

INVITED ARTICLE

RESPONSE OF AUSTRALIA'S FORENSIC MORTUARIES TO THE COVID-19 PANDEMIC

Sarah Parsons^{1,2}, Linda Iles^{1,2}, Stephen Wills³, Isabel Brouwer⁴, Andrew S Reid^{5,6}, Nadine Forde⁷, Victoria Kueppers⁸, Marianne Tiemensma^{9,10*}

¹Victorian Institute of Forensic Medicine, Melbourne, Victoria, Australia

²Monash University, Department of Forensic Medicine, Melbourne, Victoria, Australia

³Forensic Science South Australia, Adelaide, South Australia, Australia

⁴New South Wales Health Pathology, Sydney, New South Wales, Australia

⁵Statewide Forensic Medical Services, Hobart, Tasmania, Australia

⁶School of Medicine, University of Tasmania, Tasmania, Australia

⁷Forensic Pathology and Coronial Services, Pathology Queensland, Brisbane, Queensland, Australia

⁸Pathwest Laboratory Medicine Western Australia, Department of Forensic Pathology and State Mortuary Service, Perth, Western Australia, Australia

⁹Territory Pathology, Northern Territory Department of Health, Darwin, Northern Territory, Australia

¹⁰College of Medicine and Public Health, Flinders University, Adelaide, Australia

ABSTRACT

The COVID-19 pandemic had an impact on health services, including forensic pathology services, throughout the world. Throughout the COVID-19 pandemic, forensic mortuaries in various Australian jurisdictions developed and implemented local guidelines and procedures to ensure the safe continuation of providing their essential services. The jurisdictional responses are outlined in this article.

Keywords: Autopsy; COVID-19; forensic; post-mortem examination

Corresponding Author: Marianne Tiemensma

Marianne.Tiemensma@sa.gov.au

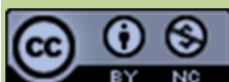
ORCID iD: <https://orcid.org/0000-0002-8437-6683>

ARTICLE HISTORY

Received: 13.09.2024

Accepted: 03.12.2024

Available online: 20.12.2024



This article is licensed under the terms of the Creative Commons Attribution-Non Commercial 4.0 International License.

INTRODUCTION

From the outset, it was thought that in most Australian jurisdictions, forensic pathologists undertaking work for coroners would have limited engagement with COVID-19 cases as they would be considered natural deaths and would not fall under the jurisdiction of the coroner. However, in certain instances, such as a person dying an unnatural death or the diagnosis not being known before death, COVID-19 autopsies would need to be performed.

Australia reported its first cases of COVID-19 on 25 January 2020, its first death on 1st of March 2020, and the first recorded case of community transmission was reported the following day.

The Royal College of Pathologists of Australasia (RCPA) was consulted about guidelines for undertaking autopsies early in 2020. At this stage, there had been much larger outbreaks elsewhere in the world and some autopsy information was available. It was deemed that it was safe and important from a disease progression point of view to perform autopsies on these cases where required. Advice on the Handling of Anatomical Specimens and Autopsy was published on the RCPA website in April 2020 with reference to guidelines for autopsy practice in the USA and UK^{1,2,3}.

Differing guidelines and testing procedures were implemented across Australian states and territories, and the jurisdictional responses and experiences are outlined in this paper.

JURISDICTIONAL APPROACHES

Queensland

From April to October 2020 the department was divided into two teams, with no cross-over between the teams. This was done to maintain continuity of service as workplace contacts of COVID-19 positive cases were required to quarantine at the time. Staff leave was minimal, enabling this system to work reasonably well. In October 2020, staff regrouped into a single department and followed the Queensland Health mandate for COVID-19 vaccinations. Required isolation periods did, at times, cause some staffing shortages. However, work-from-home arrangements meant otherwise well staff could continue to work while isolated.

Initially, it was decided to perform combined oropharyngeal/nasopharyngeal COVID-19 swabs on cases with a history of fever/upper respiratory tract infection/COVID-19-like symptoms prior to death and await the results before performing an autopsy. There were rare positive cases received through the department.

