

# Practical considerations for the Pharmaceutical Quality Control Laboratory during the COVID-19 pandemic

M Brits 

Research Institute for Industrial Pharmacy® incorporating CENQAM® a WHO Collaborating Centre for the Quality Assurance of Medicines,  
North-West University, South Africa

**Corresponding author, email:** [Marius.Brits@nwu.ac.za](mailto:Marius.Brits@nwu.ac.za)

A Pharmaceutical Quality Control Laboratory (PQCL) is one of the critical pillars in the quality assurance of medicines to ensure the availability of safe and efficacious medicines. It is thus of critical importance that the PQCL should be able to continue delivering its service to the greater public. With the reporting of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in December 2019 as the causative agent of COVID-19, a new health and safety threat was introduced into greater society and specifically the workplace. The aim of this manuscript is to provide practical guidance and easy access reference to information sources for PQCL managers in an attempt to ensure safer working environments for the analytical and administrative staff of PQCLs, and to support the continued availability of quality assured medicines world-wide during this pandemic.

**Keywords:** Pharmaceutical Quality Control Laboratory, COVID-19, medicines, quality control, quality assurance, SARS-CoV-2

## Introduction

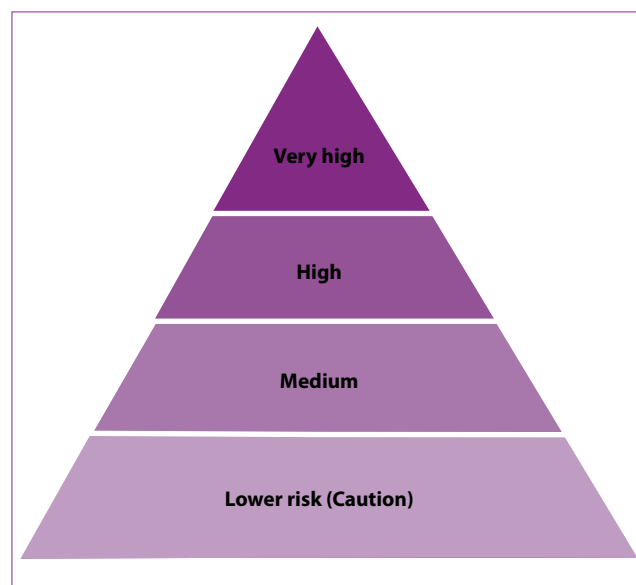
The coronavirus that was identified in Wuhan, China in December 2019 was initially known as the 2019 Novel Coronavirus (2019-nCoV). This disease is now known as coronavirus disease or COVID-19 and the virus causing the disease is known as "severe acute respiratory syndrome coronavirus 2" (SARS-CoV-2)<sup>1</sup> or COVID-19 virus.<sup>2</sup> To date (23 August 2020), 23 521 672 COVID-19 cases have been reported, 810 970 COVID-19 deaths, and 16 030 780 recoveries reported.<sup>3</sup>

The impact of this international pandemic is severe and it remains the responsibility of all to develop, implement and revise suitable control measures to prevent the spread of this virus. In the workplace (with specific reference to the Pharmaceutical Quality Control Laboratory [PQCL]) this impact has clearly been detected where increased rates in worker absenteeism, downsizing in operations and service delivery, and interrupted supply chains, have been detected.

The PQCL plays a vital role in ensuring the availability of safe and efficacious medicines to the public, thus it is of critical importance that the PQCL should be able to continue its service to the public in a safe environment. Before the implementation of control measures, current risk assessments need to be reviewed and updated, taking into account the new hazards posed by exposure to COVID-19 in the workplace.

The US Department of Health and Department of Health and Human Services classifies the worker risk of occupational exposure to the COVID-19 virus as very high to high, medium, or lower (caution) risk – based on the potential exposure (Figure 1).<sup>4</sup> It is stated that the level of risk depends in part on the industry type, need for contact within approximately two metres of people

known to be, or suspected of being, infected with the COVID-19 virus, or requirement for repeated or extended contact with persons known to be, or suspected of being, infected with COVID-19.<sup>4</sup> Based on this classification system, the personnel from the PQCL would be considered to be categorised in the medium exposure risk and/or low exposure (caution risk) classes, seeing that: (i) working in the PQCL may require frequent and/or close contact with (i.e. within approximately two metres of) people who may be infected with COVID-19 virus, but who are not known or suspected COVID-19 patients; (ii) laboratory personnel are considered to be subject specialists and may be travelling or have frequent contact with travellers returning from



**Figure 1:** The US Department of Health and Department of Health and Human Services classification of the worker risk of occupational exposure to COVID-19 virus<sup>4</sup>

international locations with widespread COVID-19 transmission; and (iii) laboratory personnel have contact with the general public. The exact classification (i.e. the medium exposure or low exposure classes) should be determined by the ability of the PQCL to mitigate the risks associated with this dreaded infection.

The World Health Organization (WHO) published a general guideline on 19 March 2020 – Getting your workplace ready for COVID-19 – which provides advice on simple ways to prevent the spread of COVID-19 in your workplace; how to manage COVID-19 risks when organising meetings and events; things to consider when you and your employees travel; and getting your workplace ready in case COVID-19 arrives in your community.<sup>5</sup>

This article provides an overview and reference to the available resources, and some practical considerations which the PQCL might consider when drafting the risk assessments and control measures to ensure the safety of its personnel within the PQCL during these challenging times.

### Organisation and management

The PQCL and its management should recognise the challenges and risks that the laboratory will have to face during this pandemic. Management should oversee and manage the quality and business risks identified in alignment with international guidelines.<sup>6,7</sup>

As the PQCL is held legally responsible,<sup>8</sup> it is the responsibility of the management of the laboratory to ensure that the facility is managed and operated within the legal framework (i.e. constitution, legislation, policy, regulations, contracts, etc.) set forth by local and international governmental institutions. With the announcement by Dr Tedros Adhanom Ghebreyesus, the WHO's Director-General, that COVID-19 can be characterised as a pandemic, numerous governments developed critical preparedness, readiness and response actions and declared a national state of disaster which lead to the publication of Associated Disaster Management Acts. It is thus the responsibility of the management of the laboratory to ensure that its operation and activities are aligned with the applicable legislation.

Legislation may have restrictions with regards to the movement and tolerable activities of citizens (i.e. lockdown). Management should ensure that the necessary approval (in the form of permits) is sought and obtained to ensure that PQCL staff do have access to the facility, to ensure that the laboratory has sufficient managerial, supervisory and technical personnel with the authority and resources needed to carry out their duties. Management should identify the occurrence of departures from the quality management system or the procedures for performing tests and/or calibrations, validation and verification, and to initiate actions to prevent or minimise such departures<sup>3</sup> during this troublesome period. Some laboratories may be forced to operate with a minimum number of staff (i.e. skeleton staff) in an attempt to reduce the transmission and contamination risk within the facility. It is important in this instance that all staff are informed of how all laboratory activities are to take place and be managed to ensure that the quality management system

(QMS) and ultimately the quality of results generated, are not compromised in any way. The responsibility, authority and interrelationships of all personnel (which may include nominated trained substitutes/deputies) who manage, perform or verify work which affects the quality of the tests and/or calibrations, validations and verifications, should be clearly communicated and documented, to avoid QMS failures and possible role confusion.

