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PRACTICAL GUIDELINE FOR THE HANDLING, STORAGE AND DISPOSAL OF COVID-19 INFECTED WASTES, INCLUDING PERSONNEL PROTECTIVE EQUIPMENT

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BACKGROUND

Although much is still being discovered with the onset of the novel COVID-19 pandemic, what is known is that the virus is transmitted through person to person contact via misting and tiny droplets of saliva, lung fluids, etc. or through exposure to objects (such as surfaces) that have been impacted with the virus. Limited studies thus far under optimum conditions indicate that the virus can remain viable on solid surfaces for several hours with limited proven temperature impacts to date[1].

Estimated residual surface times of COVID-19 on various materials[1]	
Stainless steel & plastics: door handles, push buttons, laminate surfaces	2-3 days
Cardboard: boxes, paper, books	Up to 24 hours
Copper	4 hours
Aerosols	Up to 3 hours

Given the high infectious rates at which the COVID-19 virus is advancing, higher levels of precaution are warranted to reduce the potential risk posed by contaminated surfaces in the patient care environment. Moreover, proper handling of waste materials that could potentially be impacted by the virus need to be properly managed to avoid the risk associated with disposal of these materials. In particular, it is paramount that such infected wastes are not disposed in **unsecured open dumpsites subject to waste pickers** as the potential for cross infection in these circumstances is high and should be avoided and that open burning is not conducted due to the polluting emissions this practice can produce.

Healthcare facilities across the world utilize a range of methods to treat or dispose of infectious biomedical wastes and COVID infectious wastes should be treated no differently. However, with the conceivable onslaught of COVID-19 waste materials being generated as a result of this pandemic, these systems, especially in low resource environments, may become inundated and not able to cope with the amounts of infectious waste materials produced meaning either

[1] Neeltje van Doremalen, Trenton Bushmaker, Dylan H. Morris, Myndi G. Holbrook, Amandine Gamble, Brandi N. Williamson, Azaibi Tamin, Jennifer L. Harcourt, Natalie J. Thornburg, Susan I. Gerber, James O. Lloyd-Smith, Emmie de Wit, Vincent J. Munster. **Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1**. *New England Journal of Medicine*, 2020; DOI: 10.1056/NEJMc2004973

additional standard methods will need to be employed or that less suitable disposal systems may have to be considered.

This guideline provides practical advice on how to safely handle, store and properly dispose of COVID-19 infected wastes under a range of scenarios', to prevent respiratory and contact transmission of the COVID-19 virus. **It should be emphasized that the lead agencies for advice for COVID-19 are WHO and UNICEF upon which this guidance is based**. Further infographics for COVID-19 response for waste management and environmental considerations are currently being developed by UNEP and can be provided once finalized.

1. All healthcare workers and support personnel (cleaners, waste service) in contact with COVID-19 infectious wastes should use full and appropriate personnel protective equipment (PPE) including N95, FFP2 or equivalent standard face mask, eye protection (goggles or face shield), long sleeved gowns and aprons, surgical cap, heavy duty gloves and closed footwear. For minimum specifications of appropriate PPE and use guidance please see:

   https://apps.who.int/iris/bitstream/handle/10665/331215/WHO-2019-nCov-IPCPPE_use-2020.1-eng.pdf
   https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/when-and-how-to-use-masks

   It should also be noted that in addition to the advice in the above video link, consideration of continued mask use may be useful for protection of personnel in case of association with persons who may be asymptomatic that are not yet showing symptoms but are nevertheless infected by COVID-19.

   In addition, there may be circumstances where masks are in very short supply and under such constraints single use may not be possible and reuse may be considered. For this to be viable disinfecting the mask should ideally be conducted through fine spraying the outside of the mask with a 0.5% sodium hypochlorite solution or equivalent disinfectant and then allowing the mask to dry. Similarly, dry heating and/or UV lights could help to reduce potential infection on the mask.

2. Hand hygiene is extremely important for anybody in contact with COVID-19 patients, used or soiled materials or wastes. Hands should be thoroughly cleaned based on the WHO's '5 moments for hand hygiene' using soap and water or an alcohol-based hand rub/sanitizer for a minimum of 20 seconds and preferably 40-60 seconds using the appropriate technique. Please see the leaflet in Annex I to this document for clear instructions for hand hygiene.

3. All soiled or infected materials should be collected and ideally segregated as per biomedical waste type, and thereafter placed into clearly labelled (see labels below) leak proof plastic bags (appropriately coloured where possible) or designated containers (e.g. puncture proof sharp boxes). Double bagging of these materials has been recommended by the WHO for extra safety especially if transporting of the wastes is required. For transportation all bagged materials should be placed inside a rigid properly labeled (e.g., English and host country language) container placed in the vehicle.