Following a multi-department consultation process in 2021 (including microbiology, virology, and forensic pathology) and discussion with other forensic departments, a formal guideline was developed called "Guideline for Management of Suspected PM COVID testing at

Forensic Scientific Service (FSS)". This guideline outlined an approach to triaging and handling potentially positive COVID-19 cases arriving at FSS. Testing for COVID-19 continued for cases with a history suspicious of fever or respiratory illness.

Cases requiring autopsy with COVID-19 were preferably performed in the negative pressure special dissection theatre.

External visitors were stopped, including viewings of deceased bodies, as this area of the department did not have sufficient size for required social distancing measures.

Personal protective equipment (PPE) masks utilized within the autopsy theatre were changed to N95 masks only, with mask fit tests required.

Around mid-2020 mask supply issues led to participation in a COVID-19 surety PPE supply program to ensure adequate PPE supplies, set aside by Queensland Health.

Northern Territory (NT)

Very low case numbers of COVID-19 were reported in the NT from the start of the pandemic until the end of 2021, with the first case of community transmission identified in November 2021 followed by the first COVID-related death reported in December 2021.

No routine COVID-19 screening of deceased bodies was conducted upon mortuary admission, with COVID-19 testing (nasopharyngeal swab) only performed in cases with a reported history of respiratory symptoms, fever, a history of traveling prior to death, and/or pathological evidence of respiratory infection observed during macroscopic examination. Additionally, COVID-19 screening was performed on bodies that required interstate or international repatriation. Any COVID-19 positive cases were reported to the NT Centre for Disease Control.

The procedures for the management of COVID-19 positive deceased bodies in the mortuary were in line with international and national guidelines, which included the correct use of appropriate PPE and limited handling of the

bodies (including no viewing to reduce the risk of spreading between visitors). The NT coroner did not investigate COVID-19 related deaths where the cause of death was clear, unless there were any reportable aspects. Full autopsies were performed as required. The usual body storage capacity issues were aggravated during the pandemic as a result of a reduction in the number of funeral and burial ceremonies due to imposed restrictions.

Vaccinations were available and were considered mandatory to all mortuary staff and pathologists during Australia's phase 1A of the vaccine roll-out program.

New South Wales (NSW)

On 17 March 2020, the NSW State Coroner published in the State Coroner's Bulletin No. 11 that deaths as a result of COVID-19 are regarded as natural deaths and that the expectations are that in most deaths due to COVID-19 a Medical Certificate Cause of Death ("Death Certificate") (MCCD) will be issued. Death following contact with a suspected or confirmed patient with COVID-19 was therefore not necessarily referable to the coroner unless it was a reportable as defined within Section 6(1) of the NSW Coroners Act 2009⁴.

A risk assessment tool was developed by Forensic Medicine in collaboration with the NSW Ministry of Health, NSW Police, and the Office of the State Coroner. The risk assessment tool was completed by NSW Police at the death scene, and it contained questions related specifically to exposure risk and clinical symptoms related to COVID-19 experienced by the deceased prior to death. The checklist was submitted together with the NSW Police Coronial referral documents to the relevant Forensic Medicine facility. Responses noted were used by the Duty Pathologist (DP) and/or Clinical Nurse Consultant (CNC), together with other available clinical information to determine whether the deceased person should be tested for COVID-19 with a post-mortem nasopharyngeal swab.

Changes to the NSW Coroners Act, Section 88A (preliminary examination) came into effect on 20th January 2020 allowing Forensic Pathologists to collect these samples without

obtaining consent from the NSW Coroner. Once a swab was collected, a recommendation was only made to the coroner after receipt of the results. The Coronial Direction decision is based on the guiding principle of the NSW Coroners Act to determine the cause of death in the least invasive manner. Where a deceased was believed to have died from COVID-19, no post-mortem examination was performed as the death was due to natural causes.

No post-mortem screening was available for regional cases not directly admitted to a forensic medicine facility. For these deaths, a decision regarding a potential natural cause of death (including COVID) was made based on available clinical information and information provided by NSW Police on the COVID risk assessment tool.

The Forensic Medicine approach to the management of deaths associated with COVID-19 was documented in a COVID-19 Post-mortem Procedure document providing clear guidelines to all teams. The procedure was continuously updated as the pandemic situation evolved, and immunizations were introduced. The COVID risk assessment tool is no longer used to assess risk at the death scene.