Working with limited staff and an increased testing burden, communication between staff may be compromised. It is imperative for management to implement actions to ensure adequate information flow between personnel at all levels within the laboratory. Because of social distancing protocols, management may have to schedule virtual meetings with staff instead of face-to-face meetings, distribution of news and information by means of bulletins and the written word.

One of the most important responsibilities of management in this pandemic is to ensure the safety of the laboratory personnel. Examples of some practical considerations will be discussed later.

As this pandemic is associated with significant physical and emotional stressors, it is recommended that the management and supervisory staff in the laboratory should be sensitive to the emotional health of all staff. The involvement of an employee assistance programme (EAP) at this time could be beneficial. An EAP is an external programme that employers can provide to employees to support their mental health and wellbeing. It provides employees and their immediate family members with access to professional counselling and support services when they need it most.

To maintain a positive morale, it is important that management should continuously motivate and keep staff aware of the relevance and importance of their activities. The PQCL plays an indispensable role in the fight against COVID-19, and staff needs to be recognised for their important contribution.

### Quality management system

During this pandemic the management of PQCLs may consider allowing staff to work from home where their daily tasks allow this, or to work shifts to reduce the number of personnel on the laboratory floor. This generates an ideal opportunity for satellite staff to attend to some of the following activities which contribute to the strengthening of the QMS: development and maintenance of the QMS documents (i.e. standard operating procedures), review of personnel training records and competence assessments to identify new potential development opportunities, collating documentation and applicable statistical data for management review meetings. Management review meetings could also be facilitated making use of electronic platforms such as Zoom, Webex, TalkPoint, Adobe Connect, etc., thus reducing the level of face-to-face contact, and transmission risk. Some of these platforms have the ability to record the meeting which facilitates minute taking. The laboratory should select the most appropriate service provider taking into consideration aspects such as cost, data bandwidth

requirements and usage, security functionalities, licencing agreements, etc.

As mentioned earlier, the PQCL should include a risk assessment for COVID-19 in the QMS, and appropriate procedures for sanitation of working spaces, screening of employees, isolation of potential COVID-19-exposed or -identified employees, effective communication with regards to COVID-19 and other applicable procedures should be compiled.

### Control of documentation and records

Whilst working from home may have some benefits for the PQCL, there are unfortunately some associated disadvantages and risks. Some of the disadvantages include lack of community which complicates communication; remote staff are difficult to manage and keep accountable; and management of productivity may be complex.<sup>9</sup> Most of these disadvantages can be overcome by the involvement of management which includes (but is not limited to): investing in online communication ecosystems with video and chat capabilities and familiarising staff with the functionalities thereof; drafting an on-line company value guideline on what are considered acceptable and unacceptable practices with e-communications; promoting the regular use of virtual communication tools even between staff that are in the office; using project management tools to facilitate communication and promote a culture of transparency; ensuring that all virtual discussions and meetings are always documented. Invest in time tracking and productivity monitoring tools which provide real-time project progress, app tracking, productivity gauges, detailed time reports, etc. Examples of such time tracking and productivity monitoring tools include DeskTime, 2Hours, Timecamp, Hubstaff, etc.

It should also be remembered that working from home may pose other health concerns so it is important to take the following factors into consideration:

- Check your body posture. Maintain a proper posture by paying attention to the positioning of your head, neck, spine, arms, wrists, hips, thighs and feet. Ensure that your back is supported, your shoulders are relaxed, and that there is no pressure under your thighs.
- Reduce or eliminate glare by using window shades, diffusers on overhead lighting and anti-glare screens.
- Take a sufficient number of breaks throughout the day to afford muscles and joints an opportunity to rest and recover.
- Limit distractions by making use of headphones, playing soft music white noise to reduce or mask distracting sounds.

Most of the documentation generated in and by the laboratory is considered to be confidential and sensitive in nature, thus suitable cybersecurity measures should be implemented to protect the records of the laboratory.

The goal of the implemented cybersecurity measures should be to provide a good security posture for computers, servers, networks, mobile devices and the data stored on these devices from attackers with malicious intent. Ensure that the IT policy of

the laboratory is updated to mitigate cybersecurity threats to ensure network, application, information and operational security. It is vital that the laboratory should have a validated disaster recovery plan, and that backup processes are validated. The IT division should provide adequate technical and educational support to staff during this period.<sup>10</sup> For additional guidance on good data and record management practices, please refer to the WHO Guidance on good data and record management practices,<sup>11</sup> PIC/S Good Practices for data management and integrity in regulated GMP/GDP environments,<sup>12</sup> PIC/S Good Practices for computerised systems in regulated “GXP” environments.<sup>13</sup>

### Personnel

In this period, we have recognised the importance of laboratory personnel more than ever. Having sufficient personnel with the necessary education, training, technical knowledge and experience for the assigned functions<sup>6</sup> is one of the most valuable assets to any PQCL.

In most countries, pharmaceutical quality control activities are considered to be an essential service to ensure the availability of safe and efficacious medicines. As mentioned earlier, local legislation may require management to apply for permits from local government institutions to ensure that staff will be able to reach and access the laboratory for their day-to-day activities. It is however recommended that laboratory management should consider suitable measures to ensure that social distancing is understood by personnel and adhered to within the laboratory. Some of these social distancing approaches include the following:

- Allow personnel to work from home (where possible).
- Change or introduce shift patterns. Establish alternating days or extra shifts that reduce the total number of personnel in the laboratory at a given time, allowing them to maintain distance from one another while attempting to maintain a full onsite work week.
- Limit work-related gatherings such as meetings and group training. It is recommended to make use of electronic training interfaces and virtual meetings.
- Maintain a distance of at least 1.5–2.0 metres between staff members.
- Consider assigning analyst-dedicated work benches. Discourage staff members from using other members’ phones, desks, offices, or other work tools and equipment, where possible.
- Ensure that all staff members are in possession of personal dedicated safety equipment.
- Used laboratory coats should be laundered with suitable detergents and ironed to reduce potential transmission. If the laundry of the laboratory is outsourced, ensure that the laundry services are adhering to good hygiene practices. Laundry bags/hampers should be washed and disinfected at regular intervals. It is recommended that the laboratory

should consider storing laundry in disposable bags during this COVID-19 outbreak.

