TBIS

Topic of the Speech:
Protective Properties and Comfort of Community-Masks

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Dr. Simon Annaheim completed his PhD in human movement sciences at ETH Zurich in 2009 and continued his studies in exercise physiology as a postdoc for one year. He joined the Federal Laboratories for Materials Science and Technology (Empa) in 2011 to investigate local pressure impacts and wearing comfort of backpacks. In 2012, he was promoted to a scientist researching thermal and mechanical wearing comfort for clothing and carriage systems. Simon Annaheim became a scientific group leader of the Materials-Body-Interaction group in 2013 (former Body Monitoring group [2017-2019] and Heat and Mass Transfer group [2013-2016]). The research group investigates thermal and mechanical interactions of the human body with materials (textiles and carriage systems) and its environment and develops and validates numerical and statistical models. The models are applied for materials development and the prediction of thermoregulatory responses of humans exposed to extreme environmental conditions.

For the measurement of thermoregulatory and other physiological responses, the group defines the requirements for the development of textile-based sensors and the integration of sensors into textiles (in collaboration with other research groups at Empa). Finally, Simon Annaheim and his team investigate the reliability and accuracy of the wearable systems for specific applications. They aim to develop systems for continuous long-term monitoring of workers and patients for early detection of changes in health conditions. For this reason, the group closely collaborates with partners from clinics and industry. Furthermore, the provides the basis for validation purposes of thermoregulatory models as well as for the non-invasive prediction of physiological parameters (such as core body temperature) or general health conditions.

Simon Annaheim published more than 60 papers in peer-reviewed scientific journals and presented his research at international scientific conferences. He co-supervises PhD students in collaboration with ETH Zurich (Department of Health Sciences and Technology) and other universities and continuously offers open positions for master students and interns. Furthermore, he is involved in the acquisition and management of research and applied research projects in collaboration with partners from academia, clinics and industry as a principal investigator as well as a project partner.

ABSTRACT SUBMISSION

Protective Properties and Comfort of Community-Masks

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ABSTRACT (NO MORE THAN 500 WORDS:)

Mask shortages and the opportunity to enter a new market sector has prompted companies in the textile sector to invest in the development of community masks. Community masks are recommended for the general population for source control purposes (protecting others from exhaled virus-containing droplets or aerosols emitted by the mask wearer). Besides, the masks should protect against contaminated particles and droplets emitted from people nearby. Currently, there are no norms available defining the requirements for community masks as this is the case for filtering facepiece (FFP) masks (EN 149) or surgical masks (EN14683). Hence, community masks lack quality specifications, which lead to unproven comfort and protective properties. The Swiss National COVID-19 Science Task Force developed requirements for community masks consisting of breathing resistance (for the comfort assessment), particle filtration efficiency (for source control evaluation) and droplet resistance (for personal protection assessment) as the key performance indicators of community masks. The recommendations for community masks offered on the Swiss market were derived from the existing norms and include following requirements: a maximum allowed pressure difference of 60 Pa/cm2 observed for an airflow of 1.6 l/cm2/min (8l/min for a probe area of 4.9cm2); a minimum mask filtration efficiency of 70% for particle sizes of 1 µm at 30l/min airflow; and high splash resistance with no liquid penetration observed in 10 specimens preconditioned during 4 hours at 21°C and 85% relative humidity when exposed to synthetic coloured saliva at a pressure of 12 kPa. Also, materials used for community masks have to be biocompatible (complying with the requirements according to ISO10993) and reusable (tolerating of at least five washing cycles at 60°C according to ISO6330). There are ongoing research and further development of methodologies for particle filtration efficiency and splash resistance to provide more detailed information about the functionality of the masks and for a better understanding of the interaction of the fabric layers. This aspect is very critical as it has been found, that single layers of fabrics (such as cotton) reached low breathing resistances (pressure differences below 5 Pa/cm2) while they did not provide accurate source control (filtration efficiency of 20-30%) and splash resistance. Furthermore, the combination of the fabrics affects the mask properties in a non-linear manner. Another activity is about the use of inactivated viruses to investigate the localization of viruses within fabric layers after filtration and splash resistance tests.

The most promising mask concept so far consists of a three-layer approach with the outer layer protecting from contaminated droplets and particles and the mid-layer providing the filtration of droplet and particles for source control. For these solutions, however, wearing comfort became a limiting factor. Consequently, a systematic understanding of the performance and the interaction of fabrics incorporated into masks are needed to develop masks with required and balanced protection and wearing comfort. This knowledge is built up in an ongoing innovation project funded by the Swiss government to nurture new and innovative concepts for reusable community masks.