Title: Inviting Environmental Awareness Through Small, Sustainable Acts: Medical Students Impacting the Community

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Discussion Points:

- Increasing waste of medical masks has been observed in recent years.
- These infectious wastes may be biologically harmful by being a transport medium for pathogens.
- Medical students should educate the community about the harms of improper mask disposal as well as the proper ways of disposing of masks.

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THE EXPERIENCE.

Impacting the community does not always mean creating exponential growth, but it can also mean bringing small and sustainable changes which aim to improve people's quality of life. Living in a developing country, we had first-hand experience of seeing life in underprivileged communities. This experience expanded our desire to serve communities around us. However, things started to change when COVID-19 emerged in our country. By then, most of the plans to contribute to our community were halted. Strict outbreak control measures, which restricted people's mobility, prohibited visits to said communities.

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Although the situation within Indonesia may have gone awry during the first two years, things turned out to be better in 2022. As a group of medical students, we were given a chance to organize a community service in collaboration with faculty members and hospital authorities in September. This community service was part of a series of the celebration to commemorate our academic hospital's anniversary. As a part of the service, we were trusted with the autonomy to provide community counseling regarding the impact of the COVID-19 pandemic and how to dispose used medical masks safely (Figure 1).

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This topic came into our mind after observing heaps of used masks piling up at the side of renowned beaches we visited on our days off. Disposable surgical masks are commonly made of polypropylene arranged into three layers. Each layer serves a different function, restricting the transmission of small particles and pathogens from both directions.[1] Increasing numbers of medical masks at the household level observed during recent years meant a global increase in the production of plastic waste. Though wearing a mask is very crucial as a means for health protection, these masks may pollute the environment physically and biologically, thus minimizing the effects of health protection plans. These masks could contain sufficient pathogens capable of infecting susceptible hosts. If this waste is not discarded appropriately, cross-contamination to scavengers (both humans and animals) in landfills may occur,[2] perpetuating a never-ending chain of infection in the environment. Post-landfill, leachate may flow to nearby or even further areas, spreading COVID-19 through fomites while also being a threat to marine environment.[3,4] Apart from the risks of infection, the polypropylene in face masks will eventually disintegrate into smaller micro- and nanoplastics which are genotoxic and cytotoxic to terrestrial and aquatic species.[5] The microfibers that are broken down from face masks may enter soil and water as leachable compounds, thus polluting human food chain in the ecosystem. Furthermore, it was found that direct disposal of masks into aquatic environment would release more microfibers, which might aggravate threats to the aquatic ecosystem.[5,6] In addition to microfibers, certain types of masks which contain a nose wire made from metals were also found to produce heavy metal substances, such as lead (Pb), cadmium (Cd), and Chromium (Cr). These substances could cause toxicological effects to the environment and especially to human health, such as carcinogenic effects, kidney and neurological damage, asthma, or even death. However, even if the masks were to be incinerated instead of direct disposal, the Volatile Organic Compounds (VOCs) that are produced should be considered since some of them are hazardous in nature.[5]

Comentado [A1]: Yes, we meant nanoplastics

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The management of medical mask waste can be divided into upstream and downstream management. The focuses of upstream management include mass education and strict community monitoring which will maximize household-based waste management. This process includes sorting out infectious waste from other organic

and inorganic waste and decontamination via heating or disinfectant bath. Keeping this infectious waste dry is crucial to prevent leachate.[7] Proper labeling and categorization will help garbage collectors identify which waste must be treated separately.[7] On the other hand, downstream management focuses on the need to enact the formulation of a novel system and readjustments of existing operational protocols regarding these kinds of infectious waste to countermeasure rapid fomite spreading of the pathogen. These include specific scheduled pickup times, specialized waste management areas, chemical valorization, and physical valorization.[7,8] Specialized areas for the management of personal protective equipment (PPE) waste should be assigned, where every waste being disposed of must first be disinfected to avoid the possibility of cross contamination towards workers within the area.[7] Temporary and proper storage of the disposed masks could act as a conventional method of disinfection since scientific reports have reported that viruses can only survive up to 9 days depending on several factors. The installations of developed mobile and on-site disinfection units to further reinforce the disinfection process should also be considered by the government. Regarding chemical valorization, the method of incinerating masks is not recommended due to the toxic compounds it produces in the process. Several alternatives have been discovered and should be considered by developing countries. These alternatives include pyrolisis, which is an environment-friendly process of converting solid plastic waste into liquid fuel, and carbonization, which is an energy-saving process of converting polymer waste into different valuable carbon materials.[8] As for physical valorization, developing countries could benefit from integrating plastic fibers of masks waste into building materials. Several researches have shown that the addition of masks fibers could improve the strength and endurance of asphalt, pavement, and even concrete.[8,9]

