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Analysis of Errors on Death Certificate for Trauma Related Death

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Purpose: This study was to investigate errors of death certificate (DC) issued for patients with trauma.
Methods: A retrospective review for DC issued after death related to trauma at a training hospital trauma center was conducted. Errors on DC were classified into major and minor errors depending on their influence on the process of selecting the cause of death (COD). All errors were compared depending on the place of issue of DC, medical doctors who wrote the DC, and the number of lines filled up for COD of DC.
Results: Of a total 140 DCs, average numbers of major and minor errors per DC were 0.8 and 3.7, respectively. There were a total of 2.8 errors for DCs issued at the emergency department (ED) and 5.4 errors for DCs issued beyond ED. The most common major error was more than one COD on a single line for DCs issued at the ED and incompatible casual relation between CODs for DCs issued beyond ED. The number of major errors was 0.5 for emergency physician and 0.8 for trauma surgeon and neurosurgeon. Total errors by the number of lines filled up for COD were the smallest (3.1) for two lines and the largest (6.0) for four lines.
Conclusions: Numbers of total errors and major errors on DCs related to trauma only were 4 and 0.8, respectively. As more CODs were written, more errors were found.

Keywords: Death certificates; Cause of death; Emergency department; Trauma

INTRODUCTION

The main function of a death certificate (DC) is to prove an individual's death. It provides the cause of death (COD) and serves as evidence when facing legal problems for one person's death [1]. In addition, if medical doctors write the DC as professionals who treat the patient, a well written DC would be the best consideration for the

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patient and the bereaved family. The DC of farmer Baek Nam-Gi who died in September 2016 after being water cannon shot by police during a protest in November 2015 has become a hot topic in South Korea. The manner of death for that DC was changed from disease related death to trauma related death after much social debate. The importance of DC has been highlighted once again [2].

Previous studies have determined general characteristics of errors of DCs and the effectiveness of education in reducing errors [1,3-12]. However, no study has reported errors of DC related to trauma only. Thus, the objective of this study was to investigate errors of DC issued for patients with trauma.

METHODS

Data of DC issued after death related to trauma at a training hospital designated as the regional trauma center from September 2015 located in a southeastern coast area of South Korea were analyzed retrospectively from September 2015 to August 2017. This study was approved by the relevant Institutional Review Board.

There has been no specific educational program for how to write DC in South Korea. It is possible for several CODs for one situation in the DC and even the some CODs are vaguely documented in the DC guidelines. Therefore, the knowledge and experience for the DC are important to judge the error of that. Two emergency physicians who have been well aware of guideline for DC of World Health Organization, Korea Medical Association and had experience in research on DC, judged errors of DC [7]. Also, they knew well about statistical production process associated with DC in Statistics Korea and participated in workshop for DC organized by the Statistics Korea. Although the emergency physicians did not well know the details of the surgical findings, however there was no problem to judge the error of the DC since it is critical to determine whether the surgical findings depending on the medical records were recorded appropriately in the DC. Each emergency physician judged errors of DCs respectively by referring to DC and medical records. If they had different opinions in determining errors, final errors were determined based on discussion and consensus. If it was hard to determine whether the manner of death was due to external cause or natural death based on their medical record, the case was excluded from this study. Evaluation for errors of DC was based on guidelines of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) [13,14]. Using the form of DC commonly used in South Korea (Fig. 1), assessment of errors was divided into three parts. Part I evaluated COD and the manner of death. Part II evaluated the time interval from onset to event or death, other significant conditions not associated with the COD, major findings of surgery, and date of surgery. Part III evaluated type of accident, intention, time of accident, and place of accident (Table 1).

Definition of errors

Errors on DC were classified into major and minor errors depending on their influence on the process of selecting the COD [6,8,10,11,15]. Major errors were those related to Part I of the DC: 1) mode of dying as the underlying COD (UCOD) such as cardiac arrest, heart failure, respiratory failure; 2) secondary conditions as the UCOD without an antecedent COD such as pulmonary embolism, sepsis; 3) ill-defined conditions as the UCOD such as senility, symptoms, signs, and abnormal clinical and laboratory findings not elsewhere classified corresponding to ICD-10 codes for R00-R94 and R96-R99; 4) improper sequence of time between CODs; 5) incompatible causal relationship such as two or more unrelated CODs; 6) listed more than one COD on a single line in Part I; 7) blank line between CODs or duplicated the same COD; 8) incorrect manner of death; and 9) unacceptable COD with evidence of an illogical decision (Table 1). Minor errors were those related to Part II, Part III, and some of Part I of the DC: 1) mode of dying as the COD with appropriate UCOD; 2) no cause of injury as UCOD; 3) no result of injury as COD; 4) unclear COD with clear cause of injury as UCOD; 5) incorrect time interval; 6) incorrect other significant conditions; 7) incorrect operating findings even after surgery; 8) incorrect date of surgery even after surgery; 9) incorrect type of accident; 10) incorrect intention of external cause; 11) incorrect time of accident; and 12) incorrect place of accident (Table 1).

