COVID-19 – returning to student-led dental clinical treatments (v.1.1)

A summary of relevant literature and the opportunities to identify and manage risk

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This report has been produced by the Dental Schools Council in consultation with the British Dental Association and the Association of Dental Hospitals.

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Reference this work:

Durham et al (2020) COVID-19 – returning to student-led dental clinical treatments <<https://www.dentalschoolscouncil.ac.uk/wp-content/uploads/2020/07/COVID-19-report-on-returning-to-student-led-dental-clinical-treatments-v.1.1.pdf>> Accessed on: dd/mm/yyyy

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Version control

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Version number and date	Major changes
v1.0 29/05/2020	Original version
18/6/20 v1.1	Adapted to ensure consistent with Office for Chief Dental Officer and NHS England guidance re fallow time of 1 hour in neutral rooms (In: Dental aerosol and Operationalising sections) Included new papers' findings: • recent meta-analysis highlighting importance of face-coverings, masks, and physical distancing (In: Background) • recent in vitro data on positive PCRs and their infectivity (In: Background) • recent data on viral shedding (In: Background) • new data on viral load in saliva and nasopharyngeal samples in symptomatics and asymptomatics (In: Saliva and viral load)

Background

- SARS-COV-2 causing COVID-19 emerged in Wuhan, China in December 2019 (Zhao et al., 2020).
- Thought to be a covet animal reservoir but uncertain at the moment as to how the jump between species occurred.
- Mortality rates vary because of uncertainty over denominator currently: 0.7% (Germany) to 10.8% (Italy). Wuhan's initial mortality thought to be 5.8% now with newer approach and data thought to be 1.4% (Omer et al., 2020). UK based data are as yet unavailable due to unknown number of community (untested) cases. A recent paper modelling rates suggested a population 1 year mortality rate could lie between 1.04-1.06% with rates increasing in those with known co-morbidities and increased numbers of risk factors (Banerjee et al., 2020).
- Testing: either polymerase chain reaction (PCR) or serological testing. PCR commonplace and likelihood is that reliability increases if sampling lower down the respiratory tract (lower than nasopharynx e.g. by bronchial lavage). Sensitivity and specificity are unknown as there is no reference standard (Omer et al., 2020).
- Positive PCR result does not necessarily immediately equate to infectivity as in cell culture (in vitro testing) samples from some patients with symptoms for >8 days were not shown to cause infection in vitro cell lines (Bullard et al., 2020).
- Potential increased mortality associated with older age, hypertension and cardiovascular disease, diabetes, chronic renal disease, BMI>40, COPD (Zhao et al., 2020; Banerjee et al., 2020).
- Importance of physical distancing of ≥1m (with greater decrease in risk as distance lengthens) and face-masks in public and appropriate PPE in clinical care reinforced by recent meta-analysis (Chu et al., 2020).
- Increased disease severity with lymphopenia, thrombocytopenia and increases in LDH, CRP and D-dimer (Zhao et al., 2020).
- Viral shedding is variable, but some data from naso/oro-pharyngeal swabs or sputum samples suggest for mild cases infectious virus shedding cannot

be detected after 8 days post onset of symptoms (Wölfel et al., 2020). More recent data has identified that in more severe or critical cases of COVID-19 infective viral shedding can be detected up to 13-17 days post onset of symptoms (van Kampen et al., 2020).

- Immunity and reinfection post COVID-19: animal models suggest reinfection unlikely after re-challenged with virus at 28 days, but preliminary data and small numbers (Bao et al., 2020). Concerns in Asia of 'reinfection' were demonstrated by WHO to be false positives.

- There is risk to healthcare workers of any discipline and a study examining the healthcare workers on emergency and respiratory wards during an influenza outbreak in China estimated that their risk of developing the viral infection was increased 3-fold (OR3.3, 95%CI: 1.5-7.5). This study was for high risk procedures e.g. airway suctioning and for laboratory confirmed pathogen. There is no comparable study identifiable in dentistry at the time of writing, but clearly there are some, potentially controllable, aspects of dentistry that expose dental care professionals and their patients to potential nosocomial infection (Zemouri et al., 2017). A recent publication from a tertiary referral English NHS Foundation Trust demonstrates that with appropriate personal protective equipment there are decreased rates of nosocomial infection in all healthcare workers to levels very comparable to community transmission (Hunter et al., 2020). Recent data from the same Trust's dental hospital demonstrate no nosocomial infections after being the sole urgent dental centre for c. 3 million people for 3 weeks and completing 1243 face-to-face clinical treatments (Carter et al., 2020).