Western Australia (WA)

Similar to the Northern Territory, Western Australia (WA) was delayed in experiencing community spread of COVID-19 infection compared to other parts of Australia, due to firm border restrictions put in place by the State Government. However, community spread was unable to be contained in March of 2022. Following this, additional procedures were implemented, which had been prepared as part of Emergency COVID-19 planning.

For example, whilst in the mortuary, laboratory, and any shared workplace, masks were always worn, specifically surgical masks in office spaces and N95/P2 respirators in the mortuary setting. This was an ongoing procedure, whilst some other measures were stepped down in July and August of 2022.

There was a lag of several weeks between the initial community spread and the arrival of

COVID-19 positive cases at the State Mortuary. All cases were screened upon mortuary admission via throat and nasal swabs sent for PCR analysis. Some cases were precluded, i.e., severe traumatic head injury with marked anatomical disruption or advanced decomposition. Screening for COVID-19 infection on admission was first implemented in March 2020. If a case was identified as being COVID-19 positive, the laboratory notified the mortuary manager and duty pathologist in charge of allocating cases.

If deemed appropriate after evaluation of the case details, COVID-19 positive cases had an external examination to minimize exposure risk at the discretion of the pathologist and coroner. All staff involved in dealing with a COVID-19 positive case, even if just for external examination and sampling, donned PPE, which included a disposable gown, apron, at least two layers of surgical gloves, goggles, N95/P2 respirator, and a disposable face shield. After exposing the body, an N95/P2 respirator was placed over the mouth and nose of the body, and the body was sprayed down with disinfectant several minutes before handling the body. The respirator was briefly removed for examination of the mouth and nose and/or photography. At the end of the examination, the body bag was zipped shut and sprayed down again with disinfectant several minutes before returning the body to the fridge. All staff then appropriately doffed their PPE, as advised by the WHO, to avoid personal contamination. Use of hand sanitizer in between several steps of doffing PPE, particularly between removals of layers of gloves, was advised. COVID-19 positive cases which required full autopsy were performed in the infectious mortuary theatre to limit exposure. Where possible, procedures likely to create aerosols were avoided or kept to a minimum. Manual clippers were used for chest plate removal and an electric saw covered by a clear plastic bag was used for sawing of the head. If a post-mortem CT scan (PMCT) showed no cranial abnormality and there was no indication, internal examination of the head was not performed.

As part of public health tracking of COVID-19 spread, Forensic Pathologists were obligated to report positive cases using a WA Department of

Health Infectious and Related Diseases Notification Form sent via email to the relevant authorities. An in-house record of positive cases is kept via an electronic spreadsheet completed by the examining pathologist.

South Australia (SA)

In SA in late February 2020, as the potential risk from COVID-19 in Australia became clear, the State Coroner convened a meeting with SA Police, SA Health (communicable diseases control branch), and Pathology at Forensic Science SA (FSSA). It was agreed to initiate COVID-19 testing by PCR of a nasopharyngeal swab on every admission to the mortuary. This policy was continued until April 2022. FSSA did not identify a definite positive swab until early 2022. Turnaround time for PCR testing varied depending on demand overall within the State but was typically 24 hours. PPE for pre-autopsy testing was as per the SA Health guidelines for clinical sampling.

An additional form to be completed by SA Police (SAPOL) officers reporting deaths to the coroner was initiated to specifically capture information regarding symptoms, contacts, and travel history for additional risk assessment. This form was subsequently updated to include vaccination details.

FSSA uprated the minimum PPE requirements in the mortuary to P2/N95 mask, with most choosing to wear a P3 vented hood with an electrically driven air supply, in addition to the pre-existing PPE requirements. Disposable gowns were also available for positive or potentially positive cases. All positive cases were to be examined in the high-risk autopsy suite.

Masks, gowns, and hand sanitizer were made available in the admission/release bay for funeral directors. Hand sanitizers were made available within non-clinical areas.

No post-mortems were carried out until receipt of the nasopharyngeal swab results, except for suspicious cases that needed to be performed without delay. These were managed in the high-risk suite and assumed to be positive.

No viewings were permitted without the COVID-19 status being known.

