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Commentary

# Global risk to the community and clinical setting: Flocking of fake masks and protective gears during the COVID-19 pandemic

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The 2019 coronavirus disease (abbreviated COVID-19) was believed to be originated in Wuhan, China, in late December, 2019. This disease is rapidly transmitting to more than 200 countries, and has become a pandemic. Geographically, Hong Kong is located proximally to Wuhan—the epicenter. With the rapid transmission of the COVID-19, Hong Kong has been confronted by the increasing number of confirmed and suspected cases daily, now exceeding 1,000 at the time of reporting. Hong Kong people are beyond doubt in a state of anxiety, fear, and helplessness. The latest evidence indicates that face mask helps prevent the transmission of human coronaviruses and influenza viruses from symptomatic individuals[1] and thus, an increasing number of health care authorities have recommended the use of face mask in public spheres for self-protection and others.[1-3] Consequently, Hong Kong people started a mass surge of surgical masks locally and nationally. This gives a golden opportunity to thousands of fake masks and protective gears flocking in markets ever since the pandemic.[4,5] However, there are rare empirical data to unfold this condition regarding severity and prevalence.

In accordance with ASTM F2299-03 international standard,[6] our Squina International Centre for Infection Control established a system to estimate the Particle Filtration Efficiency (PFE) of face mask. This estimation was performed to evaluate the PFE of a given face mask by comparing the artificial generated aerosols in upstream (ie, outside mask) of the test article with the downstream (inside mask). The aerosols were generated by sodium chloride and kept in the buffer chamber until reaching an optimum test environment, including aerosol concentration between $10^7$ and $10^8$ particles/$m^3$, humidity of 30%-50% (±5%), and temperature of 21°C (±3°C). Two sets of Optical Particle Counter (Grimm Aerosol Spectrometer, Model 1.109)[7] were used to capture and count the aerosols with the size of 0.3 $\mu$m and 1 $\mu$m at upstream and downstream. Five to 10 pairs of consistent data (<3% variation of particle count) were used to estimate the PFE. This system was validated with Automated Filter Tester (TSI Model 8130A as gold standard for 0.3 $\mu$m PFE)[8] by comparing the known 0.3 $\mu$m PFE materials from 40.33% to 99.99%. Results indicated that the PFE difference ranged from −6.81% to 3.85% (mean = −1.65, SD 3.47). Concurrent validity that correlated the 2 set of PFE scores was also satisfactory ($r = 0.99$, $P < .001$).

We tested 160 brands of masks from different sources and countries (Fig 1). Results showed that low-quality face masks accounted for 48.8% (ie, 0.3 $\mu$m PFE, mean = 47%; 1 $\mu$m PFE, mean = 69%). Approximately 42.6% of face masks claimed to achieve ASTM level 1 standard (ie, PFE ≥95% on 0.1 $\mu$m, provided with certification or printed description on box) but demonstrated insufficient filtration performance at 0.3 $\mu$m (range = 6%-94%). Surprisingly, we extracted seven randomly selected boxes (out of 200 boxes) of the same brand (labelled with ASTM level 1 standard), the 0.3 $\mu$m PFE of 35 sampled face masks were highly inconsistent, ranging from 29.9% to 99.9%. Only 37.5% of the sampled face masks may potentially achieve the claimed standard. By inspecting the filter layer (melt-blown Polypropylene) through microscope (×1,000), a number of tiny holes and uneven distribution of fiber were observed on face masks with low 0.3 $\mu$m PFE. Several face masks (~3.1%) were the counterfeit sourced from internationally well-recognized brands of medical equipment manufacturers. Of which, the 0.3 $\mu$m PFE varied considerably from 38% (fake ones) to 99% (good-quality ones).

Counterfeit and fake face masks are merely the tip of the iceberg in the personal protective equipment market.[9] However, general public and even health care professionals may be unable to distinguish the counterfeit and fake face masks from those quality one. More importantly, most organizations and hospitals nationwide lack the appropriate equipment to initially examine the purchased face

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**Fig 1.** The randomly selected samples of face masks for testing particle filtration efficiency.

masks prior to distribution to different units. It is anticipated that they may face similar difficulty in examining their PPEs, N95 respirators, and surgical gown.

Our test results were alarming because using fake masks/protective gears will jeopardize the health of COVID-19 patients, suspected cases, close contacts, and vulnerable subpopulation (health professionals, older adults, patients with chronic disease, poverty). Illegal fake mask and protective gears manufacturing may disrupt the infection prevention and control toward the COVID-19 outbreak in clinical and community settings. Failure to curb the rapid disease transmission may transform the infectious pandemic into a new hybrid disaster (natural and man-made events). Thus, there is a pressing need for the Food and Drugs Authority to impose stringent guidelines on proper face mask production, materials to be used, quality control, commodity labeling, distribution, and recommended price range. Local and international governing bodies should strictly enact and enforce legal guidelines to forbid fake mask/protective gears manufacturing with a serious penalty to deter those profiteers. The local government should educate the general public to distinguish between good-quality masks with those fake face masks via social media. Vulnerable subpopulation should also have heightened awareness to counterfeit/face masks to avoid falling into the profiteers' net.

## AUTHOR CONTRIBUTION

Conceptualization: S.C.L., L.K.P.S;
Literature review: S.C.L.;
Writing-original draft preparation: S.C.L.;
Writing-review & editing: S.C.L., L.K.P.S., T.C.C.C.

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