- Mortality rates in dentistry are difficult to estimate, but data available from secondary sources indicate a total of 15 dental care professional deaths in Italy[1], none at Wuhan Dental Hospital/School (Meng et al., 2020)[2], 6 in Indonesia[3] and 2 in the UK[4]. It is uncertain if these professional deaths are nosocomial or community acquired. Data are unavailable on public nosocomial infection as a result of attending dentists.

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1 https://portale.fnomceo.it/elenco-dei-medici-caduti-nel-corso-dellepidemia-di-covid-19/
2 https://www.forsyth.org/events/zoom-webinar-covid-19#.XqKxoZprxTY
3 https://www.aa.com.tr/en/asia-pacific/covid-19-19-indonesian-doctors-died-in-march/1794340
4 https://www.hsj.co.uk/exclusive-deaths-of-nhs-staff-from-covid-19-analysed/7027471.article

Aerosol procedure versus exposure and splatter

Oxford University's Centre for Evidence Based Medicine is completing a rapid review into the definition of aerosol generating exposure, rather than procedure, as a cough is not a medical procedure but can occur during one. At the time of writing this is still unpublished.

Aerosol and air change

- Aerosol definition: "*liquid or solid particles, 50 µm or less in diameter, suspended in air*". (Szymanska, 2007). Droplets "*Respiratory aerosols > 5 µm in diameter*" Droplet nuclei "*Respiratory aerosols ≤ 5 µm in diameter*" (WHO, 2007).
- Splatter definition: "*mixture of air, water and/or solid substances, e.g. dental filling material, carious tissues, sandblasting powder, etc. [diameter of] water droplets in splatter from 50 µm to several millimetres in diameter and are visible to the naked eye… have sufficient mass and kinetic energy to move ballistically and quickly settle on objects due to the action of gravitation forces. Splatter shows limited penetration into the respiratory system. Splatter particles, moving along trajectories, can come into contact with the mucosa of nostrils, open mouth, eyes and skin. They are deposited on hair, clothes and in the immediate surroundings of the splatter source. The range of splatter is from 15 to 120 cm from a patient's oral cavity*." (Szymanska, 2007).
- Particles ≤10µm are most likely to penetrate into the lung and cause infection and airborne transmission of SARS-CoV-2 occurs when smaller respiratory particles (≤5µm) circulate in the area for *prolonged periods* and are absorbed across the respiratory mucosa and conjunctiva. SARS-CoV-2 is not considered to be an airborne virus, this only becomes an issue when aerosol is generated by the patient or a procedure (Kirk-Bayley et al., 2020; Cook, 2020).
- Aerosol generation can be considered respiratory or surgically generated with procedures involving respiratory secretions often having a higher viral load (Cook, 2020), but see later information on saliva viral load.

- Air change[5] in the room for any aerosol is an important factor as air turnover is more important than whether they are negative or positive pressure rooms. Negative pressure rooms[6] are, however, recommended if possible for COVID-19 positive patients. Obviously any COVID-19 positive patients should be managed in isolated rooms with good air turnover. Each air exchange removes ~63% of the virus and after n exchanges the remaining virus is 0.37^n (Cook, 2020).
- WHO interim guidance explains natural ventilation can be improved by cross-ventilation (two opposite openings e.g. window and door) and can be estimated by air change rate = (0.8*wind speed m/s*smaller opening area*3600)/ room volume (WHO, 2007).

Dental aerosol

Prior to discussing dental aerosol, it is important to give a *generic* context about SARS-COV-2 in aerosol: laboratory data from a study that *deliberately aerosolised* SARS-COV-2 under *controlled (non-dental) conditions* suggests its half-life in aerosol may be between 0.6 and 2.6hrs (van Doremalen et al., 2020). This study was reported in the media but it is important to note the very controlled conditions that do not necessarily represent other environments.

