

# MRI patient mask wearing as part of infection control measures in neuroimaging: a potential solution to non-mask-wearing patients within radio frequency head coils

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## The impact of COVID-19 on MRI infection control measures

Since the emergence of COVID-19, human MRI has encountered significant challenges in hygiene management. There is always a requirement for some essential patient proximity by MRI radiographers while setting-up and positioning them for MRI scanning. There may also be other MRI personnel present who are required to carry out essential care and observations during MRI procedures, such as anaesthetists and nursing staff. These essential MRI personnel are often required to work within one metre or less of their MRI patients. In addition, the potential for MRI patients to contaminate complex MRI equipment during scanning creates a hygiene hazard to subsequent patients and MRI personnel if comprehensive and time-consuming cleaning procedures are not carried out between scans.

Clinical and research MRI facilities worldwide now undertake considerable additional infection control measures and cleaning protocols to meet the necessary standards relevant to COVID-19. These additional measures result in reduced MRI patient throughput and increased waiting times. Although some countries now have relatively low levels of COVID-19 in their population, strict hygiene control measures are still in place to reduce the risk of resurgence and cross-infection among MRI healthcare workers and their patients.

## Mechanisms of transmission of COVID-19

The mechanisms of transmission of COVID-19 are still not fully understood, and while tested COVID-19 positive or symptomatic patients are recognised as potential sources of COVID-19 infection to other patients or healthcare staff, asymptomatic or pre-symptomatic transmission is still a viable possibility.<sup>1</sup> It therefore appears that stringent MRI infection control measures are anticipated to be in place for the foreseeable future for all human MRI environments.

*Potential hosts of COVID-19 include:*

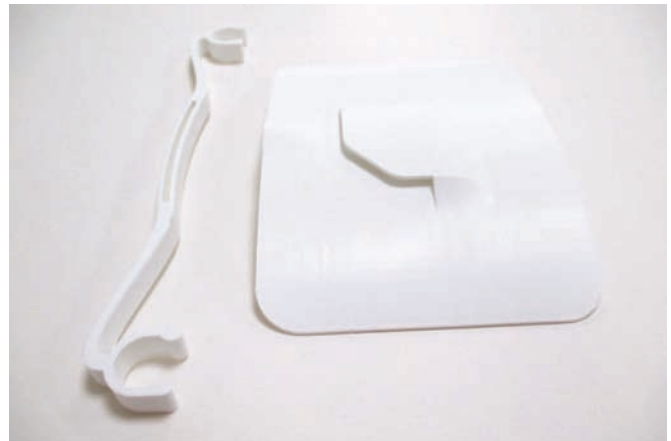
- the MRI patient and subsequent MRI patients;
- MRI personnel;
- attending MRI support personnel.

*Potential chains of infection of COVID-19 include:*

- contact between a contaminated MRI surface and an MRI patient;
- contact between a contaminated MRI surface and MRI personnel;
- airborne, between the MRI patient and attending MRI personnel;
- airborne, between the MRI personnel and an MRI patient.

## The case for patient mask wearing in MRI and diagnostic imaging settings

The guidelines for occupational MRI personal protective equipment (PPE) are set out by many regulatory bodies,



**Figure 1**  
MRI face shield, consisting of mount bar (left) and face shield.

including the UK's Royal College of Radiologists.<sup>2</sup> Many public buildings (including hospitals) now have mandatory or guideline recommendations for mask wearing or face coverings.<sup>3</sup> These rules, or in some cases laws, are now part of many healthcare settings worldwide. Recommendations also include radiology imaging guidance for patient facemask wearing 'where feasible' during their diagnostic attendance, examination and medical imaging.<sup>4</sup>

Facemasks/coverings, physical barriers and screens are proposed to reduce the risk of transmission by increasing the effective distance between humans as one part of a comprehensive infection control strategy.<sup>5</sup> These screens/barriers also act as a physical barrier to help contain airborne droplets between humans on either side of them. Many MRI clinical and research sites now have a mask-wearing policy requirement for their patients, requiring their patients to wear masks during their MRI scan 'where feasible'. However, this is often problematic, leading to:

- failed MRI imaging studies where masks are not well tolerated;
- difficulties for patients with respiratory illnesses/breathing difficulties;
- patient physiological and psychological distress during MRI examinations;
- increased levels of MRI claustrophobia and anxiety (scan abandonments);
- not scanning MRI patients who decline a mask (affecting clinical care);
- patient motion due to 'mask pulling' and mask-induced facial discomfort;
- concerns for MRI patients who cannot tolerate a mask, eg children, elderly, vulnerable, patients with exemption reasons etc.

