Impact of Post-mortem PCR Testing on Lead Time of the Medico-legal Death Investigation. A Retrospective Study During the COVID-19 Pandemic in a Tertiary Care Hospital in Sri Lanka.

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Abstract

Introduction: The lead time is defined as the time between the beginning of a process or project and the appearance of its results. A post-mortem nasopharyngeal swab is the preferred specimen and Real-time reverse transcriptase-polymerase chain reaction-based assays remain the "gold standard" for the detection of severe acute respiratory syndrome coronavirus 2. Although the RT-PCR provides a relatively rapid result (average 6 hours) the process of post-mortem specimen collection, transportation, and real-time polymerase chain reaction testing lead to the increased time duration of releasing the deceased to the next of kin. This study aims to assess the effectiveness of the institutional policies governing autopsies adopted during the COVID-19 pandemic at the medico-legal unit of Matale in decreasing the lead time of medico-legal death notification.

Methods: This study was conducted at the medico-legal unit of District General Hospital Matale, Sri Lanka. All data was collected from the post-mortem reports and records maintained at MLU of Matale from May 2021 to December 2021. All the post-mortems conducted by the author (442 autopsies) were included.

Results: The study population comprised of 283 (64%) males. The majority (30%, n=134) of the decedents were more than 80 years. The mean age of the deceased was 69.20 years and the standard deviation was 17.881. The majority (66%, n=291) of the descendants were Sinhala. The majority of inquests (n= 423, 96%) were conducted by inquire into deaths. In the months of August and October number of autopsies performed had increased 4 times and 3 times respectively to that of the same period in previous years and the following year. Out of the autopsies, 23% (n= 101) of the lead time of autopsy was on the same day of death. In the majority (64 %, 85) of the deaths lead time of autopsy was the next day of the death.

Conclusion: During the COVID-19 pandemic, excess mortality was detected, lead time of autopsy was reduced due to the policies adopted by the medico-legal unit. Lessons learned during the pandemic may help improve resource utilization without negatively influencing outcomes in a low-resource setting.

Keywords: Deaths during COVID-19, the lead time of autopsy, the lead time of PCR testing, excess mortality, institutional policies governing autopsies, post-mortem detection for SARS-CoV-2

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Introduction

The lead time is defined as the time between the beginning of a process or project and the appearance of its results.[1] The medico-legal units (MLU)of Sri Lanka perform autopsies every day of the year to release the deceased to next of kin to be taken for funeral arrangements. The autopsy process including gathering information, review of medical records of

the deceased, and physical examination of the body only takes a few hours to complete. Due to pressure from cultural practices generally, most autopsies are completed and released to funeral homes on the same day in Sri Lanka. After the autopsy provisional report is signed out and will not interfere with any potential funeral arrangements. However, there are times when the release of the deceased is delayed due to various reasons beyond the control of the forensic pathologist, such as delays in getting an order from the coroner or magistrate, lack of identification documents, scene of crime examination, etc.

During the novel coronavirus disease 2019 (COVID-19) pandemic in Sri Lanka post–mortem testing for diagnostic detection of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) caused challenges to the management of dead bodies in the MLUs. A post-mortem nasopharyngeal swab is the preferred specimen and Real-time reverse transcriptase-polymerase chain reaction (RT-PCR) based assays remain the "gold standard" for detection of SARS-CoV-2. [2] Additionally, post-mortem specimens from the nasopharynx had to be collected and post-mortem RT-PCR had to be performed. In the initial period of COVID-19 pandemic, the samples had to be transported to a few specialized centralised laboratories due to the unavailability of RT-PCR testing facilities in most of the peripheral hospitals of Sri Lanka. Although the RT-PCR provides a relatively rapid result (average 6 h) the process of post-mortem specimen collection, transportation, RT-PCR testing increased the lead time of autopsy compared to the usual practice of releasing the deceased to the next of kin on the same day.

Up to date, there is no published data on the lead time of autopsy during the COVID-19 pandemic. This study aims to assess the effectiveness of the institutional policies governing autopsies adopted during the COVID-19 pandemic at MLU of Matale in decreasing the lead time of medico-legal death notification.

The objectives of this research were to quantify the lead time of medico legal death investigation, to quantify the time duration to post-mortem nasopharyngeal specimen collection from the day of death, to quantify the lead time of RT-PCR testing from the day of death, to compare the lead time of medico-legal death investigation between deaths occurred at DGHM and Out of DGHM, to compare the lead time of medico-legal death investigation between deaths of the Matale police area and Out of the Matale police area, to compare the lead time of medico-legal death investigation between inquest conducted by the magistrate and ISD, to assess the effectiveness of the institutional policies governing autopsies adopted during the COVID-19 pandemic at MLU of Matale.