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As an alternative to treating used masks as waste, sterilizing face masks for reuse through heating is actually academically proven to be effective in killing pathogens and results in minimal reduction in particle filtration efficiency (PFE).[10,11] However, even though this solution is environment-friendly, standardization and ethical concerns may be an issue. Moreover, this solution would drive up the costs of masks as special and calibrated equipment is required. This may exacerbate the health inequity gap in underprivileged or overcrowded communities. As for the ethical issues, this may include the possibility of mask reuse by different people. Therefore, governments usually opt to appeal to the public to disfigure medical masks before disposal to prevent misuse by unwanted parties.

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Taking into consideration all the situations and methods discussed above, as medical students, we were required to think holistically and to act based on public health by educating the community about the potential harm of improper handling of medical waste. Putting our theoretical knowledge into action, we learned to apply a lot of skills and 'practical' knowledge we obtained from our in-class lectures as well as books. We learned to act based on our scope and capacity, educating the upstream while trying to gain attention from authorities regulating the downstream processes.

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The activity by itself was heartwarming. We had the opportunity to converse with people who were part of the local Family Welfare Movement. They raised their concern, later urging us to speak with local trash regulators out of concern that the trash-collecting regulations from the authorities might not have supported this movement. Faculties and hospital authorities also sponsored our activity, which was shown by the handover of labeled trash cans (Figure 2). Afterwards, news of our action was spread through social media. We were then invited to speak

at a local radio station to provide the same presentation and moral message as we had previously given, but this time in front of a larger audience (Figure 3). We also uploaded an original animated video to YouTube, which is watchable at https://www.youtube.com/watch?v=boV28Pf8tz0, to help the younger portion of our community understand the steps to dispose of medical waste safely. Again, through small and sustainable changes, we can also bring about an impact in the community and improve the people's quality of life.

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In the end, it had been a wonderful experience for the community and us. Not only did we spread awareness about the physical harm that improper handling of medical waste may have brought, but we also helped our community and children strove for a greener future. These small actions bring sustainable impact in our community. Now is not the time for medical students to be impractical intellectuals, but it is time for them to understand theoretical knowledge holistically, to process real-life issues critically, and to act upon it decisively for the betterment of our community and our future!

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SUMMARY - ACCELERATING TRANSLATION

In this article, as a group of medical students, we organized a community service in collaboration with faculty members and hospital authorities. During the service, we provided community counseling regarding the impact of the COVID-19 pandemic and the proper way to dispose of used medical masks. This topic was brought up out of concern regarding the harm towards the environment and human health that could be caused by infectious waste. There are many methods, whether upstream or downstream, that should be considered to countermeasure the adverse effects of infectious waste. From this real-life situation, we were required to think holistically and to act based on public health principles through community education. We had a heartwarming experience as we were able to converse with and to receive the point of views of the local people. The news of our action was spread through social media and we were then invited to convey our moral messages at a local radio station. We also uploaded an original animated video to YouTube, which may help with the understanding of the younger portion of our community. Lastly, medical students are not meant to be impractical intellectuals, but they should able to understand theoretical knowledge holistically, to process real-life issues critically, and to act upon it decisively for the betterment of our community and our future!

FIGURES AND TABLES.

Figure 1. Community Counseling about the Proper Ways of Disposing of Medical Masks.

Figure 2. Symbolic Handover of Labeled Trash Cans by Faculty Members and Hospital Authorities to Local Representatives.

Figure 3. Invitation to Speak at a Local Radio Station about Proper Disposal of Medical Masks.