Types of biomedical hazardous wastes/materials	
Biohazard waste	Infectious waste, blood products, contaminated personnel protective equipment, iv tubing, cultures, stacks
Sharps	Needles, ampules, broken glass, blades, razors, staples, other sharps
Soiled materials	Soiled reusable bedlinen or clothing
Trace chemical	Empty vials, ampules, empty IV's, gloves, gowns, tubing, wipes, packaging

4. For infected but reusable linens, machine washing should be conducted at 60-90ºC with laundry detergent. Alternatively, manual washing using drums of water, soap and stirring by stick, avoiding splashing, may be used. Thereafter the drum should be emptied, and the linen soaked in a 0.5% chlorine solution for 30 mins followed by cold water rinsing and complete drying of the linen in the sun.

   https://www.who.int/publications-detail/water-sanitation-hygiene-and-waste-management-for-covid-19

   Chlorine solutions can be derived either by direct chemical purchase and dilution usually in the form of solid tablets or through the use of Chlorine generators, that are features of most water treatment plants.

5. Wastes should not be allowed to accumulate at the point of production. A routine programme for their collection should be established.

6. A storage location for COVID-19 wastes should be designated inside each individual health care facility. The waste should be stored in a separate area, room, or building of a size appropriate to allow for waste production ideally for a maximum 48-hour period prior to collection and transfer. However, in the event of a breakdown in a waste management service, or to avoid the use of less suitable waste disposal technologies storage/stockpiling of COVID-19 wastes may be required for longer periods. Considering virus loads decrease over time this under some circumstances may be a more suitable approach.

   COVID-19 waste storage areas should have the following minimum characteristics:

   a. Impermeable, hard-standing floors with good accessibility, security (e.g., lock) and drainage which can be easily cleaned and disinfected
   b. A nearby water supply is recommended
   c. Free of all vectors (e.g., rodents, insects, and birds)
   d. Adequate lighting and some form of passive ventilation

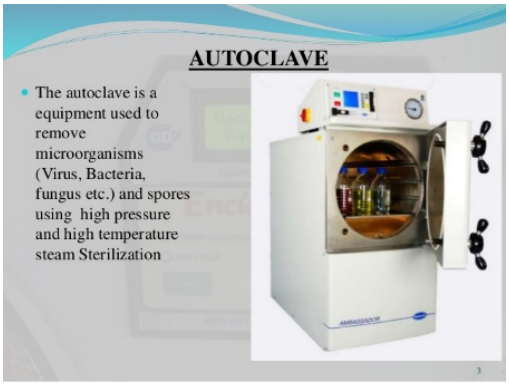
e. Include a supply of cleaning equipment, PPE, and extra bags and containers in the event of a package be compromised.
f. The storage area should be thoroughly disinfected daily using a spray of 0.5% (5 ppm) sodium hypochlorite solution (bleach),
g. The site would benefit from clear signage that infectious materials are stored at that location

http://www.euro.who.int/__data/assets/pdf_file/0012/268779/Safe-management-of-wastes-from-health-care-activities-Eng.pdf

https://wedocs.unep.org/bitstream/handle/20.500.11822/8628/IETC_Compendium_Technologies_Treatment_Destruction_Healthcare_Waste.pdf?sequence=3&isAllowed=y

7. All bags containing COVID-19 impacted materials should then be treated or disposed of and this can be achieved 1) using existing medical facilities with the appropriate technologies for safe disposal- an inventory of medical waste infrastructure and capacity could be conducted for preparedness planning and should consider waste generation under different COVID-19 scenerio's and build in contingency in the case of overburden of waste materials. 2) through being treated at source preferably onsite using the following range of options in a descending order of preference. As much as possible waste treatment methods that minimize the formation and release of chemicals or hazardous emissions should be given priority over other technologies and should accord to the Best available technology/Best environmental technology (BAT/BEP) principles.

a. **Autoclaving** is a standard practice for treating infectious wastes and sterilization of reusable medical instruments. Pressure and vacuum using high temperature steam autoclaving will destroy the pathogens prior to the wastes being sent for final landfill/dumpsite disposal. It is more effective if the waste can be pre-shredded prior to autoclaving. Waste material if in a bag should either be removed, or the bag opened or penetrated/holed so that the steam can penetrate all the internal contents of the bag. The method produces less harmful emissions than incineration processes, but throughput is often constrained except for larger units. Autoclaved waste may have to be rebagged and materials that could be reused may have to be mutilated prior to sending to landfill or dumpsite. Homemade boiler supported autoclave systems have been developed and may if proven to be viable and reach equitable and verifiable standards of sterilization be an alternative to commercial based systems.



