

Primary Head Protection for Infection Prevention

The incidents of healthcare workers (in the US and West Africa) contracting Ebola while caring for infected patients have revealed the inadequacy of existing personal protective equipment (PPE). Specifically, the problem has been inadequate and improper Primary Head Protection, from clinic offices to treatment centers as illustrated by the photos posted on the internet.

- Some healthcare workers wear a face mask and goggles when treating patients with coughing and sneezing symptoms.
- Many oral hygienists wear a face shield and a mask in dental work.

Airborne particles and droplets from patients' coughing and sneezing or from dental work are common sources of pathogens. These pathogenic substances end up on a worker's hair and clothes as well as on the shields, goggles and masks. **Contact transmission** then occurs when workers touch their hair or a contaminated surface and subsequently touch the mucous membranes of their face.

The best practice for preventing contact transmission is to keep the head and neck fully covered all the time. But, up to now there was no proper and convenient head covering.

- Hooded coverall suits are worn when caring for infected patients in treatment centers.

However, the commonly used coverall suit leaves the wearer's neck and face exposed. Usually, duct tape has to be used to seal the gaps and to attach the coverall hood to a respirator so it does not easily pull away from the wearer's face. It has been criticized by users for severely restricting head movement and mobility.

Of greater concern is that the removal of the coverall hood is the first step in the doffing procedure. When the hood is removed, the wearer's head is immediately exposed to the contaminants accumulated on the suit which defeats the intended protection purpose. **A hood independent from the suit is preferred.**

Tyvek sheets are useful for making many protective suits since they are impervious to liquids and chemically inert in shielding against corrosive chemicals and organic solvents. Tyvek hoods equipped with an air-fed system are effectively used for primary head protection in infection prevention.

However, the low volume of transmittable air through the Tyvek structure is not adequate for human breathing. The Tyvek hoods without an air-fed system are not designed to cover the wearer's face, most likely to avoid suffocation accidents. They are unbearably hot and wearing them even for short periods of time can cause uncomfortable anxiety, dizziness, and exhaustion from the buildup of heat and humidity. Unless there is no alternative, these hoods should not be the choice for healthcare workers.

VitaFlex Offers A Practical and Low-Cost Solution to This Problem

I am Dr. De-Sheng Tsai. I have been working on protective apparel (materials and designs) for over 15 years in addition to inventing elastic nonwovens technology. My comments on PPE for Ebola prevention:

1. A disease virus does not fly at bullet-speed or maneuver like a mosquito to attack people. An individual Flu or Ebola virus is carried by airborne particles and spit, body fluid, or blood. It attaches to any surface it contacts and does not have the ability to migrate through even a thin surface. A structure with liquid barrier functionality is enough to provide effective isolation.
2. Wearing a hazmat suit is unnecessary unless there is real concern that a large volume of pressurized body fluids or blood would shoot out and spray on the healthcare worker.



3. Keeping a cool head is essential. It is inappropriate to wrap the head with impervious materials without an air-fed system. Being overdressed actually compromises worker's safety.
4. I have not made the soft-stretch hoods from elastic nonwoven materials which pass the ASTM F1671 test. I cannot foresee any occasion when a healthcare worker would put their head or face tightly against a pot of pressurized blood or body fluid (of 2 pounds per square inch) for up to 1 minute.

Soft-stretch Hairnets and Biosafety Hoods for Infection Prevention

Nonwovens are the best material for achieving a balance between "breathability" and "barrier functionality". Their dense fiber-web structures have ultrafine intertexture openings for air to flow through while maintaining particle filtration quality. My patented nonwoven elastics technology creates a wide range of soft and cross-stretch elastic fabrics from spunmelt nonwovens without adding latex or other elastomers.

Our latex-free elastic nonwoven fabrics are the innovative and unique material that gives a soft and stretchy structure. They allow the head coverings to be cool and comfortable, conforming to the contours of the wearer's face. **The latex-free elastic nonwovens are the best protective apparel material except when dealing with organic solvents, corrosive chemicals or a large volume of pressurized fluids.**

The Soft-stretch Hairnet is engineered to be used for basic isolation. It is made from a special grade of latex-free elastic nonwoven composite with ultra-fine fibers and supremely uniform web formation. Its dense fiberweb structure (and the water-repellent characteristics of the polypropylene fibers it is made from) has a hydrostatic resistance of 18 cm H₂O to provide effective repellency to many fluid droplets. A small amount of static on the elastic fabric helps capture dry particles on the surface of the hairnet.



The translucent hairnet allows the wearer's face to be seen which gives a friendly appearance. **The 2016 version maximize the wearer's face coverage by reducing the eye slot.**

When in a potentially hazardous environment (ambulance, examination room, emergency room, and dental office) and wearing a full protective suit is not applicable, medical professionals now have better protection by wearing the Soft-stretch Hairnet in conjunction with a technical mask and face shield. The hairnet can be removed first to reduce the risk of contact transmission.

VitaFlex's Biosafety Hood is for primary head protection in critical work environments. It is qualified as a level 1 fluid barrier in addition to its effectiveness of blocking airborne particulates. It is engineered to protect scientists and technicians working in a variety of bio-labs or when handling hazardous materials. For healthcare professionals, it limits the risk of being exposed to a communicable virus when treating infected patients.

The triple-layer structure of Biosafety hoods is made of premium grade, super-soft, elastic nonwoven fabrics with ultra-fine fibers and supremely uniform web formation.

- **ΔP <3 mm H₂O/cm².** It can be layered over or under a mask without inhibiting the wearer's breathability.
- Particle filtration efficiency (PFE) was **>95%** against >0.1 μm particles when tested at a flow rate of 1 cubic foot per minute (CFM). Common airborne particles without pressurized driving force are rarely able to penetrate the hood.
- Qualified as a **level 1 fluid barrier** with resistance to synthetic blood penetration under 80 mm Hg sprayed from a distance of 12".



The form-fit and easy wearing VitaFlex Biosafety Hood can be comfortably worn underneath a N99 mask or an air-fed helmet. It should be the first PPE put on and the last taken off, keeping the wearer protected while the contaminated overall suit is being removed. Multiple hood-layering is recommended if used without a helmet. That way, the outer layer can be removed upon being contaminated while the inner layer remains in place keeping the wearer protected.

Caution: VitaFlex's Biosafety Hood is NOT a respiratory protection device for replacing a mask required by OSHA. Please view suggested donning and doffing procedures at <http://www.vitaflexUSAstore.com/ebola-sars-and-flu-prevention/>