

Masks, Gloves, and the Power of a Better Idea: A Brief History of PPE

The ascendance of COVID-19 has recently brought the value of effective PPE into a worldwide spotlight, and examining the history of all the equipment we take for granted today might provide us with further clarity as to its necessity

Jon Weisberg

As governments and institutions around the globe cope with COVID-19, the topics of face masks and other forms of personal protective equipment (PPE) have become a staple of the news. In the US and a handful of other nations, whether or not to wear face masks defines one's political alliance.

Last autumn, the head of the Centers for Disease Control and Prevention was shown on television defying Donald Trump, the man who hired him and a resolute mask-denier, saying that even more than a vaccine, the simple facemask will protect him from COVID-19. That concept – using a cloth covering to protect people from possible virus-bound inhalations and exhalations – is so simple and direct that many of us take it for granted. Yet the history of their use and acceptance in medicine is anything but simple.

The same applies to surgical gloves, an essential form of PPE for surgeons, nurses, and other healthcare workers around the globe. There was a time when masks, gloves, and other PPE simply were not part of the medical armamentarium. Their invention, development, and eventual adoption reflect the larger story of PPE innovation: smart solutions to serious problems that were slowly adopted by resistant practitioners.

In retrospect, rejection of these good ideas seems so unnecessary, but in medicine, as in so many other things, behavioural change can be exceedingly difficult.

Ancient Origins of the Face Mask

The history of face coverings is considerably older than that of surgical gloves. Pliny the Elder (AD 23/24-79)

came up with the idea for miners to use animal bladders as protection against toxic gasses. Leonardo da Vinci (1452-1519), whose many inventions included a form of chemical weaponry, recommended use of wet fabric over mouth and nose to avoid inhaling the fumes. During the plague years, some wore herb-filled beak-like masks to protect against miasmas, thought to be carrying disease.



Image 1: Plague doctors in the 14th century wore beak-like masks filled with herbs

Other developments occurred over the years, but it was in the 1880s that the concept of asepsis – preventing germs from infecting open wounds – caused surgeons to use protective coverings for head, body, nose, mouth, and hands.

Masks were made of strips of gauze held in place by a metal structure. The gauze could be washed and the metal frame sterilised. These reusables were popular until the 1960s when a culture of disposable medical products took root in Western hospital systems.

More Recent Development of Surgical Gloves

Surgical gloves have a different, but parallel, history, one disproportionately influenced by female innovation. Like surgical masks, their use was an outgrowth of interest in the new science of infection control. Increasingly, medical professionals understood that by creating physical barriers between physician and patient, they were better able to



Image 2: Robin Beck, CEO of BioBarrier, and developer of the BioBarrier Double Glove

Caroline Hampton had a bad skin condition, exacerbated by too much scrubbing with harsh chemicals, a practice developed decades earlier by Ignaz Semmelweis and Oliver Wendell Holmes. Their findings, based on the antiseptic practices of Joseph Lister, showed dramatic declines in mortality from postnatal infection resulting from proper hand cleansing with chemicals. Many in the European surgical community, content with using bare, often unwashed hands, rejected these new ideas. Widespread professional criticism of Semmelweis' hand-cleansing revelations resulted in the Hungarian's nervous breakdown and incarceration in a mental sanatorium, leading to an untimely death.

Back to Caroline Hampton, the scrub nurse and object of affection of her doting boss, William Stewart Halstead, often cited as a 'father of modern surgery'. Worried about her delicate hands, he made a plaster cast, which Goodyear Rubber Company used to make the first rubber gloves.

The gloves arrived. Carolyn used them successfully. She and the good doctor married, and Caroline, hands healed, started spreading the word to her colleagues.

Soon, surgical gloves were being used throughout Johns Hopkins Hospital. Then, Joseph Bloodgood, Halstead's senior resident, popularised them throughout the broader medical community.



