Written Evidence Submitted by the University of the West of Scotland (CLL0052)

Title: **The need for effective face coverings to reduce virus transmission**

We are pleased to provide evidence on an innovation to help protect the people who may be at more risk of harm from COVID-19. This evidence is based on R&D activity by research partners tensARC, Ltd, and the University of the West of Scotland, supported by a Scottish Funding Council grant and by a grant under Innovate UK Project #57852, "Novel face mask design for source control of viruses as a low-tech tool to enhance social distancing." The research included a literature review, design and engineering and laboratory testing.

Rationale for the project

Source control is crucial for managing the pandemic. **Controlling an infectious disease at the source, e.g. an infected person, reduces transmission to others.** People at significant risk from COVID-19 may not be sheltering. These people may be older, but not elderly, or they may have unidentified conditions that put them at risk Such people with a higher risk are mixing, for example, with others who may be infected but are not showing symptoms. To help manage this risk better, we made a better mask, one specially designed to filter what people exhale, to help stop a possible transmission at the source.

Critical issues to be addressed

Evidence with regards to the effectiveness of the more widely used mask types is growing but still limited. Source control research - **how well the masks we wear protect others -** can help us all understand the risk of transmission. **Transmission at the source can occur because of a poor filter**, or because what **people exhale avoids the filter altogether and flows out of a gap or other leak**. Filter performance can be measured. Unfortunately, **masks for general use have no specific standards at this time**, so without testing each kind on the market, we cannot communicate their effectiveness or any related reduction in transmission risk that they may provide. Also, **most face coverings leak aerosols, especially if not used correctly** (not sealing the nose, gapping at the cheek) – inwardly, outwardly, often imperceptibly, but certainly significantly. A mask with a high-performing filter also may leak out the sides or the nose; for this reason also, it can be difficult to assess risk and the impact of masks in reducing transmission of disease. **User compliance is also important to consider.** Users must remember to put on a face covering when needed, and if wearing a mask is burdensome, they may be less inclined to use it. Face coverings can slip during conversation, increasing leakage and exposure to others; adjusting the mask risks susceptible areas of one's own face.

Face covering efficacy to limit virus transmission can be optimized and guidelines created

We re-conceived mask construction. We put source control at the centre of our thinking, thereby prioritising the need to address leakage. We started with a "gaiter" shape and enhanced performance through **our "facegaiter" design**. As seen in Figure 1, the facegaiter is tubular in shape and has a much larger filter, plus an air circulation space that helps direct the wearer's breath into the whole filter, not just a small area in front of the mouth.

By design, the **facegaiter forces all air** – coming in and going out - **through its oversized filter**. As a result, there is no added burden when the wearer breathes, as may be the case with filters having a high filtration factor but low air permeability. To enhance wearer comfort, we located seals away from the jaw line, which means **no gapping or moving when speaking**. Based on preliminary data from aerosol tests (using a non-pathogen), the overall source control performance of a facegaiter as worn is similar to that of the FFP2 respirator as worn (Figure 2). In addition to a high level of source control (e.g. 90% for 0.3 um), preliminary data suggest that the facegaiter also provides protection to the wearer, with tests indicating 82% (air-dried) and 89% (tumble-dried) protection, tested as worn.

In addition to validating the facegaiter's source control design, our research team is developing a new knowledgebase that will be very useful to public health. During the pandemic, we have performed preliminary tests on mask fabric to assess virus transmission, and this was achieved by PCR using an animal coronavirus (SARS-CoV2 surrogate). So far, we have observed a 90% reduction in virus detection in air passed through the fabric, and tests will continue so to

understand the effectiveness of mask types against pathogens. We are not aware of another team conducting research on non-medical masks with this specific focus and intend to build out this facility and share what we learn.