As a general characteristic of DC, the place of issue of

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DC was classified into emergency department (ED) or beyond ED including intensive care unit and surgery room. The medical doctor who wrote the DC was classified as board certified emergency physician, board certified trauma surgeon, neurosurgeon, and other residents. Based on medical records, whether the patient underwent surgery between trauma onset and death was investigated. How many lines among four lines of Part I for COD (Fig. 1) were entered were also investigated. All major and minor errors were investigated.

All errors were compared depending on the place of issue of DC, medical doctors who wrote the DC, and the number of lines filled up for COD of DC. Chi-square test and student's *t*-test were used for comparing errors depending on the place of issue of DC. Errors depending on the specialty of medical doctors and the number of lines filled up for COD of DC were compared using analysis of variance (ANOVA) with Scheffe *post hoc* test, chi-square test, and Fisher's exact test. IBM SPSS version 24.0 (IBM, Armonk, NY, USA) was used for all statistical analyses. Statistical significance was defined at $p<0.05$.

<table>
<tr><td>Name</td><td colspan="2"></td><td>Sex</td><td colspan="2">[ ] M [ ] F</td></tr>
<tr><td>Date of birth</td><td colspan="2">YYYY/MM/DD</td><td>Occupation</td><td colspan="2"></td></tr>
<tr><td>Address</td><td colspan="5"></td></tr>
<tr><td>Date of onset</td><td colspan="5">YYYY/MM/DD/HH/MM</td></tr>
<tr><td>Date of death</td><td colspan="5">YYYY/MM/DD/HH/MM</td></tr>
<tr><td>Place of death</td><td colspan="5">[ ] At home [ ] Medical facility [ ] Residential institution
[ ] School, other institution, public administrative area [ ] Street and highway
[ ] Trade and service area [ ] Industrial and construction area [ ] Farm
[ ] Death during transportation to hospital [ ] Other place ( )</td></tr>
<tr><td rowspan="7">Cause of death</td><td>A</td><td>Cause of death</td><td></td><td rowspan="4">Time interval</td><td></td></tr>
<tr><td>B</td><td>Cause of A</td><td></td><td></td></tr>
<tr><td>C</td><td>Cause of B</td><td></td><td></td></tr>
<tr><td>D</td><td>Cause of C</td><td></td><td></td></tr>
<tr><td colspan="3">Other significant conditions contributing to death</td><td colspan="2"></td></tr>
<tr><td colspan="2">Major findings of surgery</td><td></td><td>Date of surgery</td><td>YYYY/MM/DD</td></tr>
<tr><td colspan="2">Major findings of autopsy</td><td></td><td></td><td></td></tr>
<tr><td>Manner of death</td><td colspan="5">[ ] Natural death [ ] Death from external cause [ ] Other or undetermined</td></tr>
<tr><td rowspan="4">Additional information of external cause</td><td>Type of accident</td><td colspan="2">[ ] Traffic accident
[ ] Poisoning [ ] Fall
[ ] Drowning [ ] Fire
[ ] Others</td><td>Intention</td><td colspan="2">[ ] Accident
[ ] Intentional self harm
[ ] Assault
[ ] Unclassified</td></tr>
<tr><td colspan="2">Time of accident</td><td colspan="4">YYYY/MM/DD/HH/MM</td></tr>
<tr><td rowspan="2">Place of accident</td><td>Address</td><td colspan="4"></td></tr>
<tr><td>Place</td><td colspan="4">[ ] At home [ ] Medical facility
[ ] Residential institution [ ] School, other institution, public administrative area
[ ] Street and highway [ ] Trade and service area
[ ] Industrial and construction area [ ] Farm
[ ] Other place ( )</td></tr>
</table>

Fig. 1. Death certificate form of South Korea.