Image 3: BioBarrier Double Glove features two separate glove layers and a single-donning cuff (1). Joins Inner and Outer Glove (2). Inner Glove (3). Outer Glove

control infection. That, in itself, would be a convincing tale of the origin of the surgical glove. However, its true genesis was to protect the highly sensitive hands of a well-regarded surgical nurse working at Johns Hopkins Hospital in Baltimore, Maryland.

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Carolyn's first use was in 1889; Joseph's, in 1893.

A recent visual analysis of surgical PPE worn by US and British surgical personnel in photographs from

1863 to 1969 shows a steady increase in the number of surgeons wearing gloves. The study concludes that 1911 was the year rubber gloves reached general acceptance among surgeons. That was only 22 years from the time of their invention.

Innovation. Invention. Ideas.

Fast forward about 100 years to a group of global patents for multilayer and antimicrobial surgical gloves issued to BioBarrier, Inc, a US company headed by Robin Beck, CEO. A pioneer in the field of PPE invention, Ms Beck holds 11 patents, including the first patent for a multilayer, single-cuff surgical glove that addresses comfort and dexterity.

Tracing the arc of surgical glove development, she came to understand that, like other forms of PPE, few improvements had occurred since they were created. Manufacturers had stopped using powder, which caused allergic reactions, and they had introduced synthetic materials. However, there was reluctance to make further changes. Among other factors, the high cost of setting up production was a disincentive for the costly retooling required to introduce important surgical glove innovations.

Ms Beck understood that conventional surgical gloves were not without problems; one in particular was the distinct possibility of pathogen-laden needle-sticks.

In the 1970s, HIV was the pandemic of the moment, and surgeons started to double-glove as a precaution against being infected from accidental needle-sticks. The practice was based on the idea that each glove layer would provide additional protection to its wearer by wiping suture needles as they passed through, therefore reducing or eliminating the amount of pathogens entering the body. However, double-donning had, and still has, problems. Putting on four separate gloves – one over the other – is uncomfortable and time-consuming. More problematic was the resulting tightness and its tendency to affect the surgeon's dexterity. Ms Beck envisioned the single-donning Double™ Glove as a way to provide additional protection and comfort for surgeons, nurses, police, fireman, and other emergency workers.

Surgical gloves are hand-specific, packaged in whole and half sizes. Each package contains a right and left glove, and each package goes through a sterilisation process. Studies using a limited run of BioBarrier prototype double gloves showed that surgeons and nurses found them preferable to the hospital-supplied single glove.

However, with a limited supply, hospital personnel concerned with sustainability never had the opportunity to understand that by adopting a single double glove, they would reduce by half the amount of hazardous waste.

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Image: Designed by pch.vectors/ Freepik

Ms Beck's extensive patent portfolio in thin film technologies was licensed by London International Group, with the intent of incorporating them into their Biogel surgical gloves as a way to enhance product safety features and to lengthen their patent protection. But LIG's glove division was sold, after which BioBarrier reacquired its intellectual property. Now the company and Ms Beck are focused on bringing the gloves and other PPE to market. COVID isn't retiring soon, and who knows when the next global pandemic will arrive? She is now developing devices and diagnostic tests related to infection prevention, sepsis, syringe redesign, and PPE.

Pliny the Elder and Leonardo da Vinci never faced manufacturing and licensing challenges for their face coverings. Carolyn Hampton Halstead, being the first to use the rubber glove, had no difficulty demonstrating its effectiveness at a time when medical professionals were recognising that performing surgery with bare, though clean, hands placed patients at risk.

There's always opportunity for inventors with better ideas, especially when those ideas save lives. Medical technology

continues to make impressive gains in diagnosis, treatment, and medicine. Unfortunately, with painfully few exceptions, PPE has remained unchanged. COVID-19 and other deadly microorganisms continue to evolve, challenging societies, worldwide.

Widespread adoption of improved protective equipment, such as surgical masks and surgical gloves – equipment that saves the lives of medical and healthcare personnel – is long overdue.



Jon Weisberg retired from Bristol-Myers Squibb where he was responsible for International Public Affairs. He is now a communications and crisis management consultant in the pharmaceutical, healthcare, and leisure business sectors.