Comfort leads to compliance

Good breathability and **comfort** mean people are **less inclined to adjust it away from the nose or mouth**, so there is no leakage from poor use. To aid in compliance with mask rules, we made the facegaiter convenient to wear. It can be pulled up when needed or left on, like a scarf. It comes in many colours and patterns, plus print-to-order, to appeal to different tastes. This variety offers a range of looks suitable for many different settings, which also encourages compliance. The facegaiter is re-usable and durable, currently tested for 30 washes without losing its filtration performance. It has the potential to be re-used and washed 100 times. Durability **addresses the environmental concerns of single use disposable masks.**

Ensuring safety in the work environment

This research may be applicable immediately to a work setting. If an employer can hand his employees a face covering with a **known performance level and usability**, that employer can quantify the business risk of bringing staff back together to try to resume near-normal operations. There is less uncertainty about the effectiveness of the face gaiter; it may give more confidence to employers who have teams that must work face to face, e.g. essential frontline workers, and/or teams which are at a higher risk, such as those in enclosed and cold environments.

Development and production

The facegaiter was developed in a collaboration between a Scottish University (University of the West of Scotland) and a company incorporated in Birmingham and based in Stirling, tensARC, Ltd. With a patent filed and imminent website launch at facegaiter.com, it is a solution ready for market. The research partnership intends to share its findings and expertise as well as further develop its knowledgebase in the future **and provide support to and knowledge towards standardizing face covering development**. Despite the good news recently around the progress with COVID-19 vaccines, the public will need to wear masks for some time yet, and our work will assist in this public health intervention.

Summary

Being **the first community mask whose design centers on source control**, the facegaiter is a new tool to help **reduce the R number**: its performance is quantifiable and it encourages compliance by reducing the discomforts of mask wearing. The facegaiter filters effectively, maintains a comfortable level of breathability, and reduces leakage dramatically, all of which helps us respect others' safety while protecting ourselves. In this way, those at most risk can be better protected.

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Figure 1. The facegaiter as displayed on a mannequin, in a herringbone pattern.

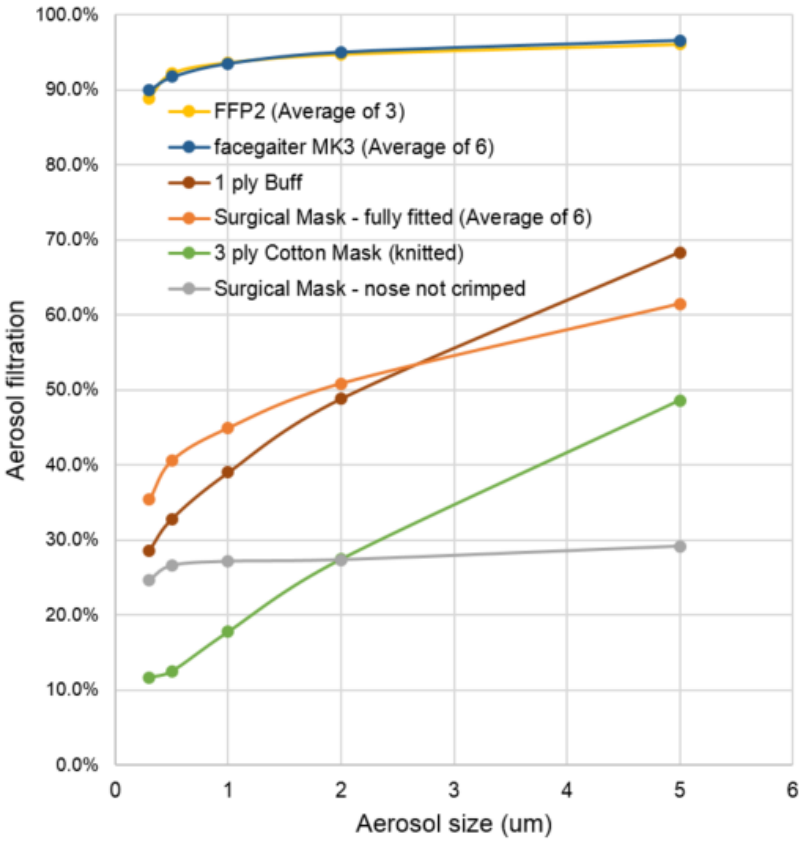

Figure 2. Preliminary data showing source control performance of FFP2 respirator, surgical mask (nose wire crimped and not crimped), 3-ply cotton knit mask, 1-ply buff, and the facegaiter (FG).