- Motivate staff to use non-contact greetings (i.e. avoid shaking hands, hugging, kissing, etc.); possible alternatives include elbow bump, toe kick, a slight bow, etc. when greeting others.
- Avoid unnecessary travel for business and pleasure.
- Do not congregate in small areas with limited ventilation (copier rooms, work rooms, etc.).
- Avoid pushing buttons (elevator buttons, light switches, etc.) with your fingers, rather use elbow or knuckles.
- When opening doors (internal and external) use a paper towel or tissue which can be disposed of immediately after use.
- The laboratory might consider making available isopropyl-swabs which could be used to sanitise fingers, before and after the use of biometric scanners where applicable in the laboratory.
- Where possible, do not make use of cafeterias when eating lunch; rather enjoy open air lunches where possible.
- Motivate staff members to stay at home when feeling ill, having a mild cough or low-grade fever (37.3 °C or more).<sup>5</sup>
- Limit food handling and sharing of food by staff members.

The above mentioned activities all relate to internal activities (within the laboratory), however personnel should also be informed of ways to minimise external exposure such as by avoiding public transport where possible, avoiding recreational or other leisure classes, meetings and/or activities, etc.

The African Centres for Disease Control recently published a guideline on social distancing during the COVID-19 outbreak which also lists some good practices.<sup>14</sup>

It is recommended that management should communicate and advocate the importance of sick employees staying home and develop non-punitive leave policies. The US Department of Health and Department of Health and Human Services recommend that employers should:<sup>4</sup>

- Not require a healthcare provider's note for employees who are sick with acute respiratory illness to validate their illness or to return to work, as healthcare provider offices and medical facilities may be extremely busy and not able to provide such documentation in a timely way.
- Maintain flexible policies that permit employees to stay home to care for a sick family member. Employers should be aware that more employees may need to stay at home to care for sick children or other sick family members than is usual.

Management of the PQCL should maintain flexible policies that permit personnel to stay home to take care of children due to school and childcare closures or to care for a sick or immune-compromised family member.

Additional safety considerations and measures will be discussed in the "General safety practices for the PQCL to consider" section of this document.

## Premises

The laboratory facilities should be of a suitable size, construction and location. These facilities are to be designed to suit the functions and operations to be conducted in them. Rest and refreshment rooms should be separate from laboratory areas. Changing areas and toilets should be easily accessible and appropriate for the number of users.<sup>6</sup> The cleanliness of the facilities, rest rooms, changing areas and toilets should be a priority during this time.

The laboratory facilities should have adequate cleaning and disinfection programmes and measures in place to ensure good housekeeping. Personnel should be trained on these programmes and measures. High-touch surfaces (i.e. door handles, chairs, balance doors, centrifuge instruments, taps, light switches, phones, computers, tablets, copier touch panels, etc.) in the laboratory should be cleaned and disinfected at regular, defined intervals as an important precaution to lower the risk of infection and/or transmission.

The Centres for Disease Control and Prevention (CDC) distinguish between cleaning and disinfecting as follows:<sup>15</sup>

**Cleaning** refers to the removal of germs, dirt, and impurities from surfaces. It does not kill germs, but by removing them, it lowers their numbers and the risk of spreading infection.

**Disinfecting** refers to using chemicals, for example, EPA-registered disinfectants, to kill germs on surfaces. This process does not necessarily clean dirty surfaces or remove germs, but by killing germs on a surface after cleaning, it can further lower the risk of spreading infection.

Surfaces which are visually dirty should first be cleaned with a suitable detergent and water before sanitising. The cleaning detergent and disinfectant instructions should be followed for safe and effective use, including precautions that should be taken when applying the products, such as wearing gloves and ensuring adequate ventilation. It is important not to wipe cleaning solutions off as soon as they have been applied. Many disinfectant products, such as wipes and sprays, need to stay wet on a surface for several minutes (i.e. contact time) in order to be effective. The CDC provides the guidelines (summarised in Figure 2) for the cleaning and disinfection of hard (non-porous) surfaces, soft (porous) surfaces, electronics and linens in households. A list of products that are EPA-approved for use against the COVID-19 virus is continuously being updated and available and can be found at the following link: [https://www.epa.gov/sites/production/files/2020-03/documents/sars-cov-2-list\\_03-03-2020.pdf](https://www.epa.gov/sites/production/files/2020-03/documents/sars-cov-2-list_03-03-2020.pdf). This list provides valuable information such as active ingredients and contact times required for effective sanitation/decontamination.<sup>15</sup>

The environmental conditions, including lighting, energy sources, temperature, humidity and air pressure, should be appropriate to the functions and operations to be performed in the laboratory. The laboratory should ensure that the environmental conditions are monitored, controlled and documented and do not invalidate the results or adversely affect the quality of the


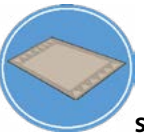


measurements,<sup>6</sup> but also take into consideration the necessary controls to prevent transmission of COVID-19.

Engineering controls should be developed and implemented to promote the isolation of employees from work-related hazards. Examples of engineering controls for SARS-CoV-2 from the literature<sup>4</sup> include (but are not limited to) installation of high-efficiency air filters, increasing ventilation rates in the work environment, installing physical barriers, such as clear plastic sneeze guards, etc.

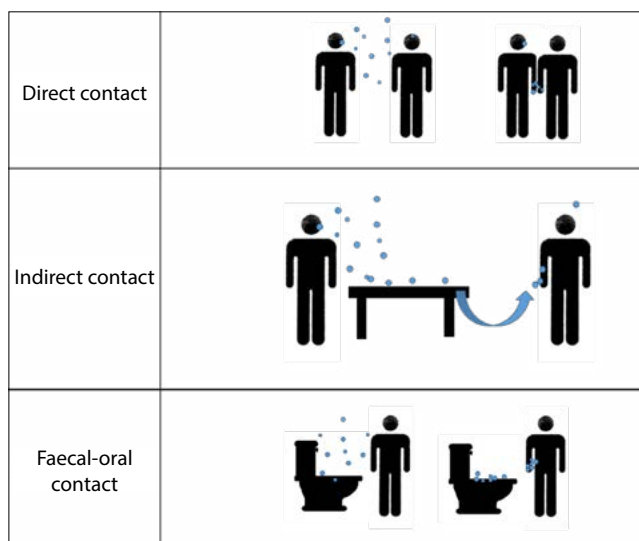
Three potential transmission routes for COVID-19 have been described in the available literature:<sup>16,17</sup> (i) via large droplets emitted when coughing or sneezing; (ii) via surface contact

(hand-hand, hand-surface, etc.); and (iii) via faecal-oral route (Figure 3). Flushing toilets with an open lid could create plumes containing droplets and droplet residue which may contain the COVID-19 virus.<sup>16</sup> The WHO stated that the risk of transmission of the COVID-19 virus from the faeces of an infected person appears to be low.<sup>2</sup>

In response to this pandemic, the Federation of European Heating, Ventilation and Air-conditioning Associations (REHVA) experts drafted a guidance document on how to operate and use building services in areas with a coronavirus outbreak to prevent the spread of COVID-19 depending on HVAC or plumbing systems-related factors.<sup>16</sup> These guidelines are continuously being updated to include the available evidence and knowledge.

