



## Commentary



## A dynamic forensic medicine approach: Management of the dead during COVID-19 outbreak in Malaysia

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## ABSTRACT

It has been a difficult year ahead since the announcement of COVID-19 as a pandemic by the Director General of the World Health Organization (WHO). Many countries including Malaysia have struggled to take urgent and aggressive measures to advise, detect, screen, test, isolate and treat their citizens in order to fight against the virus. All countries must strike a balance between protecting health, minimizing economic and social disruption and at the same time, preserving human rights which includes managing the dead with dignity and respect. The National Institute of Forensic Medicine (IPFN) Malaysia has been proactively engaging the various agencies involved in a concerted effort to ensure smooth flow in the management of the dead for all COVID-19 and non-COVID-19 cases since the beginning of the outbreak in February 2020. This is in accordance with all existing guidelines and regulations vis-a-vis infection prevention and control in the country. However, new situations that arise during the pandemic are always challenging and dynamic. The COVID-19 crisis has uncovered a plethora of issues surrounding the margin of the Forensic Medicine fraternity. Therefore, this article highlights various emerging issues encountered by the IPFN and how they are resolved through good leadership to guide and direct operations and activities during the exponential rise of COVID-19 infection in Malaysia. In the provision of the management of the dead, it is of utmost importance to note that the humanitarian aspect needs to be emphasized even in times of an outbreak to give closure to the family and the opportunity to mourn their loved ones.

### 1. Overview

The National Institute of Forensic Medicine (IPFN) Malaysia improved its existing procedures and guidelines for the management of the dead not long after the outbreak of COVID-19 in Malaysia which was published in May 2020 [1]. The revised guidelines for management of the dead were formulated within the existing regulations in order to achieve a balance between medicolegal requirements and the safety of personnel managing bodies with suspected or confirmed COVID-19 infection; these guidelines deal with practises at the site of death, during body transport, and postmortem procedures, body storage and body preparation before and during burial or cremation as well as environmental cleaning and disinfection, involving various agencies in the country. However, there are emerging issues confronted by the Institute which require preliminary steps and flexible decisions in order to further streamline the existing guidelines on management for the cases mentioned above. Hence, this document aims to provide an overview on the recent issues encountered during the management of the dead from COVID-19 in Malaysia, followed by innovative ways to manage the bodies in a lack-of-resources scenario.

### 2. Current issues

To date, there is a total of 4760 deaths of confirmed COVID-19 cases reported in Malaysia from January to June 2021. The sudden rise in deaths can be seen starting from early 2021. The number of COVID-19 deaths reported are broken down into months as shown in Table 1. COVID-19 deaths include death cases which are tested positive and cases

which are pronounced as COVID-19 cause of death.

#### 2.1. Unclaimed bodies and foreign deceased

In accordance with the Ministry of Health (MOH) Malaysia policy on the management of the unclaimed dead body, any human remains, be it complete or in parts, the authority over the human remains falls under the jurisdiction of the Director of the institution wherein the body lies [2]. After a duration of 14 days, the unknown and unclaimed body will be buried conforming to the Muslim way. Where the identity and religion are known, the unclaimed body will be disposed according to the rites of their religion and faith. In other words, Muslims will be buried by the office of the Federal Territory Islamic Religious Department (JAWI) and non-Muslims will be cremated by the office of the Kuala Lumpur City Hall (DBKL). The number of deaths which has increased disproportionately to the rate at which the bodies are claimed has more often than not, resulted in these bodies ending as unclaimed bodies. The increase in

deaths of foreigners in Malaysia is also contributing to the insufficient storage in IPFN. Bodies of foreign citizens may also end up as unclaimed bodies when family members are not contactable or when these bodies are not able to be repatriated back to their country of origin. As a result, the body storage capacity of the IPFN has been overwhelmed with the number of unclaimed bodies.

#### 2.2. Post-COVID-19 death

In the clinical setting, management of COVID-19 patients in this

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**Table 1**  
Total COVID-19 deaths in 2021 in Malaysia.