There are very few studies in the literature relating to dental aerosol and especially relating to viral transmission (Zemouri et al., 2017), but there is an ongoing systematic review examining this and some new studies emerging e.g. Allison et al in pre-print (not peer reviewed as yet). There are, however, some consistent findings about dental aerosol in general with specific investigation often examining bacterial contamination or proxies for viral transmission rather than viral transmission per se:

- Goggles/eye protection receive *more* contamination from splatter or aerosol than masks (Watanabe et al., 2018; Veena et al., 2015).

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5 **Air changes per hour (ACH)**: volume of air moved in one hour. One air change per hour in a room, home, or building means that all the air in that environment will be replaced in one hour

6 A room in which the air pressure differential between the room and the adjacent indoor airspace directs the air flowing into the room (i.e. room air is prevented from leaking out of the room and into adjacent areas such as the corridor). (WHO, 2007)

- Operator's dominant arm receives high contamination as does assistant's left arm (assuming nursing for right-handed operator) (Watanabe et al., 2018; Veena et al., 2015).

- At 1 foot (30.48cm) the following areas are contaminated by aerosol using ultrasonic scaler after 15 mins: 12, 2, 4, 6, 8 and 10 o'clock (patient's vertex of skull is 12 o'clock). At 2 foot (60.96cm) this changes to only 4, 8 and 10 o'clock, presumably because contamination to posterior of patient [12,10,2 o'clock] is 'blocked' by operator and assistant. At 4 foot (1.21m) there is one reading at 2 o'clock (Veena et al., 2015). There was no evidence of air contamination 30mins post cessation of procedure in a normal ventilation room. A separate study using an air-turbine with and without fan and/or air-conditioning identified a 6ft (1.85m) exclusion around the chair as a safe zone (Chiramana et al., 2013). However, with fan and air-conditioning switched off this study seemed to correlate with Veena's data of 4ft (1.21m) having negligible contamination (Veena et al., 2015). The key information here is the *movement of air in the room*. This would have to be balanced against the advantages offered by cross-ventilation.

- Aerosol peaks in a microbiological study using both ultrasonic and sonic scalers alongside a variety of unspecified dental drills tended to: decrease to background levels within 10-30mins of cessation of the procedure due to deposition to the ground within a c. 1m radius; not spread outside the treatment room with the door closed; be more associated with scaling (Bennett et al., 2000).

- High volume suction (8mm diameter tip at 6l/min) decreases aerosol and air microbial index[7] in comparison to less effective suction. Air microbial index at 40cm at 20-25m of piezoelectric scaler use was 1.6CFU (lesser suction was 1.8CFU) at 150cm (~5ft) at 20-40m of scaler it was 2.7 versus 4.0CFU. All these readings are considered 'good' (Timmerman et al., 2004). Some estimates suggest a 93% reduction in aerosol and no difference between magnetic and piezoelectric scalers (Trenter and Walmsley, 2003).

Pertinent to aerosol in dentistry is the potential for blood and saliva contamination in some dental procedures e.g. things that cannot occur under rubber dam e.g. minor oral surgery, finishing restorations/adjusting their occlusion. It therefore is relevant to examine the risk saliva poses in an aerosol

7 Bacterial measurement by number of CFU (colony forming units) - 0–25: good; 26–50: mediocre: 51–75: bad: 475: very bad.

as clearly blood contamination presents a relevant risk. The Office for the Chief Dental Officer and NHS England guidance defines both AGP and non-AGPs. Similarly, the devolved nations also have guidance from their respective CDOs.

Cross-contamination of hard surfaces is also a key consideration and the risk of fomite transmission must be minimised using the appropriate national recommendations for cleaning of all surfaces and minimising extraneous sources of fomites in the clinic. The half-life of SARS-COV-2 in a controlled laboratory study was found to be longer on plastic and steel (half-life 5-7 hours with viable virus still detected at 72 hours) which had not been cleaned (van Doremalen et al., 2020).

