

Biohazards of Prolonged N95 Use: Effects on Arterial Blood Gases, Peak Expiratory Flow Rate and General Well-being of Healthcare Professionals during COVID-19 Pandemic

Sir,

Globally as millions of people have been staying at home to prevent human to human transmission,¹ healthcare professionals (HCPs) stand at the front most, despite the unpredictable outcomes and daily evolving guidelines on coronavirus disease 2019 (COVID19). In these times, working as a frontline professional, where most part of day is spent in personal protective equipment (PPE) with N-95 being constant part of face (as respirators are fundamental for HCPs in aerosol borne diseases handling),² unusual symptoms were experienced and reported randomly, which included headaches, mood disturbance, fatigue and lethargy. These symptoms could be attributed to work-related stress but endemics and epidemics have not been a new experience for HCPs of the subcontinent. As the healthcare system has a very non-efficient mechanism of notifiable infectious diseases registration, starting from foundation year, most HCPs have faced the potential risk of exposure to various airborne/blood borne/waterborne endemics and epidemics, and are still exposed at various levels. Few notable exposures have been tuberculosis, and congo-crimean virus, *rota* virus, hepatitis viruses, *vibrio cholerae*, *chickengunya*, chickenpox, extremely drug resistant enteric fever and human immunodeficiency virus.

HCPs in Pakistan have developed a baseline subconscious stress coping mechanism of variable degree while working in such unfortunate situations, where odds of acquiring infection from workplace are always high. Fighting this global pandemic is not only an unprecedented challenge but has opened a Pandora box, where everything once considered safe is now under question mark. With our unusual experience of symptoms, we inquired about the actual biosafety of PPE by relooking into manuals provided by various prototype manufacturers. To our utter surprise, we failed to find any substantial data highlighting retention of noxious gases and effects on respiratory functions with use of PPE respirators/masks.

We recruited 75 HCPs (out of 110 approached) working in different COVID-19 setups all over Pakistan, wearing N95 respirator ensemble for the duration of more than 6 hours in our study. This included doctors, nurses and paramedics working as frontliners in COVID-19. Subjects with any physical or psychiatric diagnosis at the time of study were not included in the analysis. They were evaluated before and after their professional duty to study

the effects of possible CO₂ retention on development of related symptoms, peak expiratory flow rate values, variation in oxygen saturation observed on pulse oximeter, and long term changes on spirometry. CO₂ retention usually manifests with the symptoms of headache, dizziness, lethargy, flushing, tachypnea, tachycardia and dyspnea³ and these variables were assessed in subjects after documenting basic demographic and clinical characteristics of the participants (age, gender, profession, allergies and comorbid conditions).

Among the study participants, 70 (93.3%) experienced headaches, 50 (66.7%) lethargy, 38 (50.6%) dizziness, 23 (30.6%) nausea, 18 (24%) dyspnea and 12 (16%) tachypnea. A variability of an average 25ml was observed with PEFR (normal average between 350-500ml/L)⁴ pre-and post-N95 use, keeping in mind the limitation that post duty fatigue impeded full capacity exhalation. While on duty oxygen saturation variation was documented in a range of 89-95% (measured using pulse oximetry). Last parameter that was employed in this study was to ascertain arterial blood gases (not all subjects consented to it). Fifty out of 75 consented for it. Inference deduced from the partially collected data on difference of pre- and post-duty PCO₂ was between 0.3 to 0.7kPa. Spirometry could not be performed in any subject due to potential hazards of exposure to aerosols and resource constraints.

The above mentioned results, that include the parameters of CO₂ narcosis, variation in PEFR, difference in oxygen saturation, and general wellbeing of HCP's, reflect that use of this product needs scrutinising from biosafety point of view. It should be emphasised that there are no shortcuts; and quality control must never be compromised in urgency of launching the product. This letter has been written with a hope that it may help the authorities in regulating quality control of product, making it HCPs-friendly. A detailed policy is needed to implement safe duty hours' duration with work breaks in between. Proper trials are needed to assess effects on blood concentration of O₂ and CO₂, pulmonary function tests and negative impacts on frontline HCPs health using N95, and similar masks in current pandemic and related situations. Appropriate authorities, like WHO, should direct all authentic manufactures in PPE to ensure that all essential biosafety parameters are addressed by proper trails and research prior to launch of the product.⁵ Thus, in the global response, the safety of healthcare workers must be ensured as a priority; and proper steps to be taken in this regard.

CONFLICT OF INTEREST:

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

MHA: Conceived the main idea and framework of this study design.

MHA, UBZ, UZ: Contributed in the collection and management of data; discussed result and contributed to writing, drafting and proofreading of final manuscript; collectively provided critical feedback and helped shape the analysis and manuscript.

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