Month 2021	Total death
January	296
February	365
March	143
April	1184
May	405
June	2367
<b>TOTAL</b>	<b>4, 760</b>

**Table 2**  
Category of management for COVID-19 patients.

Category	Descriptions
1	No symptom
2	Symptomatic without lung infection
3	Symptomatic with lung infection
4	Symptomatic with lung infection and need oxygen supplementation
5	Critical patients with multiple organ complications

country is based on categorization of patients into 5 categories – Category I to Category V as shown in Table 2 [3]. This categorization is necessary to make patient treatment and healthcare planning more organized and coherent. Patients who contract with COVID-19 and subsequently recover will be monitored for a certain period and are allowed back into the community – these patients are known as off-tag patients. However, if during the recovery period, the patient succumbs to death within 28 days from the onset of confirmation of the COVID-19 diagnosis, the death will be managed as a post-COVID-19 death. A major issue arises when these patients have recovered are tested positive for COVID-19. This can consequently lead to confusion and compounded with unclear directives can lead to disorganized management of the dead particularly in terms of autopsy procedure, performing the last rites and release of the body to the next-of-kin. In IPFN, there are specific guidelines for managing COVID-19 and non COVID-19 cases.

**2.3. Post-vaccination death**

Our Prime Minister was the first person in Malaysia to receive the first of the two-dose Pfizer-BioNTech vaccine on 24 February 2021. This marked the commencement of the nationwide vaccination in Malaysia. As was reported in other parts of the world, deaths categorized as post-vaccination death which occur immediately after vaccination or within 30 days from the onset of the vaccination, was also observed in Malaysia. The MOH Malaysia has spelled out specific guidelines for reporting any adverse event following Immunization (AEFI) and further management of the case [4]. AEFI is defined as any untoward medical occurrence which follows immunization and which does not necessarily have a causal relationship with the usage of the vaccine. The adverse event may be any unfavorable or unintended sign, abnormal laboratory finding, symptom or disease. However, there is no clear indication or outline to certify cause of death as post-vaccination death in the country. Post mortem examination is the same for any death; it’s just taking some extra samples.

**2.4. Body release and disposal**

To date, the diagnosis of COVID-19 has relied on the detection of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), the causative agent of COVID-19 through molecular detection [5]. Real time RT-PCR (reverse transcription–Polymerase Chain Reaction) assay has been the gold standard laboratory method to confirm COVID-19 cases in Malaysia. However, the turnaround time of the analysis takes an average of 24–48 h. Brought-in-dead (BID) cases by the police (bodies brought to the Institute for postmortem examination) will be subjected to a real

time RT-PCR laboratory test. The time frame in getting the result of the laboratory test has also indirectly caused some slight delay in the autopsy procedure, release and disposal of the bodies.

With the rise of COVID-19 cases in Malaysia, more individuals and clusters were identified, tested positive and quarantined in tandem with the increase in number of deaths. Household members who are quarantined are unable to come forward to claim their loved ones at the IPFN; they may be sequestered in quarantine centers or unable to travel due to restrictions imposed by the government. Eventually, the delay in releasing the bodies to their family members will result in the piling up of bodies in the IPFN.

**2.5. Cycle threshold value (Ct value)**

Currently, available RT-PCR methods for diagnosis of COVID 19 are able to give an estimate of the viral load in terms of Cycle Threshold (Ct) values [5]. The Ct values of the PCR reaction correlate inversely with the viral load; a low Ct indicates a high concentration of the viral genetic material, leading to a higher chance of serious disease, hospital admission, and transmission to others, despite non-pharmaceutical interventions, such as physical distancing, mask wearing, well-ventilated spaces or quarantine; a high Ct indicates a low concentration of the viral load, associated with a lower risk of infectivity and patient is less likely capable of viral transmission [6,7]. However, Ct values for the deceased who have died from COVID-19 do not reflect the actual infectivity from a dead body. This creates confusion and uncertainty towards the management of the dead in IPFN.

**2.6. Personal protective equipment (PPE)**

Safety of the personnel of the IPFN is of utmost importance. Emphasis has always been a priority on proper hand hygiene and washing, and proper donning and doffing of the standard full personal protective equipment (PPE) which consists of a surgical mask, double surgical gloves, face shield, impervious gown or apron with full sleeve coverage, shoe covers and surgical cap [8]. In Malaysia, the police are bound by law to investigate all sudden death reports including homicide, suicide and accidental deaths, giving the mandate to conduct a postmortem examination of a body to a Government Medical Officer, which includes a forensic pathologist under Section 329 and Section 331 respectively of the Criminal Procedure Code [9]. The powered air-purifying respirator (PAPR) is an important element in the PPE gear in conducting full postmortem procedures in the biosafety autopsy suite, adhering strictly to the protocols and precautions. The frequent use of the powered air-purifying respirator (PAPR) in IPFN has led to frequent exhaustion of its supply with the increase in number of deaths, especially unnatural deaths brought in by the police for investigation. All unnatural deaths require PAPR upon opening up the positive COVID-19 bodies as safety requirement.