Saliva and viral load

Data on viral load vary but there is a substantial viral load in spat out saliva (~106copies/ml) in *hospitalised inpatients*. This appears to exceed that in the nasopharynx (~105 copies/ml) (Wyllie et al., 2020) and when compared to other data available on severe cases' respiratory samples also appears higher than these samples early in the course of symptoms (~4 days of symptoms ~105copies/ml) (Zheng et al., 2020). There are also data from another group that mirror these findings suggesting that load is highest in a 'saliva' sample (coughed up early in morning from oropharynx which may contain sputum) in the first week of symptom onset (To et al., 2020). It is important to note, however that the rationale behind this coughed up sample is that "nasopharyngeal secretions move posteriorly, and bronchopulmonary secretions move by ciliary activity to the posterior oropharyngeal area while the patients are in a supine position during sleep, prior to toothbrushing and breakfast". This has dual relevance as: it could be respiratory secretions contaminated the sample and raised the viral load; it could influence timing of treatment and also need for adequate oral hygiene prior to treatment given common constituents between toothpaste and soaps which are known to oxidise coronaviruses. The data available are helpful, but difficult to compare due to different chronology of disease during sampling. A recent study looking at the rate of asymptomatic carriers in 14,000 quarantined individuals in Vietnam identified that viral load may be lower in saliva than in nasopharyngeal samples in these asymptomatic carriers than in the symptomatic individual. The study also suggested those asymptomatic carriers had a faster viral clearance than symptomatic individuals (Chau et al., 2020). Similar results for viral load were also identified in nasopharyngeal samples in another study: symptomatic patients having higher viral load than asymptomatic patients (Kawasuji et al., 2020).

On the balance of probabilities, it is reasonable to assume, however, that there may be a reasonably high viral load in saliva. It is also important to note that saliva production in those without known conditions affecting saliva production is thought to lie in the following ranges (ml/min pooled across genders and age groups): unstimulated 0.02-0.383; stimulated 0.333-1.55 with older adults having decreased production (Percival et al., 1994; Ship et al., 1991). This is in comparison to aerosol producing devices such as air turbine handpieces which use irrigation at differing rates dependent on manufacturer and operator controls, but can irrigate operative sites at between 15ml/min and 40ml/min (Cavalcanti et al., 2005; von Fraunhofer et al., 2000; Yang and Sun, 2013).

Personal Protective Equipment (PPE)

Currently a centre for evidence based medicine editorial suggests, "no direct evidence one way or the other [*for or against standard PPE (Fluid resistant surgical mask, gloves, apron etc) vs FFP3 plus gown etc*], and some indirect evidence of equivalence [*for influenza*]". It should be noted that this statement is based on influenza and may or may not be translatable to SARS-COV-2.

The editorial is based on a review that demonstrated low amounts of evidence in equivalent conditions (influenza) and suggested that currently there is no evidence for **non**-aerosol generating procedures in primary care that FFP3 type masks performed any better in reducing the risk of COVID-19 in attending healthcare workers when fluid resistant masks are used in conjunction with other standard precautions (aprons, gloves, visor/goggle etc) (Greenhalgh et al., 2020). However, there is a caveat that this was in a roughly 'equivalent' conditions and there were small amounts of data.

It is highly advisable at this stage therefore to follow national/international guidance on PPE for aerosol generating and non-aerosol generating procedures whilst new data are gathered to inform practice. A recent systematic review has drawn attention to some modifications that may be possible in future iterations of PPE to help reduce errors leading to contamination and enhance protection provided by PPE (Verbeek et al., 2020). It is therefore possible over time PPE usage and donning and doffing may change.

Summarising and suggesting opportunities to rationalise and manage risk in dentistry

Assuming that the UK's 'lockdown' is released slightly, but some social distancing remains in force it is likely that some return towards normal dentistry should begin to occur to prevent and manage oral disease. The summary and suggestions in this section assume that this is the position and look to identify, quantify and manage risk. Actions taken would need to consider and be in line with the relevant NHS body's guidance. It should be noted that any suggestions made are drawn from the existing literature which is scarce. They are, however, made to the best of current clinical knowledge and expertise.

Those positive for COVID and/or within their isolation period

These individuals should only be managed with full and appropriate PPE in line with current PHE guidance. Attempts should be made to avoid aerosol generating procedures during the term of their infection/isolation period. If receiving care these individuals should be managed in a contained room with natural ventilation and that is unconnected to, or isolated from, any central air conditioning system that would take aerosol to other parts of a building. Ideally if negative pressure could be created then this would be helpful, but the literature suggests it is not mandatory. Other adjuncts include HEPA filtration systems and UV light systems might also play a role as might extra-oral suction in cases known to be positive. Other precautions would be as follows for asymptomatic individuals.

