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Original Research Article

Death certification errors in medical certificates of cause of death related to COVID-19 disease

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ABSTRACT

Background: In the case of public health emergency scenarios, mortality surveillance done by analyzing medical certificates of cause of death (MCCDs) provides accurate morbidity and mortality data. Precise death certification in the novel coronavirus disease 2019 deaths is critical to understanding the magnitude and advancement of the pandemic. Inaccurate death certificates may cause underreporting or overwhelming reporting of COVID-19 deaths.
Methods: The aim of the study was to analyse the MCCDs issued by the institute where the cause of death was attributed to or associated with the COVID-19 infection for certification errors. 729 MCCDs issued in COVID-19 deaths were audited primarily for their formal correctness and completeness and errors, using categories previously reported with some minor modifications. The study did not include analyzing the medical and hospital records of the deceased for the factual correctness of these MCCDs.
Results: All types of major and minor certification errors were observed. Incomplete MCCDs were observed in 697 (95.61%) cases. 691 MCCDs (94.8%) were having either major or minor or both types of errors. Abbreviations were used in the MCCDs in 65.29% of cases while improper sequencing of the causes of death was observed in 52.92% of cases. Wrong terminologies like "COVID", "COVID pneumonia", "COVID +ve", and "coronavirus" were used instead of the standard terminology.
Conclusions: The lack of completeness and accuracy in writing the causes of death related to COVID-19 indicates a problem faced by the certifying doctors in analyzing them, especially in the early days of the pandemic. Both major and minor errors were identified in this study.

Keywords: Death certificates, Errors, Incompleteness, COVID-19

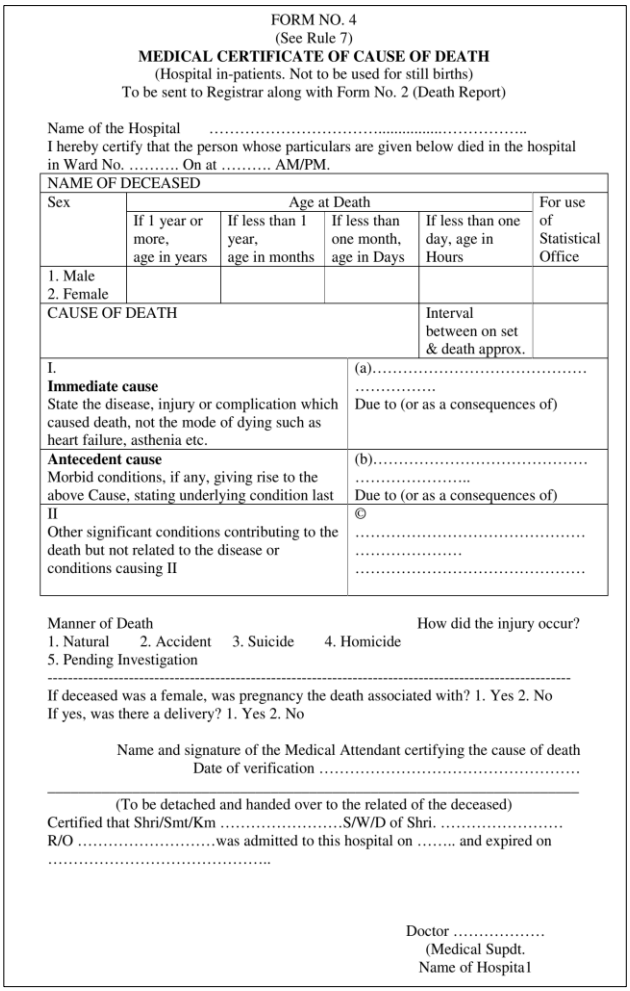
INTRODUCTION

In the case of public health emergency scenarios mortality data retrieved from medical certificates of cause of death (MCCDs) commonly called death certificates (DCs) provide crucial information about the population-level disease prevalence and its progression in the community. Mortality surveillance done by analysing these certificates provides accurate morbidity and mortality data which helps in the development of public health interventions and assessment of their impact.[1-3]