Methodology

This study was conducted at the medico-legal unit of District General Hospital Matale, Sri Lanka. All data was collected from the post-mortem reports and records maintained at MLU of Matale from May 2021 to December 2021. All the post-mortems conducted by the author (442 autopsies) were included. Matale district was selected in this study as the data collection was conducted by one of the authors who was a Forensic pathologist in this area during the study period. These time periods were chosen to reflect the impact of institutional policies governing autopsies at the peak of Covid-19 pandemic in the central part of the country. Specific data points were collected including age, gender, ethnicity, date of death, time of death, date of post-mortem nasopharyngeal specimen collection, date of issue of RT-PCR report, date of post-mortem, date of release of the body, and circumstance of death. Written approval for the study was also obtained by the head of the institution. The anonymity of the descendants was protected in this paper. Ethical approval was not needed as the secondary data were analysed in the study. Data were anonymized and irreversibly de-identified.

Reports of unclaimed bodies following autopsy were excluded from this study. Though assistance from trained doctor had been sought for collecting clinical and autopsy data, reconfirmation and interpretation of such details were done by the investigators themselves. Raw data collected on spreadsheets were shifted to an electronic format. Data were coded and entered in Microsoft Excel worksheets and analyzed by Statistical Package for Social Sciences (SPSS) version 21. Graphs and tables were used as appropriate to present the findings. The lead time of medico-legal death investigation and issue of report of testing of RT-PCR was calculated in days from the date of death. The date is defined as changing at midnight. The time duration, categorical variables were presented as percentages and numbers. Continuous data were presented as means and standard deviations. A P value of < 0.05 was considered as statistically significant.

Results

Sociodemographic data for 442 deaths were analysed. The study population comprised of 283 (64%) males and the remaining 36% females (n=159). The majority (30%, n=134) of the decedents were more than 80 years. The mean age of

the deceased was 69.20 years and the standard deviation was 17.881. The majority (66% , n=291) of the descendants were Sinhala. The majority of inquests (n= 423, 96%) were conducted by ISD.

Table 1. Distribution of details of autopsies

Details of autopsy	Variables	Total N = 442 n (%)
Gender	Male	238 (64)
	Female	159 (36)
Age group	Less than 40	34 (08)
	41-50	27 (06)
	51-60	51 (12)
	61-70	92 (21)
	71-80	104 (23)
	Above 80	134 (30)
Ethnicity	Sinhala	291 (66)
	Tamil	101 (23)
	Muslim	50 (11)
Inquest	ISD	423 (96)
	Magistrate	19 (04)
Police area	Matale	224 (51)
	Out of Matale	218 (49)
Place of death	DGH Matale	142 (32)
	Out of DGHM	295 (67)
	System missing	05 (01)
Result of RT-PCR test	Positive	146 (33)
	Negative	268 (61)
	System missing	28 (06)
Circumstance of death	Natural	333 (87)
	Accident	19 (04)
	Suicide	28 (06)
	Homicide	03 (01)
	Unascertained	59 (13)

The number of autopsies performed in MLU of Matale increased during the peak of COVID-19 in 2021. In the months of August and October number of autopsies performed had increased 4 times and 3 times respectively to that of the same period in previous years and the following year. (Figure 1)

Figure 1. Number of autopsies done during each month of 2019,2020,2021,2022 in the medico-legal unit

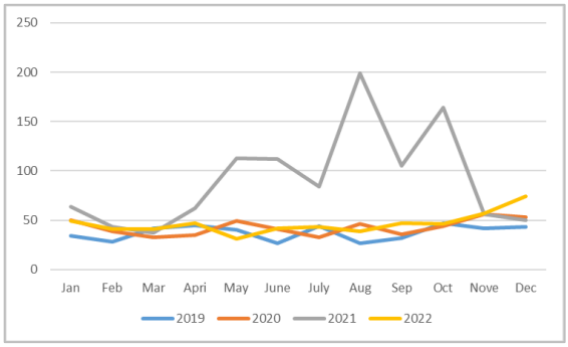

Table 2. Distribution of lead time of RT-PCR testing and lead time of autopsy according to place, time of death, police area, who conducted the inquest