In such cases, MRI sites may be forced to abandon patient mask wearing and thereby potentially increase the risk of cross-infection by doing so. Abandoning patient mask wearing requires extended downtime for comprehensive cleaning and disinfection of MRI scanners between subsequent patients. The MRI bore in particular is a difficult and problematic area to clean properly because it is surrounded by sensitive, delicate and complex electrical equipment. In



**Figure 2**  
MRI face shield inserted/removed from mount.

addition, many areas of the MRI system possess a continuously present high magnetic spatial gradient field, as well as an extremely high magnetic field at its isocentre (where the MRI patient spends most time breathing/talking/coughing/sneezing). There may also be additional MRI safety risks to staff who are required to carry out extensive cleaning within areas where very high electromagnetic fields are present.

The MRI face shield (**figure 1**) is proposed as a viable alternative where patient mask wearing is not possible in confining radio frequency (RF) coils used in MRI of the brain and central nervous system. The face shield (barrier) component is easily inserted into the RF coil-mounted component, closely covering the mouth and nose regions of the MRI patient without making direct facial contact. It is proposed that this shield acts as a physical barrier (by the protective mechanisms listed previously)<sup>7</sup> in helping prevent direct and widespread contamination of the MRI bore, RF coils and electrical components, by droplets or aerosol contaminants originating from the patient's mouth and nose during MRI scanning, with contaminants (by presence of the shield) being preferentially directly deposited onto this barrier instead. It is also proposed that the patient's breath and any contaminants originating from their mouth or nose (being preferentially deposited onto the shield) may therefore be less likely to become airborne and infect subsequent MRI patients or the attending MRI personnel.

### Shield cleaning

The shield is easily removed (**figure 2**) and safely disinfected by suitably gloved and protected MRI personnel between successive patients. At busy sites, a batch of shields can be pre-disinfected and stored for MRI patient use to reduce inter-patient turnaround times.

After use, the shield component is wiped on all surfaces with 70 per cent isopropyl alcohol, scrubbed with warm soapy water, then rinsed thoroughly with clean running water. After leaving to fully dry, the shield is stored in its clean container.

This MRI face shield (**figures 1-3**) is being successfully used at our MRI centre and is well tolerated by all clinical MRI patients and MRI research participants. It does not come into direct contact with the patient and does not restrict their vision or breathing in any way. The plastic shield and mount have no detrimental effect on image quality and both components are MRI safe. The components can be easily and fully removed and do not interfere with any existing scanner components or invalidate the FDA/CE mark of the scanner. The components are fully removed prior to any scanner servicing.



**Figure 3**  
MRI face shield in place (from inferior view).

At our site the standard operating procedure (SOP) includes the patient pulling their own standard IIR facemask down after the shield is inserted. Following scan completion, the patient pulls their IIR facemask back up over their face. This SOP maintains full continuity of patient face-covering during their attendance at all times within the facility building, as well as throughout their entire MRI scan procedure. Standard IIR mask wearing during MRI scanning at our centre previously resulted in more than 80 per cent of patients finding them intolerable.

At sites where MRI mask wearing has been abandoned, or is not feasible, we propose that cleaning routines of the MRI bore and RF coils may potentially be somewhat reduced in necessary extent as a result of containing droplet contaminants by the use of this face shield when used in collaboration with other infection control measures as part of a comprehensive MRI SOP cleaning protocol at sites of use.<sup>8</sup> The device is also fully compatible with our MRIFocus vision correction system\*.

### Summary

We propose that this MRI face shield may reduce issues related to problematic MRI scanner cleaning, and also potentially lessen the airborne droplet and aerosol mechanisms of cross-infection (compared to patient non-mask wearing). This solution therefore may help improve MRI environmental hygiene, as well as optimise MRI patient throughput.

### Declaration of interests

This MRI face shield and \*MRIFocus are design intellectual property of Cardiff University.

### References

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