing parameters are established for barrier and strength by standards setting groups [ASTM International (ASTM D5034, D5733, D1683, F1671),

American Association of Textile Chemists and Colorists (AATCC 42 and 127), and Association for the Advancement of Medical Instrumentation Hierarchy of Controls] to protect workers from exposures to biological agents found in blood and body fluids. Parameters are not being met therefore an opportunity to improve worker safety exists. .

Hierarchy of Controls

The underlying principle and practice deployed by industrial hygienists and safety professionals is the hierarchy of controls. The hierarchy begins with the most effective means of isolating a hazard, which is to eliminate it. Since patient and biological hazards cannot readily be eliminated, the next best control is to engineer the hazard out. Engineering controls can be in the form of safer medical devices that protect workers from a needle or sharp, closed systems used for suctioning, HEPA-filtration in HVAC systems, and now "smarter" textiles that can allow fluids to roll off of the worker rather than contaminating the worker's skin.

When a hazard cannot be eliminated or engineered out, it is then that we rely on safe work practices, administrative controls, and the use of PPE. These controls are highly dependent on personal and professional behavior, training, education, availability and access, adequate staffing, and the overall anticipation of hazard being likely to occur. We have already indicated that PPE use and compliance is low during an exposure with blood and body fluids, often times because that exposure is not anticipated and a worker cannot adequately prepare for it. This in part is because all factors may not be in place to create the safest environment.

In short, it is difficult to create reliable systems of protection if there are too many opportunities for that system to fail – exposures are not anticipated, PPE use is low even when they are anticipated, and PPE when worn during anticipated exposures is unreliable.

Closing the Gap

Due to manufacturers recognizing these exposures as an opportunity to create products that fill a need and narrow a gap to protect workers exposed to blood, body fluids, and other biologic hazards, new textile technologies, innovative engineering controls, and "smart textiles" are gaining traction in the work wear marketplace. Manufacturing and purchases of these alternatives are ramping up. It is the time to make sure that they are done safely, appropriately, and with the utmost quality so that they best protect the workers that wear them.

This document is intended to serve as a consensus statement developed with expertise, input, and review from a cross-functional panel of experts in the field of occupational health, infection prevention, microbiology, and textile science. It is intended to serve as a call to action and to pose recommendations to move forward relative to increasing both the national sense of urgency relative to these exposures and determining the best path forward for developing and implementing consensus standards.

RECOMMENDATIONS

We have identified the following areas as key to make progress in reducing the risk of occupational exposure to infectious microorganisms, specifically related to work wear worn in healthcare and other industries with ongoing exposure to biologic hazards.

1. *Understanding the Role of Work Wear and Occupational Exposure to Infectious Disease and Biologic Hazards*

Microorganisms shed by patients can contaminate hospital surfaces at concentrations sufficient for transmission. (Otter, *ICHE* 2011) They can survive and persist for extended periods and can be transferred to healthcare workers' (HCWs') hands and subsequently to either the patient, staff, or visitor. Microbes thrive on porous surfaces like textiles, specifically on the most commonly used textiles in healthcare - work wear and uniforms. (Otter, Scott *J Appl Bact* 1990, Neely *J Clin Micro* 2000, Weiner-Well *Am J Inf Cont* 2011, Fijan *Int J Env Hlth* 2006) The vitality of microorganisms is due in part to their ability to live in and on high levels of bioburden or microbial load if there is a splash or splatter of blood or body fluid to those textiles or fabrics. (CDC HICPAC 2003, 2008, 2014)

Contaminated textiles like work wear, are known to become colonized with organisms such as *Clostridium difficile*, Vancomycin-resistant *Enterococci* (VRE), Methicillin resistant *Staphylococcus aureus* (MRSA), *A. baumannii*, *Pseudomonas aeruginosa*, and norovirus. It is theoretically plausible that these contaminated textiles may serve as a potential vehicle for transmission of microbes that transmit infection and illness. (Hill *Lancet* 1974, Gaspard *J Hosp Inf* 2009, Otter, Scott, Casanova *Emerg Inf Dis* 2008, Standaert *ICHE* 1994, Weernick *J Hosp Inf* 1995, Das *J Hosp Inf* 1992). It has also been shown that nurse's uniforms are can be contaminated with pathogenic bacteria, including MRSA, even at the *beginning* of the work shift. (Weiner-Well, Burden *J Hosp Med* 2011, Callaghan *Nurs Stand* 1998)

An increase in contamination can be measured from beginning to end of a work shift (39% to 54% by the end of the day) and up to 100% of nurses' uniforms can be contaminated within the first day of use with *S. aureus* (Burden, Callaghan). Pockets and cuffs may be the areas of highest microbial contamination (Manian, *ICHE* 2007). Additionally, even if uniforms are highly sanitary prior to donning they can accumulate nearly 50% of their 8-hour measured Colony-forming units (CFU) after only three hours of wear. (Burden) It may be that in order to effectively reduce bacterial contamination of work wear, HCWs must change into freshly laundered work clothes every few hours which is not feasible.