Variables	Same day	Next day	Next 2 days	Next 3 days	System missing	Total N =442 n (%)
PM specimen collection	258 (58)	90 (20)	03 (01)	00 (00)	91 (21)	442 (100)
Lead time of RT-PCR testing	153 (35)	173 (39)	05 (01)	00 (00)	111 (25)	442 (100)
Lead time of autopsy	101 (23)	285 (64)	48 (11)	03 (01)	05 (01)	442 (100)
Time of death						
8.01 am - 4pm	29 (19)	106 (71)	16 (11)	00 (00)	05 (01)	151 (34)
4.01pm - 00.am	11 (07)	118 (77)	22 (14)	02 (01)		153 (35)
00.01am - 8 am	61 (46)	61 (46)	10 (08)	01 (01)		133 (30)
Place of death						
DGHM	46 (32)	83 (58)	12 (09)	01 (01)	05 (01)	142 (32)
Out of DGHM	55 (19)	202 (68)	36 (12)	02 (01)		295 (67)
Inquest						
ISD	98 (23)	279 (67)	41 (10)	01 (00)	04 (01)	419 (95)
Magistrate	03 (15)	06 (32)	08 (42)	02 (11)		19 (04)
Police area						
Matale	68 (30)	126 (57)	26 (12)	01 (01)	05 (01)	221 (50)
Out of Matale	33 (15)	159 (74)	22 (10)	02 (01)		216 (49)

PM = Post-mortem, DGHM = District General Hospital Matale, ISD = inquire in to death.

The majority of post-mortem nasopharyngeal specimens for SARS-CoV-2 detection were obtained on the day of death (58%, 258). The majority of lead time RT-PCR tests were conducted the day after the individual's death (39%). The majority of lead time RT-PCR tests were conducted the day after the individual's death (39%). Out of 152 deaths that occurred between 4 pm and midnight, the autopsy was performed on the same day of the death in 29 cases. Similarly, out of 133 deaths that occurred between midnight and 8 am, the autopsy was performed on the same day of the death in 61 cases. It was determined that there is a relationship between the time of death and the lead time of autopsy, as indicated by a chi-squared value of 64.093 with 6 degrees of freedom and a p-value of 0.000. Out of 142 deaths that occurred at DGHM, the lead time was the same day as the death in 46 cases. Similarly, out of 295 deaths that occurred outside DGHM, the lead time was the same day as the death in 55 cases.

The relationship between the place of death and the timing of the autopsy on the first day was established (Chi-squared = 10.549, df = 3, p-value = 0.014). ISD conducted 419 inquests, with the lead time of the next two days in 41 cases. Out of the 19 inquests conducted by the magistrate, lead time was within two days of death in 8 cases. The relationship between the lead time for autopsy and the inquest conducted by the ISD and magistrate has been established (Chi-squared = 46.291, df = 3, p-value = 0.000).

Discussion

Excess mortality, defined as the increase of the all-cause mortality over the mortality expected based on historic trends, has long been used to estimate the death toll of pandemics.[3] In several worst-affected countries like Peru, Ecuador, Bolivia, and Mexico the excess mortality was above 50% of the expected annual mortality expected during the pandemic.[3] In contrast, Comparatively low excess mortality rates were seen in East Asia, Australia, and high-income Asia Pacific presumably due to social distancing measures decreasing the non-COVID infectious mortality.[4]

Sri Lanka became the country with the fourth-largest number of daily deaths in the world by population just behind Georgia, Tunisia, and Malaysia.[5]

With regard to the findings of the study, the number of medico-legal autopsies increased substantially during the COVID-19 pandemic to that of the same period in previous years of 2020, 2019 and the following year of 2022.

Mandatory post-mortem testing for SARS-COV2 during the community spread and temporary halting the death certification on home death by medical officers and Grama Niladhari caused an increased number of dead bodies to the MLU. The excess mortality is not only due to the confirmed COVID-19 deaths, but also COVID-19 deaths that were not correctly diagnosed and reported as well as deaths from other causes that are attributable to the overall crisis conditions.[6] Moreover, high fatality due to the delta variant, weakened healthcare systems, fewer people seeking treatment for other health risks, and less available funding and treatment for other diseases could have caused an increased number of deaths compared with the previous years.

The excess mortality challenged on storage of dead bodies in MLUs throughout the world. The resource limitations and increased demand for morgue storage space due to COVID-19 presented a unique opportunity to assess how institutional policies on the management of death shorten the lead time of autopsy.