**2.7. Standardization of cause of death (COD) certification**

Issues surrounding the proper certification of Cause of Death (COD) in cases related to COVID-19 has also been raised. Certification by medical doctors can be very subjective and the wordings used in the certification have and can be very perplexing. The use of the term “due to COVID-19” (when death is directly caused by the infection) or “with COVID-19” (when death is due to another cause totally unrelated to the infection which was incidental) in writing the death certificates is sometimes based on personal medical judgment and there is no standardization or bench mark in doing so.

**3. Discussion**

In an opening remarks at the WHO media briefing on COVID-19, the Director General of WHO mentioned that countries must take a whole-

of-government, whole-of-society approach, built around a comprehensive strategy to prevent infections, save lives and minimize impact. These are “*First, prepare and be ready; Second, detect, protect and treat; Third, reduce transmission; Fourth, innovate and learn*” [10]. The IPFN has been adaptive and constantly innovative to combat COVID-19 during the outbreak. One such innovation was the modification of a craniotomy box to allow aerosol generating procedures to be performed on confirmed COVID-19 bodies thus ensuring a safe environment for personnel performing high risk autopsies during the pandemic [11]. In alleviating the emerging issues during the COVID-19 outbreak, the IPFN had the benefit of good leadership and direction to be adaptive and make the necessary changes to suit current needs in tandem with the latest knowledge and findings from research. This section highlights IPFN’s management strategy in improvising and maximizing existing resources and capacity to tackle and rectify emerging issues.

### 3.1. The role of postmortem computed tomography (PMCT)

The IPFN is the only Forensic Medicine center with PMCT facility in the country. In order to expedite the postmortem examination process for BID cases by police, all bodies will be subjected to a CT scan after registration. The body of the deceased will remain in the body bag during scanning and all forensic personnel will wear full Personal Protective Equipment (PPE) when these BID cases are treated as suspected or confirmed COVID-19. Two Forensic Radiologists stationed at the Institute will interpret and report on the scanned images before the pathologists proceed with the postmortem examination. The findings from the Forensic Radiologists will assist in deciding whether a full postmortem examination is needed. CT images showing ground-glass opacities, consolidation, cavitation or nodular opacities are changes on lungs that are consistent with COVID-19.

### 3.2. Antigen rapid test kit (RTK-Ag)

Prior to the postmortem examination, the body will be subjected to laboratory testing to confirm COVID-19 infection. For diagnostic COVID-19 testing, Oropharyngeal Swab (OPS) and Nasopharyngeal Swab (NPS) are standard specimens taken for RT-PCR. However, the turnaround time of the real time RT-PCR analysis of 24–48 h will cause a further holdover for completion of the cases and subsequent release to family members. For cases with PMCT lung findings suggesting COVID-19 infection, RTK-Ag is used in lieu of the real time RT-PCR. RTK-Ag has the advantage of detecting COVID-19 infection quickly whereby the turnaround time for the analysis is 60 min. The RTK-Ag used in the Institute has undergone re-assessment of its sensitivity and specificity values by the Malaysian Institute for Medical Research (IMR) and the results were within the values set by the MOH. With this RTK-Ag result, the remains of the deceased can be released quickly to the next-of-kin and it provides a guide on how the remains should be handled during the final body preparation and last rites.

### 3.3. Exclusion of cycle threshold value (Ct value)

The qualitative reporting of SARS-CoV-2 RT-PCR testing as positive or negative is sufficient for diagnosis but it is supplemented by the Ct value, a semi-quantitative value [7] that refers to the number of cycles needed to amplify the viral RNA to a detectable level [12]. This Ct value, together with the time of onset of symptoms will help guide infection control, public health, and occupational health decisions [5] which are essential in the clinical management of COVID-19 patients. However, in a study conducted by Shah et al. [13], there is no correlation shown between Ct value and the severity of disease or mortality in patients with COVID 19 disease. The authors mentioned that in patients with severe disease the Ct values of those who died were significantly lower than those who survived; but at the same time these patients had shorter duration of symptoms before testing. While it is difficult to draw

conclusions from these Ct value results, the IPFN has decided not to rely on Ct values in management of the dead of COVID-19 cases.