Those asymptomatic without recent contact history

Anyone else attending for treatment should be suspected of potentially being a case or an asymptomatic carrier. **Standard triaging** including COVID symptoms and contact history should be conducted before attending for an appointment. If in doubt over a patient's status the treatment could be deferred, or the patient can be managed as potentially being COVID positive if the treatment cannot be deferred.

If treatment is to go ahead after triaging, there are a number of ways to manage risk:

1. Modification of oral environment prior to treatment
2. Limitation of oral environment's movement into aerosol
3. Protection of the patient/public and professional

1. Modification of the oral environment is possible before any treatment, but specifically ahead of any aerosol generating treatment by:

a. Timing of the day: immediately following wakening there are more bronchial secretions (see earlier). It may be possible to consider deferring treatment until patient has been ambulatory for at least 2 hours, but this is an empirical suggestion.

b. Routine oral hygiene using toothpaste may change the viral load. This is based on the hypothesis that because coronaviruses are very susceptible to oxidation and toothpastes contain many similar agents to standard soap (e.g. Sodium Lauryl Sulphate) and so may oxidise the virus.

c. Either Hydrogen Peroxide (1%) mouthwashes or Providone Iodine (0.2-0.5% 5mg/ml[8]) mouthwashes are likely to reduce viral load through oxidation of coronaviruses, but their substantivity for doing so is unknown although hypothesised as perhaps lasting up to 20 minutes (Kirk-Bayley et al., 2020).

A staged approach could therefore be used for non-aerosol generating procedures: ambulatory patient; completed oral hygiene with a Sodium Lauryl Sulphate containing toothpaste (e.g. Colgate total) within the last 30 minutes.

8 A 10% solution of PVP-I licensed for oral mucosal use (e.g. Videne® Antiseptic Solution Povidone-iodine 10% w/w solution, Antiseptic Cleanser for Skin and Mucous Membranes, ECOLAB Ltd) can be diluted to 1:20 using sterile water to yield a 0·5% solution.

For aerosol generating procedures either Hydrogen Peroxide or Providone Iodine mouthwash could be used immediately prior to the procedure and the procedure kept as short as possible. Please note these are empirical suggestions.

2. Limitation of oral environment's movement into aerosol can be achieved by any of, or combinations of, the following:

a) High volume suction (6l/min via 8mm diameter tip suction) at all times for any procedure will minimise air contamination (Timmerman et al., 2004).

b) Rubber dam is highly effective in reducing aerosol - up to 98% reduction of aerosol in 15m procedure (El Din et al., 1997; Cochran et al., 1989) and could be used for any aerosol generating restorative procedure on any patient. Should a restoration then require occlusal adjustment this could be done in the most expedient manner immediately on removal of the dam using high volume suction.

c) Extra-oral suction could be considered in addition to the intra-oral high-volume suction, but its efficacy is uncertain as in the study identified that used it compared it to low volume saliva ejection and found an 89-90% reduction in aerosolised particles near the patient (Jacks, 2002).

It is also important to note that with precautions taken under 1b and c that viral load may be diminished at least in the short term and that the very nature of generating the aerosol will result in a dilution effect due to the volume of irrigation used.

3. Protection of the patient/public and the professional can be achieved by a variety of methods:

a) Scheduling changes: to facilitate social distancing of appointments to reduce footfall and contamination. Shielding appointments ahead of any appointment in the rest of the day. Designated room for any COVID positive patient that must receive treatment. Scheduling to allow air change of ~30mins post any aerosol generation (this will vary depend on room structure).

b) Consideration of the use of HEPA filtration and UVC systems to improve air quality (Li et al., 2004), but their efficacy over and above precautions taken under (2) above is uncertain and there are potentially both structural and financial problems with widespread implementation.

c) Scrupulous cross-infection control including: hand hygiene (washing and alcohol gel as per PHE recommendations) for patients and professionals and surface cleaning with appropriate solutions e.g. Clinell. Appropriate water line and suction line cleaning with proprietary solutions.