An example autoclave unit can be found at; https://tuttnauer.com/medical-autoclaves, https://celitron.com/en/biomedical-waste-disposal

b. **Sterilization** using thermal or microwave processes followed by landfill disposal is also a viable biomedical waste management practice. Often sterilization units will shred the waste material as part of the process ensuring a reduced final volume of the waste material. The sterilized waste may have to be rebagged and materials that could be reused may have to be mutilated prior to sending to landfill or dumpsite.

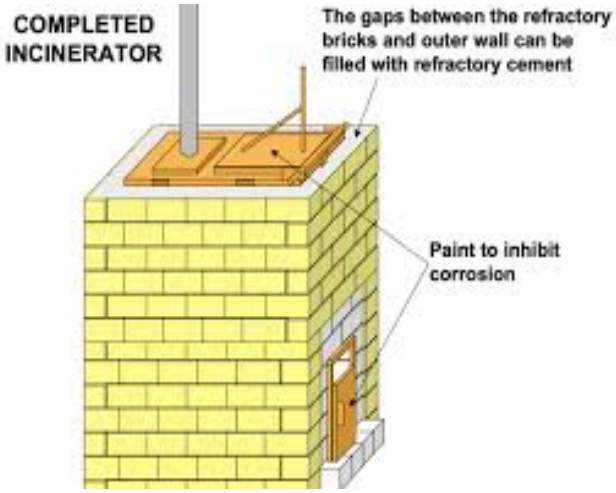
An example sterilizer can be found at; https://www.bertin-medical-waste.com/

c. Properly sized commercial **twin chamber biomedical incinerators** are a secondary preferred technology recommended as a safe and efficient means of incineration for the destruction and reduction of COVID-19 waste materials.

The advantage is that most biomedical wastes can be incinerated but when low quality units are used or with poor operatorship harmful emissions (dioxins and furans) may be emitted. Care should be

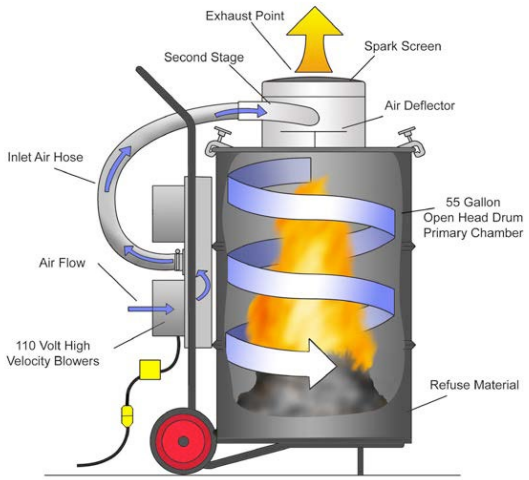
taken to preheat the incinerator empty (850ºC for minimum of 20 mins) prior to loading wastes ensuring not to overload the incinerator. In addition, proper mixed feedstocks should be developed prior to use (e.g., combination of paper, plastic, garments, etc.). Proper hazardous bottom ash management is also necessary including temporary storage of ash in 200L steel drums followed by ash disposal at a designated hazardous ash monofill or entrainment of the ash through standard encapsulation. Where possible advanced emissions control systems such as the use of Venturi scrubbers, bag or ceramic filtering systems should be utlised.

d. An alternative short term stop gap solution for effective safe biomedical incineration can be achieved through the use of cost effective easy to build home-made **De-Montfort brick-built incinerators**. Fabrication of these units will require the correct design and the purchase of various components (e.g., lids, ash removal hatch, exhaust stack) and the provision of cured bricks or heat resistant stone. These units can be built within 5-6 days once materials are obtained. They are however **less efficient than commercial units** so they should only be considered as a **stop gap solution** to be superseded by improved technology in the longer term. Care should be taken to not overload the primary chamber and to provide a balanced feedstock mix. Placement should also consider prevailing wind direction and distance away from communities. A proper flat base or foundation is necessary for this installation and adequate operating space and security provisions as shown below.