 <p><b>Hard (non-porous) surface</b></p> <ul style="list-style-type: none"> <li>• Wear disposable gloves when cleaning and disinfecting surfaces.</li> <li>• Consult the manufacturer's instructions for cleaning and disinfection products used.</li> <li>• Wash hands immediately after gloves are removed.</li> <li>• If surfaces are dirty, they should be cleaned using a detergent or soap and water prior to disinfection.</li> <li>• For disinfection, most common United States Environmental Protection Agency (EPA)-registered household disinfectants should be effective. <ul style="list-style-type: none"> <li>◦ A list of products that are EPA-approved for use against the virus that causes COVID-19 is continuously being updated and is available at the following link: <a href="https://www.epa.gov/sites/production/files/2020-03/documents/sars-cov-2-list_03-03-2020.pdf">https://www.epa.gov/sites/production/files/2020-03/documents/sars-cov-2-list_03-03-2020.pdf</a>. It is important that the manufacturer's instructions are followed for all cleaning and disinfection products with specific reference to the concentration, application method and contact time, etc.</li> <li>◦ Additionally, diluted household bleach solutions (at least 1 000 ppm sodium hypochlorite) can be used if appropriate for the surface. Follow manufacturer's instructions for application, ensuring a contact time of at least one minute, and allowing proper ventilation during and after application. Check to ensure the product is not past its expiry date. Never mix household bleach with ammonia or any other cleanser. Unexpired household bleach will be effective against coronaviruses when properly diluted.</li> </ul> </li> <li>• Prepare a bleach solution by mixing: <ul style="list-style-type: none"> <li>◦ 5 tablespoons (1/3<sup>rd</sup> cup) bleach per gallon of water, or</li> <li>◦ 4 teaspoons bleach per quart of water.</li> </ul> </li> </ul>	 <p><b>Soft (porous) surfaces</b></p> <ul style="list-style-type: none"> <li>• For soft (porous) surfaces such as carpeted floor, rugs, and drapes, remove visible contamination if present and clean with appropriate cleaners indicated for use on these surfaces. After cleaning: <ul style="list-style-type: none"> <li>◦ Launder items as appropriate in accordance with the manufacturer's instructions. If possible, launder items using the warmest appropriate water setting for the items and dry items completely.</li> <li>▪ Otherwise, use products listed at <a href="https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2">https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2</a> and that are suitable for porous surfaces.</li> </ul> </li> </ul>
 <p><b>Electronics</b></p> <ul style="list-style-type: none"> <li>• For electronics such as cell phones, tablets, touch screens, remote controls, and keyboards, remove visible contamination if present. <ul style="list-style-type: none"> <li>◦ Follow the manufacturer's instructions for all cleaning and disinfection products.</li> <li>◦ Consider use of wipeable covers for electronics.</li> <li>◦ If no manufacturer guidance is available, consider the use of alcohol-based wipes or sprays containing at least 70% alcohol to disinfect touch screens. Dry surfaces thoroughly to avoid pooling of liquids.</li> </ul> </li> </ul>	 <p><b>Linens, clothing and other items that go in the laundry</b></p> <ul style="list-style-type: none"> <li>• Wear disposable gloves when handling dirty laundry from an ill person and then discard after each use.</li> <li>• Clean hands immediately after gloves are removed.</li> <li>• If possible, do not shake dirty laundry. This will minimise the possibility of dispersing virus through the air.</li> <li>• Launder items as appropriate in accordance with the manufacturer's instructions.</li> <li>• If possible, launder items using the warmest appropriate water setting for the items and dry items completely.</li> <li>• Dirty laundry from an ill person can be washed with other people's items.</li> <li>• Clean and disinfect clothes hampers according to guidance above for surfaces. If possible, consider placing a bag liner that is either disposable (can be thrown away) or can be laundered.</li> </ul>

**Figure 2:** Adapted CDC guidelines for the cleaning and disinfection of hard (non-porous) surfaces, soft (porous) surfaces, electronics and linens<sup>15</sup>



**Figure 3:** Reported potential exposure mechanisms of COVID-19

Refer to the most current guideline available online at: <https://www.rehva.eu/activities/covid-19-guidance>.

The WHO recommends that people with suspected or confirmed COVID-19 disease should be provided with their own flush toilet or latrine. Each toilet cubicle should have a door that closes, to separate it from the general facilities. Flush toilets should operate properly and have functioning drain traps. Where possible, the toilet should be flushed with the lid down to prevent droplet splatter and aerosol clouds. Toilets should be cleaned and disinfected at least twice daily by a trained cleaner wearing PPE (impermeable gown, or if not available, an apron, heavy-duty gloves, boots, mask and goggles or a face shield). It is also recommended that hand hygiene facilities should be available within five metres of toilets.<sup>2</sup>

The PQCL should follow a risk-based approach taking into consideration the most applicable guidelines for implementation so as to ensure that the environmental conditions remain appropriate to the functions and operations to be performed in the PQCL. The laboratory should ensure that the environmental conditions are monitored, controlled and documented in alignment with cGMP expectations.

### Equipment, instruments and other devices

The requirements for laboratory equipment, instruments and other devices to be calibrated, qualified, verified and maintained in the local environment<sup>6</sup> of use, may be one of the most challenging aspects during this pandemic, due to travel and import restrictions imposed in some countries. Numerous suppliers of laboratory equipment, instruments and other devices have recently published business continuity plans and enterprise risk management frameworks to ensure continued support to laboratories. Some of these continuity/support plans include:

- Continuation of the sale and distribution of equipment, instruments and service parts.
- Provision of remote support where necessary using available technology.

- Continuation of provision of prioritised, on-site service where local legislation and regulations permit.
- Implementation of global supply chain commitments and policies to mitigate potential risks and place expedited orders for items with extended lead times.
- Establishment and continuous monitoring of logistics teams to develop and implement suitable action plans to minimise disruption to distribution networks, and to ensure the timely delivery of equipment, instruments and other devices where needed.
- Implementation of virtual training sessions as most face-to-face training has had to be cancelled.