No deceased person was released to a funeral director without the COVID-19 status being known. Before the pandemic, a service was offered in cases from rural and regional areas where the autopsy was performed within a day, allowing admission and release to the funeral director within the working day. This was ceased due to the requirement for a COVID-19 result to be known prior to the autopsy and release.

An in-house CT scanner was put out for tender, sourced, and installed/commissioned by July 2020. This had been planned pre-COVID-19. However, its rapid installation before the end of the financial year assisted with our response and created an additional element of pre-autopsy screening with the avoidance of internal examination when appropriate.

Pathologists and mortuary staff in SA did not automatically qualify for vaccinations as healthcare workers. Forensic Pathologists and mortuary staff in SA are employed by the Attorney General's Department and not SA Health. The employer had to specifically engage with SA Health so that at-risk staff could receive vaccines in group 1b along with healthcare workers.

Vaccinations were made mandatory for all staff by direction from the (Chief Executive Officer) CEO in November 2021 and for staff and visitors to FSSA on 15th December 2021 by Emergency Management Direction. This was modified in January 2022 to include the booster. This remained in place until late 2022.

It was not possible for the pathologists and technical staff to split into teams due to insufficient staff numbers to allow this. However, a rota was initiated where one pathologist was working from home or otherwise isolated from colleagues, to at least maintain the on-call service if there were an outbreak in the workplace requiring mandatory isolation.

Meetings were moved online or with restricted numbers, masks, and social distancing.

Rotation of Anatomical Pathology trainees from SA Pathology and medical student placements were postponed.

Positive cases were reported to the SA Health Communicable Diseases Control branch.

FSSA provided advice to the State Coroner in June 2021 regarding the management of suspected vaccination complications (based on THANZ clinical guidelines⁵).

Victoria

At the start of the pandemic, three goals were set: protection of the health of the staff, maintenance of essential services, and contribution to community efforts to slow the spread of COVID-19.

From the end of March 2020, most of the Victorian Institute of Forensic Medicine (VIFM) staff were working from home where possible. All staff on site were required to wear masks, and those staff working in the mortuary were equipped with full PPE. Group meetings and case discussions were held virtually.

During the first wave, COVID-19 testing was performed only on suggestive history, as testing capacity at the beginning of the pandemic was limited. During the Victorian second wave, nasopharyngeal swabs were performed on all cases on admission where possible. A COVID-19 screening working group was created to document and communicate results (including reporting to the Department of Health). Across the board screening was discontinued in November 2020, and between November 2020 and the 3rd wave, testing was performed only based on suggestive history, imaging, or autopsy findings.

During the delta-driven third wave, screening all VIFM admissions was re-instituted in August 2021 and subsequently de-escalated to a targeted screening approach in November 2021 as the incidence of COVID-19 in the community became very high (with increasing detection of asymptomatic and historic cases on testing). This approach remains in place.

On-site temporary body storage facilities were deployed at varying stages of the pandemic,

largely due to the cumulative delays in funerary processes. Vaccination against COVID-19 was made mandatory for all VIFM staff in accordance with the Victorian state government directives.

Autopsies on suspected and known COVID-19 positive decedents were performed at all stages throughout the pandemic, where it was deemed necessary for the determination of the cause or manner of death. During the second wave, with the family's consent, Victorian post-mortem tissue samples were used for an international study on the effects of SARS-CoV-2 on lung tissue. During the third wave, autopsy findings of home deaths due to COVID-19 were useful to reflect the management of COVID-19 outside the hospital setting. The correlation of post-mortem CT imaging findings with autopsy data informed a study of the utility of post-mortem CT imaging in suspected COVID-19 cases⁶. SARS-CoV-2 infection caused no impediment to autopsy examinations, and autopsies continued to be performed where there was a demonstrable need.

Tasmania

Tasmania had a unique geographical advantage during the pandemic as an island offshore to another island, compared to the mainland Australian States and Territories with their respective land borders. The rapidly evolving nature of the pandemic required continued vigilance and flexibility in the approach taken by the state.

In March 2020, State wide Forensic Medical Services (SFMS) had discussions with the Tasmania Magistrate's Court Coronial Division about mortuary procedures during the pandemic.