In our study post-mortem specimen collection for detection of SARS COV2 were obtained in 58% for RT-PCR testing on the same day. The post-mortem specimens were collected by the forensic pathologist or the Medical Officer-Medico-Legal. Even with increased workload institutional policies assisted in reducing the lead time of specimen collection PCR testing.

Even with overwhelmed transport facilities, transportation was arranged by the hospital as the centralised laboratory was at the distance from the MLU.

In 35% of deaths lead time of PCR testing was the same day of the date of death. Although being a developing country the Ministry of Health, Sri Lanka expand the COVID-19 surveillance system. With the strengthening of IT and communication facilities in the reports were received via email which reduced the lead time of RT-PCR testing.

The Global Response to Infectious Diseases [GRID] index was introduced based on a research study commissioned by the Institute of Certified Management Accountants, Australia.[7] The index was created to rank countries across the globe taking into account the effectiveness and efficiency of leadership and preparedness of health systems in each country in managing the COVID-19 pandemic. [7] In April 2020 Sri Lanka ranked 10th in the GRID index thus, achieving global recognition for its response to the pandemic.[7]

Usually in Sri Lanka when a death in which medico-legal autopsy is indicated, occurs during the office hours of the MLU the body is released to the next of kin after autopsy on the same day.

However, with the COVID-19 pandemic, the autopsies were done after post-mortem RT-PCR testing. This additional procedure increased the lead time of the autopsy.

However due to institutional policies on autopsy 23% of cases, the lead time of autopsy was on the same day of the day of death. Also out of deaths that occurred between 4 pm to midnight 77% of cases the lead time was the next day from the death. Even during the non-covid time, deaths occurred outside the working hours of MLU, autopsy is done on the following day.

Many institutional policies were implemented to reduce the lead time such as the extension of the post mortem time, increasing the staff members with training, the addition of new shifts of duty, etc. The contributions of the next of kin, public health inspector, medical officer of health in the preventive sector, funeral homes, investigating police, and ISD also contribute to reducing the time taken to transport the deceased to the MLU from the place of death.

Our data demonstrate a statistically significant increase in lead time of autopsy on deaths occurred outside DGHM compared to DGHM deaths.

Moreover, data demonstrate that deaths that occurred at the Matale police area during the pandemic had a significantly shorter lead time of autopsy compared with deaths that occurred to the rest. As the MLU is also situated in the city of Matale deaths that occurred in the Matale police area is closer compared to the rest. The MLU is also situated in the DGHM. These could have been due to factors related handling and transporting of dead bodies to the morgue.

Although there is no evidence so far of transmission of SARS-CoV-2 through the handling of bodies of deceased persons, the handlers of dead bodies are likely at higher risk of infection compared to the general population because of the occupational exposure to infectious droplets and other potentially infectious materials.[8] In the initial part of the COVID-19 pandemic, there were issues related to the personal safety of undertakers, lack of public transport facilities, lack of personal protective equipment, lack of vaccination of undertakers, ISD, the police officers involved in death investigation, may have caused hesitancy of them owing to the fear of acquiring infection leading delays in transposition of deceased to the morgue.

Moreover, there was a statistically significant increased lead time of autopsy in inquest conducted by magistrate compared to the ISD. The magistrate conducts inquests on homicides, deaths in custody, and suspicious deaths. In this mandatory scene examination is needed with the involvement of scene of crime officers compared with the inquest conducted by the ISD. The magistrates have to complete the cases in the magistrate's court before the inquest procedure.

Limitations

This study is not without limitations. This was a retrospective observational study based on a single MLU and data of the autopsies done by the specialist in Forensic Medicine. Additionally, the experience, many factors of the other medical officer medico-legal may have led to a variation of the timing of the autopsy, which may have contributed to selection bias.

We only considered lead time in days from the day of death and did not measure duration in hours due to the non-availability of such data and we still found a considerable decrease in lead time in days.

Other variables that were not considered in this study that may have an impact on the lead time of autopsy include whether the autopsy was a complete autopsy or selected autopsy with external examination.

Further exploration of the reasons for increased lead time with the place of death may also be of interest for future investigation.

Conclusions

During the COVID-19 pandemic, excess mortality was detected, lead time of autopsy was deceased due to the policies adopted by the MLU. Lessons learned during the pandemic may help improve resource utilization without negatively influencing outcomes in a low-resource setting.

Disclosure statement

Conflicts of Interest: The author(s) declared no potential conflicts of interest concerning the research, authorship, and publication of this article.

Ethics statement

Ethical approval was not obtained as secondary data were analyzed in this study. Data were anonymized and irreversibly de-identified.

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