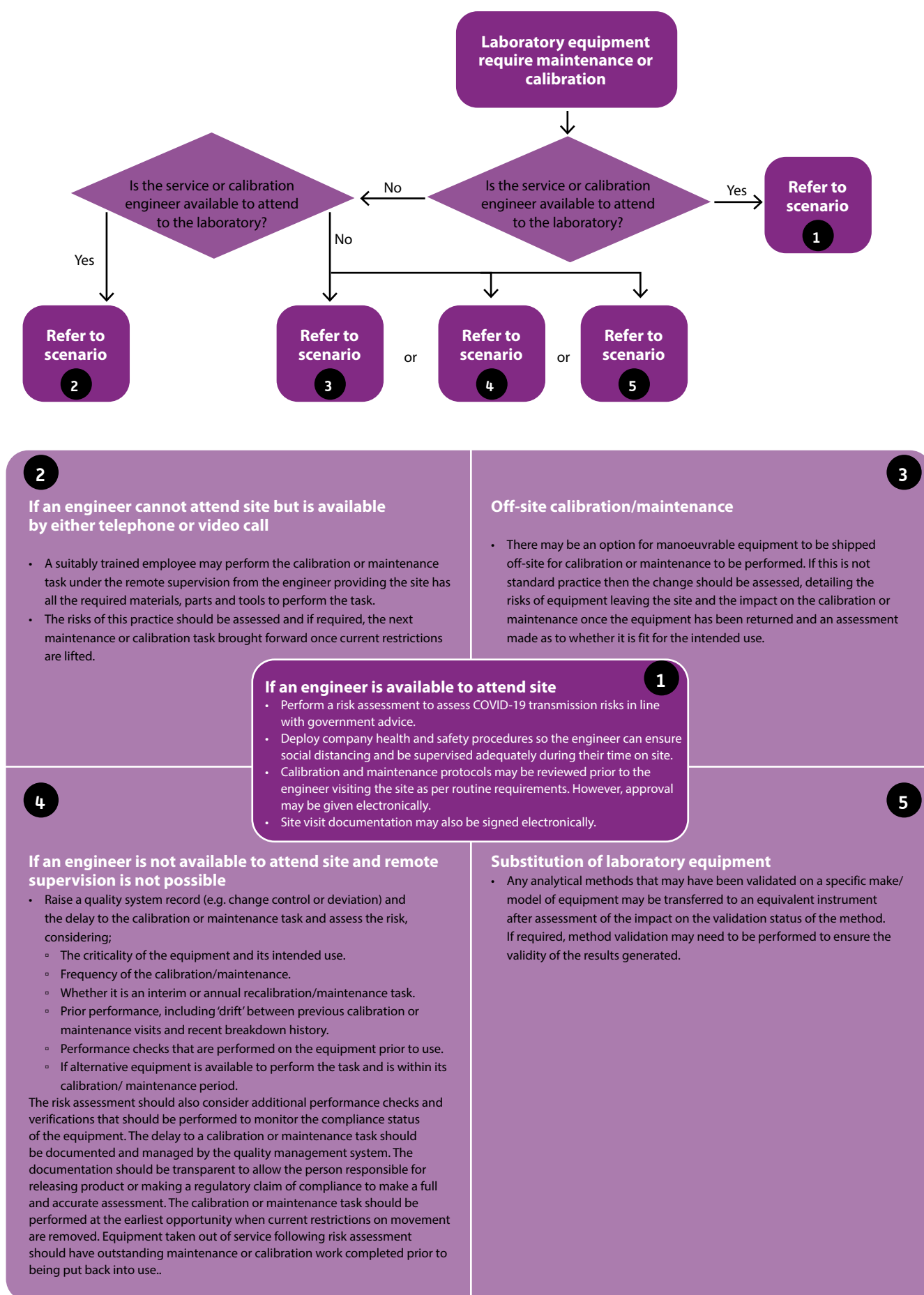
It is important for the PQCL to contact the suppliers of their equipment, instruments and other devices to discuss the development of an action plan to ensure that these devices remain calibrated, qualified, verified and maintained during this global pandemic. Some regulatory agencies<sup>18</sup> have introduced tolerated alternative courses of action for manufacturing of laboratory equipment during this outbreak, which allow exceptional flexibilities for maintenance and calibration of the mentioned equipment. Figure 4 provides a depiction of the guidance issued by MHRA which may be considered by laboratories. It is recommended that PQCLs should contact their regulatory authorities to enquire on the availability of similar exceptional flexibilities that may be applicable during this outbreak.

In some instances it may be necessary to commit instruments to standby mode or to be shut down completely due to the availability of limited staff or other reasons. Standby mode or shut down procedures should also take into consideration the rinse or cleaning procedures and selection of the most appropriate storage conditions of components such as chromatographic columns, automated sampling compartments, etc. It is recommended that the suppliers of the specific instruments be contacted or the user manuals supplied to be consulted to guide the PQCL with this.

### Materials and reagents

Shortages in the availability of reagents and chemicals, including solvents and materials used in tests and assays of pharmaceuticals, may be experienced by some PQCLs, especially those countries relying on the import of such items. The PQCL may consider the following to ensure the availability of these items:

- The PQCL should negotiate order and delivery timelines with qualified vendors to ensure that there is no confusion or unrealistic expectations with regards to the supply of chemicals and materials.
- In some instances PQCLs may have to request in advance, a national permit to allow suppliers to deliver the ordered chemicals to the PQCL facility, as some travel restrictions may be implemented during national lockdowns.
- Reiterate the importance of not wasting chemicals by analysts. It is important to plan for an experimental analysis in advance



**Figure 4:** Schematic presentation of guidance for manufacturers and Good Practice (GxP) laboratories on exceptional flexibilities for maintenance and calibration during the coronavirus COVID-19 outbreak, issued by MHRA<sup>18</sup>

and calculate a realistic and conservative amount or volume of reagents to be used, for example, most pharmacopoeial reagent preparatory chapters describe the preparation of 1 L solutions, however if a test only requires 10 mL, surely the preparation of a 1 L should not be considered.

- Ensure that reagents and chemicals, including solvents and materials, are stored under the most suitable conditions as specified by the supplier/manufacturer to ensure the integrity thereof.
- All reagent containers should be visually inspected upon receipt from the supplier to ensure that the seals are intact, to avoid unexpected surprises later.
- Where stability data is available for solutions prepared in the laboratory, these should be considered, and re-use of pre-prepared solution be applied.
- Staff should be informed that reagents or chemicals with a "recommended retest date" may be subjected to retest to extend the expiration date thereof, once the retest date has been used. These retests are usually performed by the suppliers of the chemicals, and an updated certificate of analysis with the newly assigned "recommended retest date" should be issued.
- The laboratory should ensure that their chemical inventory is well managed, to ensure that a real-time overview is available on stock levels. It is recommended that the PQCL should consult their stock levels before accepting a new project for testing to confirm the availability of all reagents, chemical and other consumables required. Not having these available may delay the testing of the product(s) which may not be acceptable to the clients served by the laboratory.

Request suppliers if it is possible to download the reagent/chemical support information (i.e. MSDS, CoA, etc.) rather than receiving a hard copy with the supplied materials.