The novel coronavirus was first reported in the city of Wuhan, China in the month of December 2019 and with its further worldwide spread, the World Health Organization (WHO) declared Coronavirus Disease 2019 (COVID-19) a global pandemic on 11 March 2020.[4,5] As of 01 January 2022 and prior to the surge of COVID-19 infection by Omicron variant, India has reported over 35 million cases of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[6] The official cumulative COVID death count of 0.48 million implies a death rate of 345 per million population.[7] The total COVID-19 deaths in India is widely believed to be underreported because of incomplete certification of COVID 19 deaths, and most deaths occur in rural areas and often without medical attention.[8,9] It is estimated by the United Nations Population Division (UNDP) in 2020 that of about India's 10 million deaths,

over 3 million were not registered and over 8 million did not undergo medical certification.[10]

With the advent of COVID-19 disease, guidance for certifying deaths due to this disease and the importance of proper death certification has been highlighted in many studies and by the WHO and the Centre for Disease Control (CDC).[1,11,12] The new ICD-10 codes for COVID-19 are U07.1 COVID-19 if the virus was identified and U07.2 COVID-19 if the virus was not identified, chiefly when it was suspected or probably caused by COVID-19 infection.[13] In India, the Indian Council of Medical Research (ICMR) and the National Centre for Disease Informatics and Research (NCDIR) issued guidelines for the appropriate recording of COVID-19-related deaths in India. These guidelines were primarily based on the WHO COVID-19 coding in ICD-10.[14]



FORM NO. 4
(See Rule 7)
MEDICAL CERTIFICATE OF CAUSE OF DEATH
(Hospital in-patients. Not to be used for still births)
To be sent to Registrar along with Form No. 2 (Death Report)

Name of the Hospital ……
I hereby certify that the person whose particulars are given below died in the hospital in Ward No. ……. On at ……. AM/PM.

NAME OF DECEASED					
Sex	Age at Death				For use of Statistical Office
	If 1 year or more, age in years	If less than 1 year, age in months	If less than one month, age in Days	If less than one day, age in Hours	
1. Male 2. Female					
CAUSE OF DEATH				Interval between on set & death approx.	
I. **Immediate cause** State the disease, injury or complication which caused death, not the mode of dying such as heart failure, asthenia etc.	(a)…… Due to (or as a consequences of)				
Antecedent cause Morbid conditions, if any, giving rise to the above Cause, stating underlying condition last	(b)…… Due to (or as a consequences of)				
II Other significant conditions contributing to the death but not related to the disease or conditions causing II	© ……				

Manner of Death
1. Natural 2. Accident 3. Suicide 4. Homicide
5. Pending Investigation

How did the injury occur?

If deceased was a female, was pregnancy the death associated with? 1. Yes 2. No
If yes, was there a delivery? 1. Yes 2. No

Name and signature of the Medical Attendant certifying the cause of death
Date of verification ……

(To be detached and handed over to the related of the deceased)
Certified that Shri/Smt/Km ……S/W/D of Shri. ……
R/O ……was admitted to this hospital on …….. and expired on ……..

Doctor ……
(Medical Supdt.
Name of Hospita1

Figure 1: Sample of MCCD (Form no. 4) used in India.

The common cause of death certificate format used in India is based on the recommendation of the WHO and the correct method of filling has been extensively mentioned in studies and in national/international guidelines (Figure 1).[15-17] As per these guidelines, the condition recorded on the lowest line of part I is mentioned as the underlying cause of death and used for statistical analysis of mortality by ICD-10. In the case of COVID-19 deaths, the term COVID-19 has been allowed to be used officially by WHO and the use of other terms is not recommended. In cases where COVID-19 is the underlying cause of death (confirmed/suspected/probable) the code for the same should be used in the last line of part I. While, in the cases where the underlying cause of death is other than the COVID-19 but is associated with COVID-19, then the COVID-19 must be mentioned in part II.[18]

Existing literature search on the quality of death certificates in non-COVID-19 deaths has demonstrated a high proportion of errors sufficiently enough to affect the accuracy and identification of the underlying cause of death including mortality statistics.[19-21] The primary objective of this study was to identify and categorize the errors reported on the death certificates (MCCDs) of COVID-19 deaths issued at our institute. The study also explored the extent of these errors along with the degree of completeness of information mentioned in these death certificates.

METHODS

This cross-sectional record-based study was conducted at All India Institute of Medical Sciences, Patna during the period from 01 April 2020 to 31 March 2021. The MCCDs issued by the Institute during this period where the cause of death was attributed to or associated with the COVID-19 infection were analyzed for certification errors. Other death certificates issued in non-COVID-19 infection including brought dead, and perinatal deaths were excluded from the study.