Deaths of individuals investigated, diagnosed, confirmed to have COVID-19, and treated and then dying in hospital from pneumonia/ complications were not reportable to the coroner. The manner and cause of death was known to be natural. A separate concern was raised regarding deaths in the community where reliable information was not available or revealed "*a recent flu-like illness*", a scenario encountered during every flu season. Suspicious cases of this type would ideally

undergo a PMCT with the body remaining in the sealed body bag, followed by acquiring a swab for respiratory virus testing, including COVID-19.

Closing of international and domestic interstate and territory borders initially reduced forensic case numbers. This allowed SFMS to adopt respiratory virus PCR screening for all cases reported to and as agreed by the coroner. The final decision about the scope (nature and degree) of external and internal post-mortem examination was deferred until screening results were available. SFMS accepted the *Advice for handling of anatomical specimens and Autopsy* published on the RCPA website in April 2020 and adopted, when applicable, guidelines for autopsy practice from the USA and UK.¹⁻³

SFMS obtained increased stocks of N95 masks and purchased advanced PPE masks with filters, hoods, and headgear.

When screening revealed relevant COVID-19 nucleic acids on PCR testing in the context of sudden natural death, a limited autopsy was performed for the purposes of issuing a report to the coroner to make findings for those purposes.

Where PCR testing detected COVID-19 nucleic acids in reportable cases where the circumstances of death were suspicious, traumatic, or otherwise unnatural, the proportionate extent of autopsy examination and use of appropriate PPE was determined accordingly.

This approach was complicated in the autumn of 2020 by an outbreak in the Northwest of the state linked to patients, who were previously passengers that had disembarked in Sydney from the Ruby Princess Cruise ship on which there had been an outbreak. The coroner regarded fatal cases linked to this outbreak as potentially reportable under the Coroners' Act 1995⁷. There was also initial concern at this early stage of the COVID-19 pandemic that a mass fatality situation would arise. In early 2020, permanent mortuary storage capacity was increased at the Royal Hobart Hospital. This capacity was further increased temporarily

with a rigid container facility. This additional refrigerated storage was consistent with the State mass fatality/ disaster plan. However, the Northwest Tasmania outbreak was limited, controlled, and investigated by the Public Health Service. Thereafter, case numbers were reduced to almost negligible numbers by December 2021.

The Northwest Tasmania outbreak investigation made recommendations, in support of actions already taken, to reduce or eliminate face-to-face meetings and replace them with online meetings. SFMS adopted an online platform for all forensic meetings with the police and case management reviews with the court and other agencies. Only the duty pathologist attended the mortuary. Microscopy was performed in separate offices within the department. Reports were completed online, working remotely if possible.

Case numbers suddenly increased when Tasmania reopened its borders in line with the mainland states and territories in December 2021. With increased numbers came increased requests from public health services to gather further information about the primary cause of death in reportable death cases in which pre-autopsy PCR screening had detected COVID-19 nuclei acids. COVID-19 is a notifiable disease, and a positive PCR test triggers obligations for the director of Public Health and public health services.

In 2021, the Federal Health Department's definition of COVID-19 related death (*COVID-19 death*) was adopted by the Public Health Service in Tasmania.

COVID-19 death

A COVID-19 death is defined for surveillance purposes as a death in a confirmed or probable COVID-19 case unless there is a clear alternative cause of death that cannot be related to COVID-19 (e.g., trauma). There should be no period of complete recovery from COVID-19 between illness and death. Where a Coroner's report is available, these findings are to be observed.

In 2020, a Public Health Emergency Operations Centre (PHEOC) was established. By December 2021, following the implementation of the

vaccination program, the incidence and prevalence of COVID-19 were such that PHEOC was not concerned with contact tracing. The emphasis was upon notifiable disease obligations, including implementation of isolation strategies for positive cases and advice to and support for those infected and their close contacts.

PHEOC was notified by SFMS whether there was a "clear alternative cause of death" without revealing further details, as preliminary findings and autopsy findings are non-disclosable without the coroner's consent. This helped to maintain the integrity of the ongoing death investigation while allowing PHEOC to identify cases where there was an alternative cause of death where COVID-19 infection was probably an incidental finding. When there was no obvious alternative cause of death, then public health measures could be taken with the inference that death was due to natural causes in the context of COVID-19 infection. Determination of whether COVID-19 infection was a primary cause of death, or a significant contributory condition remained pending the completion of ancillary forensic investigations, the coroner's findings, and final Death registration.