In some instances the PQCL may consider the procurement and installation of on-site gas (i.e. hydrogen and nitrogen) generators, to produce hydrogen and nitrogen on demand.

### Incoming samples for testing in the laboratory

The PQCL may experience some delays in the delivery of cross-border parcels containing test samples due to travel and movement restrictions. It is thus important for the PQCL to discuss transport and importation logistics in advance with the client and, where required, apply for import permits in advance from the local regulatory authority or other applicable institutions. In instances where the PQCL is responsible for on-site sampling, the necessary personal protective equipment (PPE) should be issued to the person(s) responsible for the sampling, to ensure his/her safety.

For most PQCLs samples are delivered to the facility by means of a courier service. This may raise the concern on the potential infection risk for the laboratory receiving these samples (and consumables for that matter). The WHO and the US CDC have stated that the likelihood of novel Coronavirus contaminating cardboard or other shipping containers is low. In a recent

publication<sup>20</sup> the aerosol and surface stability of SARS-CoV-2 was investigated and it was found that the longest viability of the virus was on stainless steel and plastic, where viable virus was detected up to 72 hours after application. On cardboard, no viable SARS-CoV-2 was measured after 24 hours, however large standard error was observed, thus caution needs to be taken when interpreting these results.<sup>20</sup>

The PQCL might consider contacting the courier services to gain an understanding on the protective/preventive measures taken by the company to reduce the risk of transfer. Some courier services are implementing revised signature-required guidelines, where consignees no longer need to sign for deliveries, but other identification measures are required.

Upon receipt of parcels the following protective measures may be considered:

- Identify and use a dedicated room or area where parcels can be received. The surface on which the parcels are to be handled should preferably be non-porous to support good sanitisation procedures.
- Where possible, limit contact with delivery staff; if not possible ensure that you and the delivery staff are using suitable PPE.
- Consider using disposable gloves when handling the parcel.
- Consider disinfecting the outer surface of the parcel using a suitable cleaner from the EPA's approved list or using 70% (v/v) ethanol. Allow sufficient contact time before wiping it off and opening the parcel.
- Once the outer packaging has been removed discard it safely, and ensure that you have washed your hands.

A standard test request form usually accompanies each test sample submitted to the laboratory for testing. It could be recommended that these forms should rather be filled electronically by the client and submitted to the laboratory, to limit potential exposure.

### Analytical reports and certificates of analysis

The PQCL will prepare an analytical test report or certificate of analysis (CoAs) which is to be issued to the client upon completion of the analytical testing. Some PQCLs still prefer to issue hard copy CoAs to clients, however it is recommended that the PQCLs should rather consider issuing e-copies of the analytical test report/CoA during this period, to limit potential exposure. Should the laboratory consider this it should perform a risk assessment to assess and address all potential data integrity-related risks with the e-transmission of reports and CoAs.

### General safety practices for the PQCL to consider

The WHO Good Practices for Pharmaceutical Quality Control Laboratories requires that general and specific safety instructions reflecting the identified risks, should be made available to each staff member and supplemented regularly as appropriate.<sup>6</sup>

For most employers, protecting their employees from COVID-19 will depend on emphasising basic infection prevention measures. Based on information currently available in the public domain

about COVID-19, the following basic infection prevention measures are presented:

### **COVID-19 training and information sharing**

Management of the laboratory should ensure that all staff are informed and regularly updated on COVID-19 risk factors, safety considerations, risks and protective measures/behaviours (e.g. cough etiquette and care of PPE). Numerous training resources have been developed and are available online for use. Examples of some of these training resources include (but are not limited to):

- WHO real-time, online training resource (referred to as COVID-19 Course Series) which is available, free of cost, in the official WHO languages at the following link: <https://openwho.org/channels/covid-19#channel-info>.
- US CDC training for healthcare professionals is available at the following link: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/training.html>.
- UNICEF COVID-19 information and updates are available at the following link: <https://www.unicef.org/coronavirus/covid-19>.

Management should ensure that staff are familiarised with the outcomes safety risk assessments performed in the PQCL and the associated mitigation steps that are to be implemented to ensure a safe working environment for all.

A number of facts sheets, posters and infographics have been made available by the WHO and the CDC which could be downloaded and shared within the PQCL to create a greater awareness and share information:

**WHO:** <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>.

**CDC:** [https://www.cdc.gov/coronavirus/2019-ncov/communication/print-resources.html?Sort=Date%3A%3Adesc&CDC\\_AA\\_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fcommunication%2Ffactsheets.html](https://www.cdc.gov/coronavirus/2019-ncov/communication/print-resources.html?Sort=Date%3A%3Adesc&CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fcommunication%2Ffactsheets.html).

### **Hand hygiene**

The laboratory should promote frequent and thorough hand-washing. Hand washing stations with soap and disinfectants should be made available to staff. It is also recommended that hand sanitation stations should be made available at the entrances and exits of facilities, to ensure that all visitors can sanitise their hands before entering the facility.

Many countries are experiencing a shortage of alcohol-based hand sanitisers; the WHO has published a guide for the local production of handrub formulations.<sup>21</sup> This guideline provides formulas for the preparation of ethanol and isopropyl alcohol handrub, as well as some guidance with regards to the quality control of the prepared formulas.

Staff should be trained on good hand washing and sanitisation practices. The WHO released descriptive pictorials which describe these best practices and are available for use by the PQCL.<sup>19,22</sup> It is recommended that handwashing signs should be

posted in restrooms to remind staff of the importance of good hand hygiene.

The use of no-touch trash cans, hand soap and alcohol-based hand rub dispensers is recommended. The availability of disposable towels and tissues will also reduce the potential risk of virus transmission. Numerous hands-free 3D-printed door openers are marketed on the internet. The door opener consists of a hook mechanism/adaptor which can be used to open the door with your forearm instead of using hands, thus limiting hand contact on door handles. Other possibilities to consider is to install photocells or movement switches which automatically open a door when approached.

### **Respiratory etiquette**

Personnel should be encouraged to exercise respiratory etiquette, i.e. covering coughs and sneezes with disposable tissues or clothing followed by hand washing. Ensure that disposable tissues are available onsite for staff to use. In some countries it is recommended that when in public places all people should wear cloth masks to reduce potential transmission when speaking, coughing and sneezing. It has been recommended that cloth face coverings (or masks) should: fit snugly (but comfortably) around the face, be secured with ties or ear loops, include multiple layers of fabric, allow for breathing without restriction, and be able to be laundered and machine dried without damage or change in shape.<sup>23</sup> General guidelines with regards to the use and care of fabric masks include:<sup>24</sup>

- Avoid touching the mask or your face while you're out and when you get back home, wash the mask with soap and water immediately without using chemicals. Remember to wash your hands thereafter.
- After washing, the masks should be ironed or left out in the sun to dry.
- Masks should not be shared with anybody else, and it is preferable for every person to have two masks so they can be interchanged during washes.
- Remember that the inside layer of the mask should not be handled when taking it off or putting it on.