### 3.4. Improvised standard operating procedure (SOP)

The inability of family members to physically be present to claim the remains of their loved ones due to quarantine or traveling restrictions, contributes to the backlog and taking up of body storage space in IPFN. According to the Institute’s SOP for body release, the next-of-kin will need to be present in order to identify the deceased and prevent wrongful release of the body [14]. To ensure fast release of the body to the claimants during COVID-19 pandemic, the Institute has made some adaptations to the existing procedures by utilizing modern-day technology – instead of having the next-of-kin physically view the body, facial recognition is made via video call.

### 3.5. The role of the health inspector

As the number of COVID-19 cases increase, Malaysia has responded by having in force its Prevention and Control of Infectious Diseases Act 1988. According to this Act, a Health Inspector in the service of the Government or of any local authority shall investigate and monitor potential health hazards to keep the public safe [15]. The Health Inspector plays an important role during the COVID-19 outbreak in the country. IPFN has engaged the Health Inspector of the MOH’s Public Health Unit in several meetings and discussions to detail out the best management of the dead of suspected or confirmed COVID-19 cases. With the power vested in him by the above Act, the Health Inspector is authorized to supervise and guide police officers at the scene of death on proper donning and doffing of the standard full PPE before handling a COVID-19 body. The transportation of the body to the mortuary, area decontamination of the scene as well as the hearse will be supervised by the Health Inspector. Following this, the Health Inspector will also ascertain that funeral directors abide by the SOP in the handling of positive COVID-19 bodies.

### 3.6. Facility and equipment

It is a medicolegal requirement to perform a postmortem examination on a body, even in times of an outbreak in order to assist the police in their investigation into unnatural deaths, including homicide, suicide and accidental deaths. However, the findings from the PMCT coupled with real time RT-PCR or RTK-Ag laboratory results, anamnesis from family and friends and preliminary police enquiries will place the Forensic Pathologist in a better position to decide whether to conduct a full, partial or external postmortem examination. In order to limit the heavy usage of the Powered air-purifying respirator (PAPR) equipment, the IPFN reviewed and made adjustments with regards to the use of PPE by its personnel. For all positive COVID-19 cases with positive where the death is solely attributed to the infection and/or its complications, only an external postmortem examination will be performed in the biosafety autopsy suite without the use of the PAPR. For these cases, an N-95 respirators will be used in lieu of a surgical mask with full standard PPE. N95 respirators are tight-fitting respirators that filter out at least 95% of particles in the air, including large and small particles, approved by the National Institute for Occupational Safety and Health (NIOSH) and used in accordance with Occupational Safety and Health Act (OSHA) standards [16]. We reckon that it is safe to just use N-95 respirators and standard PPE for external postmortem examination.

### 3.7. Collaboration with external agencies

As mentioned earlier, burial and cremation services are performed by external agencies and not listed under services provided by IPFN. Arrangements were secured with JAWI and DBKL to accelerate the preparation of Muslim and non-Muslim bodies for burial and cremation



Fig. 1. Two 20-foot refrigerated storage containers.

respectively. The DBKL Cremation Center is operating in full capacity with the assistance from the National Disaster Management Agency (NADMA) to facilitate the cremation process as well as planning for a centralize 1-stop body storage center. Other agencies such as the International Committee of the Red Cross (ICRC) also contributed immensely to our cause by donating much needed cadaver body bags. Shortage of these bags became a problem as COVID-19 positive bodies are double-bagged to prevent transmission of the disease which is an important element in the management of the dead.

### 3.8. Body storage capacity

As part of an earlier disaster management planning exercise, the IPFN had previously installed three-phase power supply to the external wall of the building abutting the existing staff car park in preparation for a disaster, to allow for the installation of refrigerated containers within the perimeter of the Institute (Fig. 1). As a contingency plan during the current pandemic, the IPFN was able to prepare two 20-foot refrigerated storage containers fitted with racking for approximately 12 bodies. With this additional storage capacity, unclaimed bodies awaiting repatriation back to their country of origin can be temporarily stored.

### 3.9. Disposal/temporary controlled burial

When COVID-19 cases continue to escalate and all storage facilities are overwhelmed, the temporary controlled burial is a practical solution. The temporary controlled burial is a method for a long-term temporary storage of unclaimed bodies. This is due to the temperature underground being lower than at the surface, therefore providing natural refrigeration [17]. Human remains will be buried in individual plots and each plot will be marked clearly with GPS, to facilitate future exhumation in the event a next-of-kin comes forward [17,18]. The temporary controlled burial provides a practical and elegant solution for the unclaimed or unidentified victim to be treated with dignity and respect while waiting for formal identification as well as an opportunity to be identified in future.

