

## The art of medicine

### A history of the medical mask and the rise of throwaway culture



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The shortage of face masks during the COVID-19 pandemic has become a symbol of the fragility of modern medicine and public health. Several explanations have been advanced for this situation, from a panicking public hoarding masks to the offshoring of manufacturing and the disruption of global trade. The history of medicine suggests another factor could be considered: the progressive replacement of reusable face masks by disposable ones since the 1960s. Medicine has been transformed by consumer culture—what *Life Magazine* enthusiastically named “Throwaway Living” in 1955. The history of the medical mask illuminates how this vulnerability was created.

Covering the nose and mouth had been part of traditional sanitary practices against contagious diseases in early modern Europe. This protection was primarily about neutralising so-called miasma in the air through perfumes and spices held under a mask, such as the plague doctors’ bird-like masks. Such practices, however, had become marginal by the 18th century. Face masks, as they are used today in health care and in the community, can be largely traced back historically to a more recent period when a new understanding of contagion based on germ theory was applied to surgery.

In 1867, the British surgeon Joseph Lister postulated that wound disease was caused by the germs of the microscopically small living entities that Louis Pasteur had recently described. Lister suggested eliminating germs through the use of antiseptic substances. But in the 1880s, a new generation of surgeons devised the strategy of asepsis that aimed to stop germs from entering wounds in the first place. This was a risky strategy. Hands, instruments, even the operator’s exhalations were suspect now. Johann Mikulicz, head of the surgery department of the University of Breslau (now Wrocław, Poland) started working with the local bacteriologist Carl Flügge, who had shown experimentally that respiratory droplets carried culturable bacteria. In response to these findings, Mikulicz started to wear a face mask in 1897, which he described as “a piece of gauze tied by two strings to the cap, and sweeping across the face so as to cover the nose and mouth and beard”. In Paris, the surgeon Paul Berger also began wearing a mask in the operating room the same year. The face mask stood for a strategy of infection control that focused on keeping all germs away, as opposed to killing them with chemicals. Such a narrowly targeted strategy was not uncontroversial. The physician Alexander Fraenkel in Berlin, for example, was sceptical about the “whole surgical costume with a bonnet, mouth mask and veil, devised under the slogan of total wound sterility”. However, masks became increasingly widespread. A study of more than 1000 photographs of

surgeons in operating rooms in US and European hospitals between 1863 and 1969 indicated that by 1923 over two-thirds of them wore masks and by 1935 most of them were using masks.

It was mainly the use of the mask to cover the mouth and nose (and beard) during the Manchurian plague of 1910–11 and the influenza pandemic of 1918–19 that turned the face mask into a means of protecting medical workers and patients from infectious diseases outside of the operating room. During the 1918–19 influenza pandemic, wearing a mask became mandatory for police forces, medical workers, and even residents in some US cities, although its use was often controversial. Yet in cities like San Francisco, the decline in deaths from influenza was partly attributed to the mandatory mask-wearing policies. At this point, the rationale for wearing masks moved beyond their original use in the operating theatre: they now also protected the wearer against infection.

Meanwhile, masks continued to be developed in medicine. Although medical practitioners agreed on the general function of the mask, in the first decades of the 20th century



Red Cross workers fold reusable masks during the influenza pandemic, Boston, MA, USA, March, 1919

Courtesy National Archives (165-WW-2698-37)

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they attempted to determine the most efficient type of masks and there were patents on various designs. Masks were usually made of several layers of cotton gauze, sometimes with an additional layer of impervious material, held by a metal frame. Their main goal was to prevent respiratory droplets from being transmitted from and to the wearer, as Mikulicz and Flügge had suggested for the operating theatre. Most masks were washable and the metal parts could be sterilised and "thus permit the use of the mask for a long time", as one US inventor explained, who had a medical mask patented in 1919.

Medical researchers tested and compared the filtering efficiency of reusable masks with experiments involving the culture of bacteria nebulised through masks or spread by infectious volunteers wearing masks in an experimental chamber, as well as observational studies in clinical settings. They found that masks varied greatly in the extent to which they filtered bacteria. But when used properly, some masks were considered to offer protection from infection.

Medical masks started to be replaced by disposable paper masks during the 1930s and were increasingly made of synthetic materials for single use in the 1960s. By the early 1960s, there were advertisements for new kinds of filtering masks made of non-woven synthetic fibres in nursing and surgery journals. These filtering masks were all disposable. Advertisements highlighted their performance, comfort, and convenience. Unlike most traditional medical masks, these cup-shaped respirator masks fitted snugly on the face and were designed to filter incoming, not only outgoing, air, as well as to prevent the spread of droplets like traditional masks. These masks could be used only once because their synthetic fabric would deteriorate during sterilisation.

The substitution of reusable masks was part of the broader transformation in hospital care towards what a hospital administrator in 1969 called a "total disposable system" that included syringes, needles, trays, and surgical instruments. In part, disposability was supposed to reduce the risk of compromising the precarious state of sterility. However, another reason for switching to disposable masks was a desire to reduce labour costs, facilitate the management of supplies, and to respond to the increased demand for disposables that aggressive marketing campaigns had created among health-care workers. Disposables were convenient, an advantage apparent to anyone "who has seen staff disentangling the tapes and reassembling autoclaved linen masks", as a British medical researcher put it in 1980.

Industry-sponsored studies found the new synthetic masks to be superior to traditional reusable cotton masks. More frequently, however, reusable masks were omitted from comparative studies. In 1975, in one of the last studies to include an industrially manufactured cotton mask, the author concluded that the reusable mask, made of four-ply cotton muslin, was superior to the popular

disposable paper masks and the new synthetic respirators. He noted that "cotton fabrics may be as effective as synthetic fabrics when incorporated in a good mask design". Some studies have suggested that washing reusable masks might increase their bacterial filtering efficiency, perhaps by tightening their fibres. In the absence of commercial cotton masks, more recent studies have only compared artisanal or homemade masks with industrially produced disposable masks, finding the latter to be superior. These results to some extent reinforced the idea that reusable masks were potentially unsafe, partly discouraging further research into well designed and industrially manufactured reusable masks.

During the COVID-19 pandemic, health authorities in some countries have recommended that citizens wear masks in public under certain circumstances. In this context, a number of grassroots initiatives has emerged, typical of our participatory age, to help people sew cloth masks at home for their personal use and in some communities to supply nearby hospitals. These improvised masks typically overlook some of the design elements that were crucial for the efficiency of earlier cotton masks. Yet the public response has been enthusiastic in some places, at least as measured by the number of people viewing instructional videos. The home production of reusable masks for use in the community offers last resort solutions to some and comfort to many, but is unlikely to contribute more than marginally to solving the shortage of personal protective equipment globally. As for health-care workers and hospitals, in some settings they are experimenting with methods to sanitise disposable masks, even though they were not designed to be reused. Such an approach is a far cry from the carefully designed, manufactured, and tested reusable masks in use until the 1970s.

Reusable masks were once an essential part of the medical arsenal. However, the industrial production and further research and development of reusable masks was largely halted with the transition towards disposable masks in the 1960s. Disposable masks and respirators will certainly remain an essential part of medical personal protective equipment in the future, since some of them possess specific filtration qualities designed for health-care situations. To avoid a shortage of masks during the next pandemic, one should look beyond the creation of large stockpiles of disposable face masks and consider the risks of the throwaway consumer culture applied to life-saving devices. Perhaps one day it might again be possible to say about protective face masks what medical researchers wrote in 1918: "A mask may be repeatedly washed and used indefinitely."

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