A total of 729 MCCDs were selected as per the inclusion criteria and were audited primarily for their formal correctness, completeness and errors, using categories previously reported with some minor modifications (Tables 1 and 2). The study did not include analyzing the medical and hospital records of the deceased patients for the factual correctness of their MCCDs. Errors that could affect the accurate coding of the underlying cause of death were considered major while errors that were less likely to lead to miss-classification of the underlying cause of death were considered minor. The MCCDs were also analyzed for completeness of information related to the age, sex, and status of pregnancy/delivery in the case of females, mentioning of registration number, seal and signature of the physician issuing the certificate.

The data was recorded on a data capture sheet and then entered in Microsoft excel. The data was then imported to the statistical package for social sciences 21.0 version (SPSS 21.0) software developed by IBM corporation for analysis.

This study was approved by the institutional research committee (IRC approval letter no. AIIMS/Pat/IRC/2020/587).

Table 1: List of criteria for incompleteness.

S. no.	List of criterions
1	Hospital name
2	Ward name
3	Date and time of death
4	Deceased details
	a) Name
	b) Age
	c) Sex
5	Part I
6	Manner of death
7	Status of pregnancy and delivery (if applicable)
8	Certifying authority
	a) Name
	b) Designation
	c) Seal of certifying doctor
9	Date of certification
10	Not mentioning the time interval between death and the morbid conditions

Table 2: List of variables as major and minor errors.

S. no.	List of variables	
	Major errors	**Minor errors**
1	Unacceptable cause of death	Not mentioning the time interval between death and the morbid condition for all lines in part I
2	Unacceptable order of causes	Not mentioning the age in proper column, provided for different age groups
3	Competing cause of death	Using 'with' instead of 'due to'
4	More than one cause in any line of part I	Illegible handwriting
5	Mechanism of death not followed by a proper cause of death	
6	Using abbreviations	
7	Others	

RESULTS

The mean age of the deceased patients was 60.37 years while the minimum and maximum ages were 11 and 91 years respectively. The age group of more than 60 years had the maximum mortality with 358 (49.1%) cases, while the age group 11-20 years had minimum mortality (1% cases) (Table 3). The incidence of the male gender was the highest (75.30%) as compared to females (18.24%) while the gender was not mentioned in 47 MCCDs (6.44%).

Incomplete MCCDs were observed in 697 (95.61%) cases and in 32 cases (4.38%) the MCCDs were complete with the requisite information. In regard to the incompleteness of MCCDs, in 656 cases (89.98%) the time interval between the death and the morbid condition was not mentioned (Table 4). The name, age and sex of the deceased was not mentioned in 64 (8.77%), 50 (6.85%) and 47 (6.44%) MCCDs respectively. Of the 729 death certificates examined, 38 MCCDs (5.2%) were without any error and 691 (94.8%) were having either major or minor or both types of errors. Certificates with at least one major error were observed in 642 MCCDs (88.06%) and 671 (92.04%) had at least one minor error.

Table 3: Age distribution.

Age categories (years)	Frequency	Percentage
11-20	7	1.0
21-30	15	2.1
31-40	34	4.7
41-50	90	12.3
51-60	167	22.9
>60	358	49.1
No mention of age	58	8.0
Total	729	100.0

Table 4: Frequency of MCCDs with different categories of incompleteness.

Variables	Frequency	Percentage
No mention of the hospital name	0	00
Admitted ward not mentioned	3	0.41
Not mentioning date and time of death	37	5.07
Not mentioning of the deceased details		
Name	64	8.77
Age	58	7.95
Sex	47	6.44
No information on part I	1	0.13
Not mentioning the manner of death	29	3.97
No mention of the status of pregnancy and delivery (wherever applicable)	3	0.41
Absence of details of certifying physician		
Name	129	17.69
Designation	643	88.20
Seal of certifying doctor	689	94.51
Date of certification not mentioned	62	8.50
Not mentioning the time interval between death and the morbid conditions	656	89.98

The frequency distribution of major errors revealed that 476 (65.29%) MCCDs abbreviations were used in part I and part II of the certificate (Table 5). In 471 MCCDs i.e., 64.60% cases, competing causes of death were mentioned in part I and in 390 (53.49%) MCCDs more than one cause was mentioned on the single line of part I. In 386 (52.92%) MCCDs the cause of death was mentioned in improper sequences. 134 MCCDs (18.38%) were having an unacceptable cause of death and 17.96% were having other major errors like the use of the wrong terminology for the disease.