## 4. Conclusion

Management of the dead in Malaysia in this current pandemic is not without its moments of difficulty and complexity. By being proactive in regularly reviewing and updating the workflow and guidelines as well as by putting innovative and new knowledge to good use to improve strategy, a holistic approach in management of the dead has been

achieved in this country.

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## References

- [1] L.S. Khoo, A.H. Hasmi, M.A. Ibrahim, M.S. Mahmood, Management of the dead during COVID-19 outbreak in Malaysia. *Forensic Sci. Med. Pathol.* (2020) 1–8.
- [2] HKL/FOR/AK-07, Disposal of Unclaimed Body (Amendment May 2019).
- [3] M.O.H. COVID-19 Management Guideline in Malaysia No. 5/2020. Updated 18 June 2021.
- [4] NPRA. Clinical Guidelines on COVID-19 Vaccination in Malaysia. 2nd Edition. National Pharmaceutical Regulatory Agency. 2021.
- [5] J. Bullard, K. Dust, D. Funk, J.E. Strong, D. Alexander, L. Garnett, C. Boodman, A. Bello, A. Hedley, Z. Schiffman, K. Doan, N. Bastien, Y. Li, P.G.V. Caesele, G. Poliquin, Predicting infectious SARS-CoV-2 from diagnostic samples, *Clin. Infect. Dis.* 71 (10) (2020) 2663–2666.
- [6] F.T. Yu, L.T. Yan, N. Wang, S.Y. Yang, L.H. Wang, Y.X. Tang, G.J. Gao, S. Wang, C. J. Ma, R.M. Xie, F. Wang, C.R. Tan, L.X. Guo, Y. Zhang, Quantitative detection and viral load analysis of SARS-CoV-2 in infected patients, *Clin. Infect. Dis.* 71 (15) (2020) 793–798.
- [7] Public Health England. Understanding cycle threshold (Ct) in SARS-CoV-2 RT-PCR. A guide for health protection teams. Protecting and improving the nation's Health. 2020.
- [8] K.B. Nolte, D.G. Taylor, J.Y. Richmond, Biosafety considerations for autopsy, *Am. J. Forensic Med. Pathol.* 23 (2) (2002) 107–122.
- [9] Act 593. Criminal Procedure Code (CPC). Laws of Malaysia. 2012.
- [10] WHO. WHO Director General's opening remarks at the media briefing on COVID-19. World Health Organization. 11 March 2020.
- [11] A.H. Hasmi, L.S. Khoo, Z.P. Koo, M.U. Ahmad Suriani, A.N. Hamdan, S.W. Md Yaro, S. Arshad, S.F. Siew, M.A. Ibrahim, M.S. Mahmood, The craniotomy box: an innovative method of containing hazardous aerosols generated during skull saw use in autopsy on a COVID-19 body, *Forensic Sci. Med. Pathol.* 16 (2020) 1–4.
- [12] L.C. Poon, B.W. Leung, T. Ma, F.N.Y. Yu, C.W. Kong, T.K. Lo, P.L. So, W.C. Leung, W. Shu, K.W. Cheung, S. Mounghaithong, C.C. Wang, Relationship between viral load, infection-to-delivery interval and mother-to-child transfer of anti-SARS-CoV-2 antibodies, *Ultrasound Obstet. Gynecol.* 57 (6) (2021) 974–978.
- [13] S. Shah, T. Singhal, N. Davar, P. Thakkar, No correlation between Ct values and severity of disease or mortality in patients with COVID 19 disease, *Indian J. Med. Microbiol.* 29 (2021) 116–117.
- [14] HKL/FOR/AK-06, Release of Body (Amendment May 2019).
- [15] Act 342. Prevention and Control of Infectious Diseases Act 1988. Laws of Malaysia. Amendment 2006.
- [16] CDC. Management of Patients with Confirmed Coronavirus Disease (COVID-19). The United States Centers for Disease Control and Prevention. Feb 2021.
- [17] ICRC. Management of Dead Bodies after Disaster: A Field Manual for First Responders. 2nd Edition. Washington D.C. International Committee of the Red Cross. 2016.
- [18] M.S. Mohd Noor, L.S. Khoo, W.Z.Z. Alias, A.H. Hasmi, M.A. Ibrahim, M. S. Mahmood, The clandestine multiple graves in Malaysia: the first mass identification operation of human skeletal remains, *Forensic Sci. Int.* 278 (410) (2017) e1–e9.

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