Unlike countries in Europe, the U.S. lags behind in relation to uniform policies and the acceptability of wear outside of the healthcare facility. In European countries scrubs and lab coats are *not* permitted to be worn outside of the healthcare facility as an institutional policy to prevent transmission of endemic healthcare pathogens into the community. (UK Royal College Nursing, Otter, Stepanovic *Lett App Micro* 2008)

Given what is known based on evidence published in the peer-reviewed literature, it is critical to understand the role of work wear and occupational exposure to infectious disease and biological hazards.

We recommend that:

1. New work wear contamination data collected in clinical settings is shared with government agencies including OSHA, NIOSH, CDC, and others so that they have the most up-to-date information to consider in updating their worker safety and health standards, guidance, and recommendations.

2. Health and Human Services agencies such as CDC/NIOSH and other government and non-governmental agencies and professional organizations support epidemiological research that evaluates risks to workers as it relates to the role of work wear occupational exposure to infectious disease.

2. Professional groups and manufacturers join forces to encourage development of work wear that provides the best protection for workers when they are not wearing PPE or barrier garments.

3. Institutions adopt policies that include measuring blood and body fluid exposures to identify incidence of work wear contamination.

2. *Reducing Occupational Exposures by Improving Compliance with and the Protective Factor of PPE and Barrier Garments for Anticipated Exposures*

Occupational surveillance data capturing splash and splatter incidents from the EPINet network of US hospitals indicates that when exposures do happen, employees are infrequently wearing PPE or barrier garments that prevent blood and body fluids from touching skin or mucous membranes.

Table: *EPINet Report for Blood and Body Fluid Exposures, Exposure Area 2010-2014*

Exposure Area	%	TOTAL
Touched Unprotected Skin or Mucosa		
- Non-Intact Skin	13.8	152
- Eyes	62.5	688
- Nose or Mouth	12	132
Total Skin or Mucosa*	84	925
Touched Skin through Gap in Protective Equipment	6.5	72
Soaked through Protective Garment	1.2	13
Soaked through Clothing	2.4	26
		1,101

*Some exposure incidents touched multiple locations (e.g. skin on face and eyes), therefore total percent is greater than 100%

While both general compliance with Contact Precautions used for infection prevention and required compliance with the OSHA Bloodborne Pathogens Standard dictate the use of appropriate PPE and barrier garments when exposures to blood or body fluids are anticipated, it is clear from EPINet data that even when these items are worn, there continue to be exposures (7.7%).

To improve safety and prevent exposure to skin or mucous membranes, we recommend that:

1. Health and Human Services agencies such as CDC/NIOSH and other government and non-governmental agencies and professional organizations support epidemiological research that evaluates compliance of PPE use and programs that support improving PPE use.

2. Professional organizations and medical product distributors collaborate to make PPE use and work wear a priority and ensure that educational and training materials are available to their members and customers.

3. Accrediting and licensing bodies and healthcare and workers' compensation insurers enhance compliance incentives for employers with specific PPE and work wear programs in place.

4. Institutions record PPE use on incidents of employee blood and body fluid exposure reports.

3. *Increasing Consideration of Work Wear as an Engineering Control for Unanticipated Exposures*

As illustrated above, more than 80% of blood and body fluid exposures to skin and mucous membranes were not from gaps or soak through in protective garments. It can be inferred that these exposure incidents are from exposures that were not anticipated and therefore the employee was not prepared and was therefore not wearing PPE (other than gloves) or barrier garments at all.

Relative to these types of unexpected or unanticipated exposures, we recommend that:

1. Health and human services organizations and professional organizations partner with device manufacturers to assess and prioritize needs for specific work wear technologies (active barrier, fluid repellent, antimicrobial), their clinical applications, monitor progress in closing existing gaps, and to identify future needs.

2. Institutions identify if PPE is immediately accessible in all locations that exposures are occurring.

3. Institutions evaluate commercially available work wear technologies and implement them where feasible.

4. *Determining Best Path Forward for Developing and Implementing Consensus Standards for Work Wear*

Controls are in place to protect both patient and worker, including the use of diagnostics, standard precautions, engineering controls, and personal protective equipment - however, growing evidence in the peer-reviewed literature and consensus from agencies like OSHA tells us that current controls are not adequately preventing the spread of pathogens on surfaces and affiliated with textiles or garments, therefore we must explore new and innovative approaches.

Since new protective textile technologies, innovative engineering controls, and PPE are gaining traction in the marketplace, efforts need to focus on identifying the most important design and performance parameters for the soft surfaces and textiles that play a growing role in the transmission of infectious pathogens and relevant occupational hazards.

We recommend:

1. Convene expert panel to review, discuss, and propose considerations for standards setting groups like ASTM, AAMI, and ISO; regulatory agencies including FDA, OSHA, EPA; and professional organizations such as AORN, APIC, SHEA, AATCC, and others.

    a. Panel to include experts from multi-disciplinary fields, including epidemiology, infectious disease, textile production, quality, academia, labor unions, and technical fields

2. Explore the development and execution of a consensus standard defining the performance parameters of a new textile classification for active barrier apparel.

If your or your organization would like to join our Call to Action, we welcome your participation!

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