Table 5: Frequency distribution of different categories of major errors in MCCDs.

Variables	Frequency	Percentage
Unacceptable cause of death	134	18.38
Unacceptable order of causes	386	52.92
Competing cause of death	471	64.60
More than one cause in any line of part I	390	53.49
Mechanism of death not followed by a proper cause of death	141	19.34
Using abbreviations	476	65.29
Others	131	17.96

The frequency distribution of minor errors revealed that in 656 (89.98%) MCCDs the time interval between death and the morbid condition was not mentioned (Table 6). In 195 cases (26.74%) instead of 'due to' it was mentioned as 'with' or used of some 'symbols like +, or +ve were used. 193 (26.47%) MCCDs had illegible handwriting while in 149 cases (20.43%) the age was not mentioned in the proper column.

Some of the common errors identified in these MCCDs are as follows.

Abbreviations were used in part I or part II of the MCCD instead of correct terminology of the disease e.g., the abbreviation 'DM' was mentioned instead of diabetes mellitus, 'HTN' instead of hypertension, 'CAD' instead of coronary artery disease, 'ARDS' instead of acute respiratory distress.

More than one condition/disease was mentioned on the single line of part I (for example mentioning septicemia with pneumonia, and septicemia with ARDS for deaths due to complications of COVID-19 disease).

Table 6: Frequency distribution of different categories of minor errors in MCCDs.

Variables	Frequency	Percentage
Not mentioning the time interval between death and the morbid condition for all lines in part I	656	89.98
Not mentioning the age in proper column, provided for different age groups	149	20.43
Using 'with' instead of 'due to'	195	26.74
Illegible handwriting	193	26.47

The sequence of the causes of death was incorrect (for example mention of COVID-19 on line (a) of part I followed by septicemia or ARDS on line (b).

Unacceptable underlying cause of death (UCOD) is mentioned in the last line (c or d) of part I. For example, instead of mentioning UCOD as COVID-19, it was stated as a multiorgan dysfunctional syndrome (MODS), or cardiorespiratory failure, or fracture of the femur.

Use of wrong terminology for describing COVID-19 disease like COVID, COVID pneumonia, COVID +ve, and coronavirus. Also, Use of sign language like '+' for COVID-19 positive, or 'c' for with.

DISCUSSION

The results of earlier studies done on non-COVID-19 death certification errors were compared with our results (Table 7). The age distribution appears to be skewed to the right in our study, where maximum mortality due to COVID-19 was seen in the elderly age group of more than 60 years (49.1%). This distribution is consistent with other studies which revealed that advanced age is a significant risk factor for death and is true for novel coronavirus disease.[22-24]

Table 7: Result of studies with the frequency of most common major and minor common errors in MCCDs.

Study	Major error N (%)	Most common type of major error	Study	Minor error N (%)	Most common type of minor error
Sehdev et al[2]	-	"Mechanism" as the immediate cause of death (34%)			
Nojilana et al[19]	(32.2)	Serious major error: No acceptable underlying COD (n=170, 17.3%); other	Nojilana et al[19]	967 (98.4)	Absence of time interval (n=967, 98.4%)

Continued.

Study	Major error N (%)	Most common type of major error	Study	Minor error N (%)	Most common type of minor error
		major error: improper sequencing (n=236, 24.0%)			
Patel et al[30]	23 (57.5)	Improper sequencing (55%)	Patel et al[30]	-	Time interval (92.5%)
Myers et al[29]	48 (32.9)	Mechanism listed as the underlying cause of death (n=23, 15.8%) and Improper sequencing (n=23, 15.8%)	Myers et al[29]	123 (84.2)	No time interval (n=101, 69.2%)
Haque et al[25]	-	Grade V error (underlying cause of death was incorrectly attributed or placed in an improper sequence, n=176, 87%)			

The percentage of complete and error-free MCCDs was low (2.6%) and almost matched with Haque et al and Ganasava et al who observed it in 1% and 1.1% of death certificates respectively.[25,26] In this study, abbreviations were used in writing the part I and part II of the MCCDs by the certifying physicians in 65.29% of cases, which was also reported from studies done in Bangladesh and India.[27,28] It is a standard practice that abbreviations should be avoided in the death certificates and complete and correct terminology for the disease should be mentioned.