CONCLUDING REMARKS

The COVID-19 outbreak outlined the need for forensic pathology services to be responsive and adaptable when new diseases emerge to ensure that services can continue safely, whilst still meeting legal and public health obligations. Whilst each Australian jurisdiction had somewhat differed in its response to the COVID-19 pandemic, all the centers undertook routine COVID-19 testing, and full autopsies were performed only where necessary. Performing COVID-19 autopsies with proper PPE is safe and to date, there are no known cases of COVID-19 infection contracted from the mortuary.

Many Australian jurisdictions participated in research both locally and in collaboration with international groups to study the effects of COVID-19 on the human body using autopsy and imaging findings.

ACKNOWLEDGEMENTS

None.

CONFLICTS OF INTEREST

The authors declared no conflicts of interest.

DISCLOSURE

MT is a member of the Editorial Board of the Sri Lanka Journal of Forensic Medicine, Science & Law. Therefore, they did not participate in any way in the publication/decision-making process of this submission, as per journal policy.

ETHICAL ISSUES

None.

SOURCES OF SUPPORT

None.

AUTHOR CONTRIBUTIONS

SP: Collated comments into a first draft of the manuscript; provided edits and comments on manuscript drafts. **LI:** Data preparation and provision of edits and comments on manuscript drafts. **SW:** Data preparation and provision of edits and comments on manuscript drafts. **IB:** Data preparation and provision of edits and comments on manuscript drafts. **ASR:** Data preparation and provision of edits and comments on manuscript drafts. **NF:** Data preparation and provision of edits and comments on manuscript drafts. **VK:** Data preparation and provision of edits and comments on manuscript drafts. **MT:** Data preparation and provision of edits and comments on manuscript drafts; prepared final submission draft.

REFERENCES

1. RCPA Advice to Anatomical Pathology (AP) and Forensic Pathology (FP) Fellows and Trainees. 2020. Available at: https://www.rcpa.edu.au/Library/COVID-19-Updates/COVID-19-Useful-Resources/Docs/RCPA-advice-to-APs-and-FPs-COVID19_April2020 [Accessed: 12th September 2024].
2. The Royal College of Pathologists: Briefing on COVID-19 Autopsy practice relating to possible cases of COVID-19 (2019-nCov, novel coronavirus from China 2019/2020). Available at: <https://www.rcpath.org/static/d5e28baf-5789-4b0f-acecfe370eee6223/fe8fa85a-f004-4a0c-81ee4b2b9cd12cbf/Briefing-on-COVID-19-autopsy-Feb-2020.pdf> [Accessed 12th September 2024].
3. Occupational Safety and Health Administration. *COVID-19 - control and prevention*. Available at: <https://www.osha.gov/coronavirus/control-prevention#deathcare> [Accessed: 12th September 2024].
4. New South Wales Coroners Act 2009 no 41. Available at: <https://legislation.nsw.gov.au/view/pdf/asmade/act-2009-41> [Accessed 12th September 2024].
5. Australian Government Department of Health and Aged Care. *Joint statement from Atagi and Thanz on thrombosis with thrombocytopenia syndrome (TTS) and the use of COVID-19 vaccine AstraZeneca*. 2022. Available at: <https://www.health.gov.au/news/joint-statement-from-atagi-and-thanz-on-thrombosis-with-thrombocytopenia-syndrome-tts-and-the-use-of-covid-19-vaccine-astrazeneca> [Accessed 12th September 2024].
6. O'Donnell C, Iles L, Woodford N. Post-mortem CT lung findings at a medicolegal institute in SARS-CoV-2 RT-PCR positive cases with autopsy correlation. *Forensic Science, Medicine and Pathology*. 2021 Dec;17(4):611-620. <https://doi.org/10.1007/s12024-021-00389-7>.
7. Tasmanian Coroners Act 1995. Available at: <https://www.legislation.tas.gov.au/view/whole/html/inforce/current/act-1995-073> [Accessed 12th September 2024].