d) PPE: for patients and the public consideration could be given to face coverings whilst attending for appointments ahead of their treatment (and could be worn during consultation). For non-aerosol generation the data available suggest that a fluid resistant mask and visor/goggles/eye protection would reduce risk to around normal precautionary levels. This could be paired with careful laundry of scrubs/clinical attire on a daily basis and or the [sensible precautions suggested by the BDA] in this respect. For aerosol generating procedures it is possible to use N95, FFP2 or FFP3 (95% [USA certification], 94% and 99% filtration efficiency respectively) masks, appropriate waterproof covering of chest, arms, down to knees accompanied by gloves and goggles/ visor/eye protection. The data that are available suggest eye protection is the primary risk area followed by the mask. FFP3 should be used in *preference* to N95 or FFP2 if available[9]. Careful donning and doffing as described by PHE would be required for any aerosol generating procedure. Sessional use of up to 4 hours of filtering face piece respirators is permissible via PHE guidance.

e) Shielding vulnerable staff (as defined by PHE) from procedures or clinic as appropriate.

f) Carefully considering the space between dental chairs on an open clinic (≥1.5m may be desirable), the barriers to aerosol spread between chairs, the overall aerosol load in the air and the air change. These considerations will have to occur at an individual provider basis as any estimates provided in this document are not uniformly applicable but provided for guidance to start from.

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9 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/881242/COVID-19_Infection_prevention_and_control_guidance_complete.pdf

Operationalising recommendations for student provided dental care

It is of paramount importance that any return to clinical education does so whilst mitigating as much risk as possible within the constraints of current knowledge. This is because the safety of the students, staff, patients and the public are of primary concern. All parties must be well-informed on the risks and how they have been addressed and minimised by employing the evidence currently available. Students or staff who have known and declared vulnerabilities in relationship to COVID-19 must be protected and appropriate occupational health advice sought in this regard.

Equally, however, it is of crucial importance that dental treatment and professional education recommences. Students in the UK provide over 400,000 patient episodes per annum. Without students' input these patient episodes would undoubtedly fall back to primary care which will be dealing with a backlog of reviews, management, and potential harm that has arisen as a result of the cessation of routine dentistry (Long and Corsar, 2020). It is also important to expand our education on providing care within a pandemic situation both for our students and other dental care professionals. This will help future proof the profession as far as possible should further pandemics occur in the future.

We must try to reduce the risk this pandemic poses to longer-term workforce planning such as delays to registration of newly qualified dental care professionals. This is because it is conceivable that the current pandemic may accelerate some dental care professionals' declared plans for retirement (one-fifth actively planning this in 2019) (BDA, 2020). Even if this hypothetical situation did not emerge it is known that the current dental workforce within the NHS is stretched with two-thirds of practices struggling to recruit dental professionals prior to any impact of the end of the transitional arrangements of Brexit (BDA, 2020).

Plans to restart routine dental procedures, including those undertaken by students, will need to be tempered by an understanding of the practical difficulties arising from the presence in both clinical and associated non-clinical facilities of variable numbers of students, staff and patients, and the requirement for social distancing. This includes things such as student, staff and patient flow through various parts of buildings used for clinical activities e.g. changing areas, common rooms, waiting rooms. The following section outlines general principles DSC feels can be applied to any clinical encounter involving student-led treatment, but it is acknowledged there will be a degree of variability dependent on local environment and protocols.

It is also important to note that at the time of writing the risk of community transmission is still high and as this changes some risk management strategies will undoubtedly undergo modification.

General principles applicable to any clinical encounter

All patients for student treatment should be:

- Triaged for COVID using nationally agreed and locally implemented screening parameters including being subject to a temperature check at presentation to the hospital. Currently these are defined by Public Health England at this link. The devolved nations also have their own guidance e.g. Welsh CDO guidance on aerosol generating procedures in dentistry.
- Staged in such a manner conducive to reducing footfall in the NHS clinical placement host (often a dental hospital).
- Unaccompanied as far as is possible in order to reduce footfall.
- Shielded as appropriate if identified as potentially vulnerable in the screening process. This may include utilisation of dedicated clinical space or appropriate timing of appointments.

Students should only provide treatment to patients who have screened *negative for COVID-19* using national parameters on self-report and temperature check. Students should not be involved in COVID-19 positive patients' treatment given they will take longer to complete procedures than other staff. The same is true for anyone suspected of suffering from COVID-19.