### **Workplace health screening and isolation of potentially infectious personnel**

The daily screening of personnel for any of the known COVID-19 symptoms could assist in the prevention of the spread thereof. It is recommended to screen laboratory personnel and visitors daily. Staff could be requested to complete these screening checks at the start of their shifts before entering the laboratory and then again at the end of the shift, so that an overview of the whole day is available. By introducing a workplace health screening procedure, staff members are motivated to have a heightened self-health awareness. An example of a typical workplace screening questionnaire is depicted in Figure 5.

Staff members should be clearly informed that this tool is not meant to replace consultations with healthcare providers or to diagnose or treat a condition. It is recommended that temperature monitoring of personnel should be performed using

## COVID-19 Symptoms Screening

<b>Name:</b>					<b>Surname:</b>				
<b>Personnel number:</b>					<b>Date of birth:</b>				
<b>Job title:</b>					<b>Section / Division within laboratory:</b>				
<b>Contact details</b>									
<b>Cell phone number:</b>					<b>Other contact number:</b>				
<b>Next of kin (name and relationship):</b>					<b>Contact number for next of kin:</b>				

	Monday		Tuesday		Wednesday		Thursday		Friday	
<b>Date:</b>										
<b>Time:</b>	Start of shift	End of shift	Start of shift	End of shift	Start of shift	End of shift	Start of shift	End of shift	Start of shift	End of shift
<b>Do you experience any of the following symptoms? Encircle the most applicable answer.</b>										
 Fever / chills	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
 Cough	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
 Sore throat	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
 Shortness of breath or difficulty in breathing	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
 Body aches	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
 Redness of eyes	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
 Loss of smell or taste	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
 Nausea / vomiting	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
 Diarrhoea	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
 Fatigue / weakness	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
<b>Temperature (°C):</b>										
<b>Other</b>										
 Exposure to a COVID-19 patient?	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
<b>Are you taking any pain / fever medicines?</b>	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
<b>Any other info or concerns?</b>										

Figure 5: Example of a typical workplace screening questionnaire

non-contact infrared thermometers. Personnel should indicate if they were exposed to or had any contact with any persons infected by COVID-19, as this may require the member of staff to self-isolate for at least 14 days.

Should any of these symptoms present, the affected member of staff should be isolated and referred for a medical check-up and possible testing for COVID-19. It is recommended that the PQCL should have suitable policies and procedures that clearly outline the approach and directive of proposed actions to be taken relating to the outcome of the workplace screening activities. It is recommended that the laboratory should develop policies and procedures for the immediate isolation of persons who show any signs and/or symptoms associated with COVID-19. Move potentially infectious people to a location away from personnel and other visitors. Where dedicated isolation rooms are not available, a designated area with closable doors may serve as isolation rooms until potentially sick person(s) can be relocated from the facility.

The US Department of Labour Occupational Safety and Health administration issued the following guidelines<sup>25</sup> when a potentially infectious person is identified in the workplace:

Where appropriate, employers should:

- Take steps to limit spread of the respiratory secretions of a person who may have COVID-19. Provide a face mask, if feasible and available, and ask the person to wear it, if tolerated. Note: A face mask (also called a surgical mask, procedure mask, or other similar terms) on a patient or other sick person should not be confused with PPE for a worker; the mask acts to contain potentially infectious respiratory secretions at the source (i.e. the person's nose and mouth).
- If possible, isolate people suspected of having COVID-19 separately from those with confirmed cases of the virus to prevent further transmission, using either permanent (e.g. wall/ different room) or temporary barrier (e.g. plastic sheeting).
- Restrict the number of personnel entering isolation areas.
- Protect workers in close contact with (i.e. within approximately two metres of) a sick person or who have prolonged/repeated contact with such persons by using additional engineering and administrative controls, safe work practices, and PPE. Workers whose activities involve close or prolonged/repeated contact with sick people are addressed further in later sections covering workplaces classified at medium and very high or high exposure risk.

Personnel should be motivated to be extra vigilant on any changes in their health and to report immediately to management should they feel ill.

An attendance register should be maintained for all staff present at work during this pandemic, to account for all personnel.

As the information about COVID-19 is constantly changing, and the level of COVID-19 activity varies by community, as does the availability of testing, check with your local public health agency to ensure that the actions implemented within your laboratory are aligned with the expectations.

### Travel safety of laboratory personnel

Laboratory personnel may be required to travel as part of their duties. It is recommended that management should be informed in advance of all (personal and duty) travel plans so as to ensure the safety of travellers and laboratory personnel upon their return. The following general considerations are presented:

- Ensure that the laboratory and its employees have access to the most current information on areas where COVID-19 is spreading. The WHO publishes regular updated situational reports, which can be accessed using the following link: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/>. It is recommended that the laboratory management should review the latest information and then assess the benefits and risks related to upcoming travel itineraries.
- Subjecting personnel to medical examinations and considering the risks based on the health profile of the potential traveller is recommended. Avoid sending employees who may be at higher risk of serious illness (e.g. older employees and those with medical conditions such as diabetes, heart and lung disease) to regions where COVID-19 is spreading.
- Travellers should be acquainted with the local restrictions on travel, movement or large gatherings as determined by the countries which they are to visit.
- Ensure that employees who are about to travel have access to alcohol-based hand rub or sanitisers (less than 100 mL containers, as liquids and gel volumes are usually restricted at airports) as well as masks.
- Train and motivate staff on social distancing practices which should be applied during travel.
- It is important for travellers to ensure that they have access to adequate medical care during their trip.
- Ensure that the employees are supplied with contact details of a support team should they feel ill during the travelling or are in need of medical advice.
- It is recommended that immunisation schedules should be reviewed and should be suitable for the country of travel.
- Some countries expect that when employees return from travelling from an area where COVID-19 is spreading, they should self-isolate and monitor themselves for symptoms for at least 14 days and measure their temperature twice a day. If they should develop a low-grade fever (i.e. a temperature of 37.3 °C or more) or any of the known COVID-19 symptoms, they should immediately contact their healthcare provider for further assessment.
- It is important that travel history should be disclosed to healthcare providers should their services be required.

### Summary

To ensure the safety and continuity of PQCLs, management in these institutions need to perform and document risk-based assessments which should focus on critical units/activities such as (but not limited to) organisation and management, quality management system, control of documentation and

records, personnel, premises, equipment, instruments and other devices, materials and reagents, incoming samples for testing in the laboratory, analytical reports, certificates of analysis and general safety practices. Once all the associated risks have been identified, the necessary mitigation steps (by means of policies and procedures) should be developed and implemented. The outcome of the risk assessment and its action plans to mitigate the identified risks should be shared with all PQCL staff and continuously reviewed to ensure the efficacy thereof in order to reduce the impact of COVID-19 on the safety and continuity of the PQCL activities.