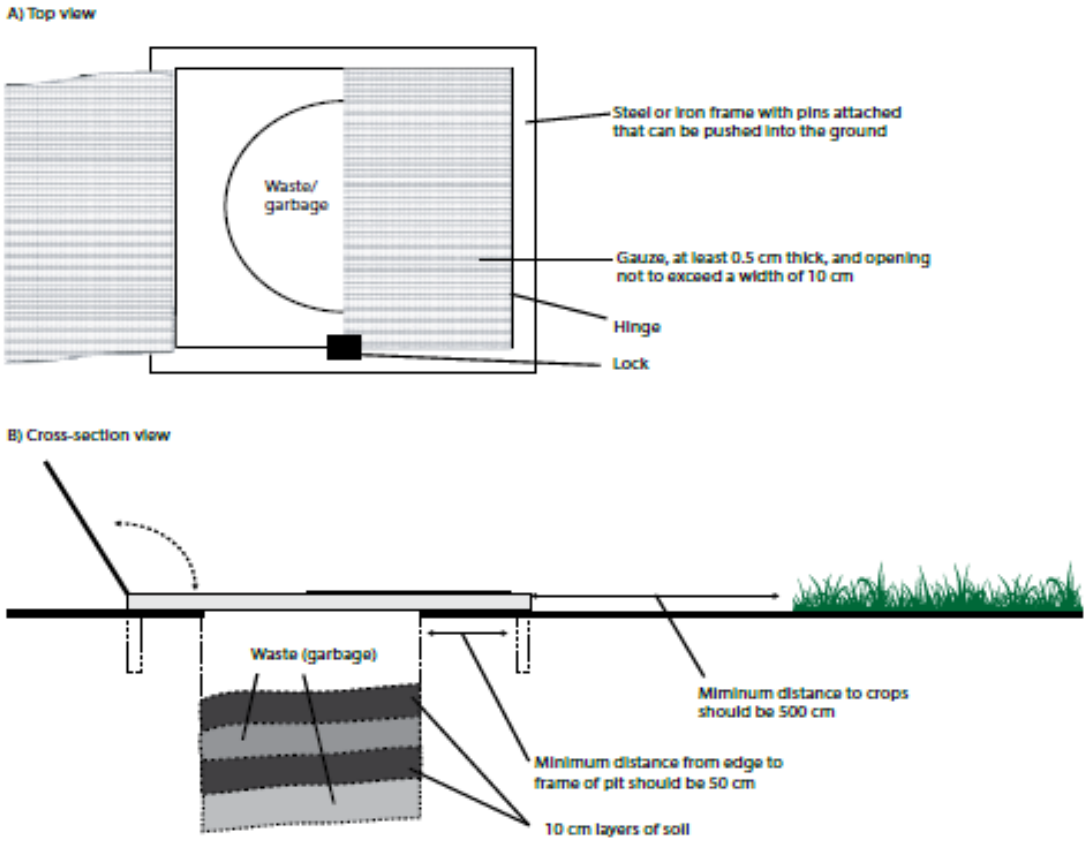
Designs for De-Montfort incinerators can be found at; https://mw-incinerator.info/en/304_Mark_9.html

e. In resource constrained environments the use of **air induction barrel incinerators** is a viable stop gap alternative although a less efficient means for the destruction and reduction of smaller volumes of COVID-19 waste materials. The advantage of these units is that they are versatile, relatively easy to obtain within a short timeframe, are cost effective, easy to operate and maintain and have very useful portability. Multiple units can be procured and utilized and there are plans on the internet for self-build units using air fans (e.g. leave blowers) to create the cyclonic air induction for an improved burn cycle. It should be noted that barrel incineration without air induction is not recommended as this is simply akin to open burning.



See the following links; https://www.inciner8.com/the-sirocco.php, https://www.elastec.com/products/portable-incinerators/smartash/ https://www.instructables.com/id/Barrel-Incinerator/

f. A less suitable emergency option but one that may be necessary at specific sites is the use of **onsite pit burial** protected from scavenging. The site should be clearly signed with biohazard signs that infectious waste is at that location. Prior to waste placement in the pit all infected materials can be thoroughly sprayed with a 0.5% solution of sodium hypochlorite (bleach) or an equivalent disinfectant. Ideally the pit should be lined with an impermeable material such as clay, plastic liner or even cow dung and should be located away from water sources, waterways and agricultural crops. Such sites cannot be used for more than 5-10 tonnes of waste and should have a daily application of soil cover to discourage vermin. If required more than one pit may be excavated.



Source: COSsen Zuid-Holland (2006)

Figure 8.7 Example of a low-cost pit cover

Schematic copied from; https://www.who.int/water_sanitation_health/publications/safe-management-of-wastes-from-healthcare-activities/en/

g. **AT NO POINT SHOULD COVID-19 WASTE MATERIALS BE DISPOSED OF AT OPEN DUMPSITES** WHERE WASTE PICKING EXISTS NOR VIA OPEN BURNING GIVEN THE POTENTIAL EXPOSURE PATHWAYS IN ADDITION TO THE FACT THAT THE BURNING OF PLASTICS, RUBBER, ETC. HAS BEEN THOROUGHLY PROVEN TO HAVE HARMFUL CONSEQUENCES ON HUMAN HEALTH AND THE ENVIRONMENT.

ANNEXES

Annex I: Hand Hygiene: When and How leaflet