Appropriate levels of (training in) PPE and cross-infection control is paramount. These should follow nationally agreed protocols. Currently this would be:

- Fluid resistant facemask, full face visor, gloves and apron for any clinical encounter that is *unlikely* to present an aerosol generating exposure, e.g. routine examination, hand scaling of teeth, denture adjustments/fits once denture has been cleaned.
- Appropriately fit-tested FFP2 (or N95) or FFP3 mask, fluid-resistant coverall or gown, full face visor, and gloves should be used for clinical encounters that are *likely* to present aerosol generating exposure e.g. impressions on a patient with a known gag reflex, use of air turbine or surgical handpieces.
- Careful cross-infection control including donning and doffing. Doffing should include scrupulous hand hygiene up to elbow. Careful consideration should be given to any cultural or religious exceptions given for the 'bare below the elbow' standard and how to minimise any risk these exceptions may pose to the student, staff member, or patient.

NHS clinical placement hosts should:

- Ensure students are provided with the same testing facilities as other NHS staff in the event that the host suspects a student has contracted COVID-19. This may include locally arranged regular and timetabled screening for COVID-19 dependent on local or national policy. There will also need to be measures in place between the higher education institution and the NHS provider for appropriate tracking and tracing as required.
- Establish a clear, pragmatic, policy on cross-infection control for supervisors moving between students dependent on level of risk of the procedure. This will most likely be stratified by aerosol generating versus non-aerosol generating procedures.
- Ensure adequate nursing support to help assist students with donning and doffing and/or providing care. Verbeek et al (Verbeek et al., 2020) systematic review suggested observation for any colleague during doffing is

one mechanism by which to enhance safety by either taking the colleague through the steps or prevent an error that is about to occur (Verbeek et al., 2020).

- Consider the provision of centrally laundered scrubs per session.
- Consider the provision of appropriate changing and showering facilities if unavailable already.
- Examine, and if possible, test in *simulated* situations, the cross-contamination risk of any clinics (open or otherwise) providing aerosol generating procedures. Allied to this the host should consider ways of reducing and mitigating risk, for example 'fallow time' between patients, chairs left empty between cubicles etc. Air change is crucial and should be ascertained by the host and optimised as far as is possible. For neutral pressure rooms the Office for Chief Dental Officer for NHS England (OCDO) and Public Health England recommends 1 hour fallow time prior to terminal clean. For negative pressure rooms this decreases to 20 minutes fallow time. The British Endodontic Society has defined the 1 hour as beginning from the end of the AGP.

Aerosol generating procedures should be limited as far as is possible especially in the early stages of recovery from the pandemic. However, the aspiration is that with appropriate PPE and careful arrangement and testing of the clinical environment, patients should not be disadvantaged by being offered a limited choice of interventions. The OCDO guidance provides a list of AGPs.

Sensible removal of some aerosol generating procedures where the alternative offers no change in clinical or educational outcome for instance 3 in 1 air-drying versus gauze drying of teeth, hand scaling versus ultrasonic scaling (Suvan et al., 2019). This should be examined in the context of NHS General Dental Services (GDS), for example hand-scaling should be performed instead of piezoelectric or ultrasonic scaling, but in this example students should also be given instruction in the original alternative in a simulated manner e.g. ultrasonic scaling on mannequins, in order to ensure they are able to translate the skills learnt if/when current arrangements are terminated/relaxed. This would remain the case for any other substitution of procedures to reduce aerosol generation and the situation may offer opportunities to explore the use of alternatives such as Atraumatic Restorative Technique (ART) and Silver Diamine Fluoride when appropriate.

Additional measures aimed at reducing the ‘extent’ of aerosol including rubber dam usage, high volume aspiration (6l/min via 8mm diameter aspirator tip) should be considered for use in all/any restorative procedures. This may include additional procedures that wouldn’t have necessarily been considered pre-Covid-19.

Pre-operative mouthwashes can be considered, but their substantivity (and efficacy) is unproven and therefore they are probably best reserved for high risk procedures where rubber dam is not possible, for example surgical removal of teeth. The most ‘palatable’ is probably Hydrogen Peroxide 1%, but data on its efficacy are lacking and a Cochrane review is underway.

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