

FACESHIELD: PROTECTING OUR FRONTLINERS

When the first few cases of COVID-19 arrived in Singapore, healthcare workers at the frontline were up against an invisible enemy, a new coronavirus with an evolving nature that kept citizens of the world on edge.

As they rushed to implement the crisis protocol and coped with the changes required in a pandemic, the only thing that protected them was their armour – the Personal Protective Equipment (PPE), which was critical to mitigating the risk of being infected.

One item that is common in the PPE across the healthcare circuit dealing directly with COVID-19 patients are the goggles.

As the increase in COVID-19 cases intensified globally, the social media network started displaying the harsh reality and sacrifice that the healthcare frontliners goes through.

Some images constantly shared across social media are of frontliners with facial imprints due to prolonged use of the goggles, and highlighting the pain and discomfort they have had to tolerate in order to carry their duties. The lenses of the goggles also tend to fog up, reducing visibility and may cause giddiness for the wearer.

The situation presented an opportunity for rapid innovation to develop a face shield for better staff protection.



Rapid Innovation

It was all hands on deck for the CHI Living Lab team, and together with Dr Shawn Vasoo, Acting Medical Director of National Centre for Infectious Diseases (NCID), and Dr Brenda Ang, TTSH's Head of Infection Control, they conceptualised and produced several face shield prototypes within one weekend in early February.

This was the beginning of an innovation by staff for staff.



The design requirements of the face shield are:

1. **Protective fit:** Able to shield the face (full coverage) with staff having their N95 masks on, fit different head sizes and secure to use.
2. **Clear visibility and no fogging**
3. **Disposable or easy to wipe down**
4. **Ease of donning and doffing**
5. **Use materials that are easily available and inexpensive**
6. **Easy to scale and manufacture**
7. **Comparable price or cheaper compared to face shield options available in the market.**

After more than 100 design iterations upon rapid testing with clinical staff, two face shield prototypes which met the abovementioned requirements were selected for further production: the CHI Disposable Face Shield, and the CHI Spectacle Face Shield.

Design 1: The CHI Disposable Face Shield

The CHI Disposable Face Shield is made up of a plastic frame fitted around the head, with an attached one-piece plastic shield.

It is a comfortable wear and a universal fit for any user, and is disposable. Its simple and clean design makes the production fast and affordable.

Design 2: The CHI Spectacle Face Shield

The CHI Spectacle Face Shield is a spectacle frame with a mechanism to attach and remove a disposable face shield.

The spectacle frame is a one-piece design, produced with 3D printing using medical grade material that can be easily wiped down with one wipe.

The locking mechanism attaches the disposable shield firmly and offers stability while users carry out their routine care, and it facilitates easy removal. It also uses the same one-piece plastic shield.

As the spectacle frame is made with 3D printing technology, it allows a shorter manufacturing lead time as compared to the commercial method of injection moulding technique.

The removable shield allows the shield to be replaced while reusing the spectacle frame, making it a cost effective solution.

Internal Use and Testing

Funded by the Ng Teng Fong Healthcare Innovation Programme, 7,500 pieces of the disposable face shield prototype and 100 pieces of the spectacle face shield prototype with 15,000 disposable shields were deployed for use from 19 February 2020 for internal use and trial testing at the NCID, Screening Centre and CDC 2.

Design 1, which is disposable, is found to be more suited for use at the Inpatient Wards, where frequent change of shields is required.

Design 2, which has a reusable spectacle frame, is more suited for use in ambulatory settings such as the Emergency Department and NCID Screening Centre, where extended use is required.

One of the nurses at NCID who had a chance to use the disposable shield is Ms Lin Ying, who has positive feedback saying that the face shield is “easy to use, is light in weight, and does not add pressure the forehead.”

She also adds that because it is disposable, she does not have to carry out the usual “wipe down” on the face shield as she normally would for any equipment used.



The CHI Disposable Face Shield (Design 1) used by a the nurse on the left from the Community Swab Team



The CHI Spectacle Face Shield (Design 2) used in NCID Screening Centre.

Into the Future

The face shield design has been iterated further since deployment in February, based on feedback by staff.

The plastic shield, used for both disposable face shield and spectacle face shield, is now angular in shape which improves visibility by reducing reflection and refraction of light further.

The disposable face shield is also using a different plastic grade to further improve clarity. These will be deployed for internal use soon.

The team has also filed for two registered design patents with Intellectual Property Office of Singapore (IPOS) for the 2 shield designs.

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