### Disclaimer

The views, opinions and recommendations presented in this publication represent those of the author and do not necessarily represent the views, opinions and recommendations of his employer and/or other associated institutions. The author accepts no liability for any loss or damage suffered as a result of the use, misuse or reliance on the information and content in this publication.

### Conflict of interest

I do not have any conflicts of interest to disclose.

### Funding source

None.

### ORCID

M Brits  <https://orcid.org/0000-0003-0197-300X>

### References

- Canadian Centre for Occupational Health and Safety [Internet]. c2020 [cited 2020/04/26]. Coronavirus. Available from: <https://www.ccohs.ca/>.
- World Health Organization. 2020. Water, sanitation, hygiene, and waste management for the COVID-19 virus. Interim guidance 23 April 2020.
- Worldometer [Internet]. c2020. COVID-19 Coronavirus pandemic. [cited 2020/08/23]. Available from: <https://www.worldometers.info/coronavirus/>.
- US Department of Health and Department of Health and Human Services. 2020. Guidance on preparing workplaces for COVID-19. OSHA 3990-03 2020. Available from: [https://www.osha.gov/Publications/OSHA3990.pdf?utm\\_medium=email&utm\\_source=govdelivery](https://www.osha.gov/Publications/OSHA3990.pdf?utm_medium=email&utm_source=govdelivery)
- World Health Organization [Internet]. c2020. Getting your workplace ready for COVID-19. [cited 2020/04/06]. Available from: <https://apps.who.int/iris/handle/10665/331584>.
- World Health Organization. 2013. WHO Guidelines on quality risk management. WHO Technical Report Series, No. 981.
- International conference on harmonization of technical requirements for registration of pharmaceuticals for human use. 2005. Quality Risk Management, Q9.
- World Health Organization. 2010. Good practices for pharmaceutical quality control laboratories. WHO Technical Report Series, No. 957.
- Go R. 7 disadvantages of working from home and how to counter them [Internet]. Hubstaff Blog. 9 Jan 2018 [cited 2020/04/20]. Available from: <https://blog.hubstaff.com/disadvantages-of-working-from-home/>.
- Rouse M. What is cybersecurity? Everything you need to know [Internet]. TechTarget. c2020 [cited 2020/04/20]. Available from: <https://searchsecurity.techtarget.com/definition/cybersecurity>.
- World Health Organization. 2016. Guidance on good data and record management practices. WHO Technical Report Series, No. 996.
- Pharmaceutical inspection convention, pharmaceutical inspection co-operation scheme. 2018. Good Practices for data management and integrity in regulated GMP/GDP environments. [cited 2020/04/20]. Available from: [https://picscheme.org/users\\_uploads/news\\_news\\_documents/PI\\_041\\_1\\_Draft\\_3\\_Guidance\\_on\\_Data\\_Integrity.pdf](https://picscheme.org/users_uploads/news_news_documents/PI_041_1_Draft_3_Guidance_on_Data_Integrity.pdf).
- Pharmaceutical inspection convention, pharmaceutical inspection co-operation scheme. 2007. Good practices for computerised systems in regulated "GXP" environments. [cited 2020/04/20]. Available from: <https://picscheme.org/docview/3444>.
- Africa Centres for Disease Control and Prevention [Internet]. Guidance on community social distancing during COVID-19 outbreak. c2020 [cited 2020/04/20]. Available from: <https://africacdc.org/download/guidance-on-community-social-distancing-during-covid-19-outbreak/>.
- Centres for Disease Control and Prevention [Internet]. Coronavirus Disease 2019 (COVID-19) – Cleaning and disinfection of households. c2020 [cited 2020/04/20]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/disinfecting-your-home.html>.
- Federation of European Heating, Ventilation and Air-Conditioning Association (REHVA) [Internet]. REHVA COVID-19 guidance document, April 3, 2020: How to operate and use building services in order to prevent the spread of the coronavirus disease (COVID-19) virus (SARS-CoV-2) in workplaces. c2020 [cited 2020/04/26]. Available from: <https://www.rehva.eu/activities/covid-19-guidance>.
- Chen Y, Chen L, Deng Q, et al. The presence of SARS-Cov-2 RNA in feces of COVID-19 patients. Journal of Medical Virology. 2020;92(7):833-40. <https://doi.org/10.1002/jmv.25825>.
- Medicines and Healthcare Products Regulatory Agency. Guidance for manufacturers and Good Practice (GxP) laboratories on exceptional flexibilities for maintenance and calibration during the coronavirus COVID-19 outbreak. c2020 [cited 2020/04/29]. Available from: <https://www.gov.uk/guidance/guidance-for-manufacturers-and-good-practice-gxp-laboratories-on-exceptional-flexibilities-for-maintenance-and-calibration-during-the-coronavirus-co>.
- World Health Organization [Internet]. How to handwash? c2020. [cited 2020/04/29]. Available from: [https://www.who.int/gpsc/5may/How\\_To\\_HandWash\\_Poster.pdf?ua=1](https://www.who.int/gpsc/5may/How_To_HandWash_Poster.pdf?ua=1).
- Doremanlen N, Bushmaker T, Morris D, et al. Aerosol and surface stability of SARS-COV-2 as compared with SARS-COV-1. New England Journal of Medicine. 2020;382:1564-67. <https://doi.org/10.1056/NEJMc2004973>.
- World Health Organization [Internet]. WHO Guide to local production: WHO-recommended Handrub Formulations. c2020 [cited 2020/04/26]. Available from: [https://www.who.int/gpsc/5may/Guide\\_to\\_Local\\_Production.pdf](https://www.who.int/gpsc/5may/Guide_to_Local_Production.pdf).
- World Health Organization [Internet]. How to handrub? c2020 [cited 2020/04/29]. Available from: [https://www.who.int/gpsc/5may/How\\_To\\_HandRub\\_Poster.pdf?ua=1](https://www.who.int/gpsc/5may/How_To_HandRub_Poster.pdf?ua=1).
- Centres for Disease Control and Prevention [Internet]. Use of cloth face covering to help slow the spread of COVID-19. c2020 [cited 2020/04/29]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/diy-cloth-face-coverings.html>.
- Department of Health: South Africa [Internet]. Dr Zweli Mkhize recommends the widespread use of cloth masks. c2020 [cited 2020/04/29]. Available from: <https://sacoronavirus.co.za/2020/04/10/dr-zweli-mkhize-recommends-the-widespread-use-of-cloth-masks/>.
- US Department of Labour – Occupational Safety and Health Administration. 2020. Guidance on preparing workplaces for COVID-19. OSHA 39990-03 2020.