A common error usually observed in death certification is improper sequencing of the causes of death mentioned in part I of the MCCD where the causes are not chronologically provided in logical sequences with the immediate cause mentioned on line I (a) and the underlying cause of death mentioned on the last line of part I. It is a common observation and is found in 15% to 87% of death certificates.[27,29,30] However, in our study improper sequencing was observed in 52.92% of cases. The casual sequences reported in part I should be logical in terms of time and pathology.[1] For, example, in our study, it was reported that COVID-19 infection occurred due to septicaemia or adult respiratory distress syndrome (ARDS) in part I, which is an illogical sequence as septicaemia or ARDS will not cause the infection. In fact, COVID-19 should be reported as UCOD in line (b) the last line of part I and septicaemia or ARDS should be reported in line (a). It is possible that such sequencing errors in COVID-19 deaths may be due to the emergence of this new disease where much is still unknown about the disease pathophysiology and its progression thereby creating differences in the medical opinion concerning the sequence of causes of death.

An unacceptable cause of death is a major error found in improperly filled MCCDs and is mostly attributed to not mentioning the primary disease (as UCOD) which was responsible for starting subsequent disease conditions as the immediate, and antecedent cause of death in part I of the death certificate. Such errors were seen in 18.38% of MCCDs in our study which was much less in comparison to another study which reported it in 37.76% of cases.[31] A similar finding was noted in the Indonesian study on the quality of COVID-19 death certificates.[22]

In the present study wrong terminology like “COVID”, “COVID pneumonia”, “COVID +ve”, and “coronavirus” were used instead of COVID-19 and novel coronavirus disease. It has been made clear by COVID-19 guidelines for death certification and coding that only COVID-19 is an official terminology to be used for all certification of this cause of death.[13,14] The lack of an accurate description of underlying medical illness and contributory conditions responsible for death due to COVID-19 disease would seriously jeopardize classifying them to COVID-19 deaths and this would not aid in understanding the pandemic.[11] Mentioning more than one cause on a single line of part I of MCCD was found to be present in 53.49% of cases. Hazard et al reported a similar major error in their qualitative analysis of medical death certification of cause of death in 41.5% of cases.[27]

Many medical data elements were not filled in or filled inaccurately/incompletely in the studied death certificates. All types of minor errors were identified in this study. Our high frequency of minor errors is largely accounted for by not mentioning the time interval between death and morbid conditions in 89.98% of cases. This finding is regrettable as determining the period interval from the occurrence of illness to death can help identify the causes of death and sort them into the correct sequence of the underlying, intermediate and direct causes of death. Meilial et al reported that in most COVID-19 death certificates, the time interval was not filled.[22] Not mentioning the time interval is a common error made by certifying physicians and has been reported in a frequency ranging from 69.2% to almost 98.9% of cases in death certificates issued in non-COVID-19 deaths.[19,20,25,29] Illegible handwriting, classified as a minor error, was found in 26.47% of death certificates, however, Burger et al reported it in 2.5% of cases.[20] Though illegible handwriting in the death certificate does not affect the accurate coding of the cause of death it affects the quality of the death certificate and is most likely to be misinterpreted.

CONCLUSION

The implication of inaccurate death certificates is widespread ensuing in underreporting or overwhelming reporting of COVID-19 deaths. The lack of completeness

and accuracy in filling in the elements of the cause of death indicates a problem faced by the certifying doctors in analysing the causes of death, especially in the early days of the pandemic as death due to and death with COVID-19 were considered as synonymous. However, errors identified in this study like not mentioning time intervals, use of the wrong terminology, illegible handwriting etc. should be avoided in the MCCDs. Lack of training, absence of wide circulation of guidelines and dissemination of information about writing COVID-19 as a cause of death in MCCDs may have caused inconsistencies in the writing out of such death certificates. The authors emphasize that the physicians should be trained in the accurate and correct writing of the medical certificate of cause of death to improve the system of recording causes of death in COVID-19 and also in non-COVID-19 deaths.

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