Table 1. The definition of major and minor errors on death certificate

Type of error	Definition
Major errors	
Mode of dying as UCOD	Listed only mode of dying listed without other UCOD
Secondary condition as UCOD	Included obviously secondary conditions as UCOD without an antecedent COD
Ill-defined conditions as UCOD	Included only ill-defined conditions as UCOD
Improper sequence	Indicated an improper sequence of time between CODs
Incompatible causal relationship	Listed an incompatible causal relationship
≥1 cause of death on a single line	Listed more than one COD on a single line in Part I
Blank/duplication	Included a blank line between CODs or duplicated the same COD
Incorrect manner of death	Indicated a wrong judgement for manner of death such as natural cause or external cause
Unacceptable cause of death	Indicating an unacceptable COD with evidence of an illogical decision
Minor errors	
Mode of dying as COD with appropriate UCOD	Included the mode of dying as COD even though appropriate UCOD are included
No cause of injury as UCOD	Listed disease codes only for result of injury corresponding S00-T98 as the UCOD without cause of injury corresponding V01-Y89 in Part I
No result of injury as COD	Listed disease codes only for cause of injury corresponding V01-Y89 as the UCOD without result of injury corresponding S00-T98 in Part I
Unclear COD with the clear cause of injury as UCOD	Listed unclear result of injury as COD even though recorded clear cause of injury as UCOD in Part I
Incorrect time interval	Listed an incorrect or no records of time interval in Part I
Incorrect other significant conditions	Listed incorrect or no records of other significant conditions in Part II
Incorrect operating findings even after surgery	Listed incorrect or no records of major findings of surgeon in Part II
Incorrect date of surgery even after surgery	Listed incorrect or no records of specific date of surgery in Part II
Incorrect type of accident	Included incorrect classification or no records for type of accident in Part III
Incorrect intention of external cause	Included incorrect or no records for intention in Part III
Incorrect time of accident	Included incorrect or no records for time of accident in Part III
Incorrect place of accident	Included incorrect or no records for place of accident in Part III

UCOD: underlying cause of death, COD: cause of death.

RESULTS

A total 140 DCs out of 142 DCs were analyzed during the study period except two cases for which COD could not be determined. Regarding the place of issue of DC, 38% were ED and 62% were others. Regarding medical doctors who wrote the DC, 35% were board certified trauma surgeon, 31% were board certified emergency physician, 27% were neurosurgeon, and 7% were others under medical residency. An average of 2.4 lines for COD were recorded. The most common cases were recorded in two lines (34%) or three lines (29%) for COD. Average numbers of major and minor errors per DC were 0.8 and 3.7, respectively. In particular, 5.4 minor errors were found in 45 cases that had surgery while 2.8 minor errors were found in 95 cases that had no surgery (Table 2).

DCs issued at the ED were filled up with 1.8 lines for COD. For DCs issued beyond ED, they were filled with 2.8 lines. There were a total of 2.8 errors for DCs issued at the ED and 5.4 errors for DCs issued beyond ED. The most common major error was more than one COD on a single line for DCs issued at the ED and incompatible casual relation between CODs for DCs issued beyond ED. Minor error with mode of dying followed by a legitimate

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Table 2. Characteristics of death certificates

Characteristic	Value (n=140)
Place of issue	
Emergency department	53 (37.9)
Beyond emergency department	87 (62.1)
Specialist who wrote death certificate	
Board certified trauma surgeon	49 (35.0)
Board certified emergency physician	43 (30.7)
Neurosurgeon	38 (27.1)
Other resident	10 (7.1)
Surgery before death	45 (32.1)
Number of lines filled up for cause of death	2.4±1.0
One	28 (20.0)
Two	47 (33.6)
Three	40 (28.6)
Four	25 (17.9)
Number of total errors of death certificate	4.4±2.0
Number of major errors	0.8±0.7
Number of minor errors	3.7±1.5
Number of total errors in case of surgery (n=45)	6.4±1.3
Number of major errors in case of surgery	0.8±0.7
Number of minor errors in case of surgery	5.4±1.5
Number of total errors in case of no surgery (n=95)	3.5±1.6
Number of major errors in case of no surgery	0.6±0.7
Number of minor errors in case of no surgery	2.8±1.3

Values are presented as mean±standard deviation or number (%)

COD was 2% for DCs issued at the ED and 56% for DCs issued beyond ED. Minor error with no cause of injury as the UCOD was 51% for DCs issued at the ED and 79% for DCs issued beyond ED (Table 3).

The number of lines filled up for COD was 3.4 for neurosurgeon, 2.4 for trauma surgeon, and 1.9 for emergency physician. The number of major errors was 0.5 for emergency physician and 0.8 for trauma surgeon and neurosurgeon. Major error with incompatible causal relationship was the most common in neurosurgeon (63%). More than one COD on a single line was the most common in trauma surgeon (29%). Major error with incorrect manner of death was common in other medical doctors under medical residency (50%). Minor error with mode of dying followed by a legitimate COD was

Table 3. Errors of death certificates according to place of issue

	ED (n=53)	Beyond ED (n=87)	*p*-value
Number of lines filled up for COD	1.8±0.6	2.8±1.0	0.000
Number of total errors of death certificate	2.8±1.3	5.4±1.7	0.000
Number of major errors	0.5±0.6	0.9±0.7	0.001
Number of minor errors	2.3±0.9	4.5±1.7	0.000
Major errors			
Mode of dying as UCOD	0 (0.0)	4 (4.6)	0.297
Secondary condition as UCOD	0 (0.0)	4 (4.6)	0.297
Ill-defined conditions as UCOD	5 (9.4)	3 (3.4)	0.155
Improper sequence	1 (1.9)	0 (0.0)	0.379
Incompatible causal relationship	4 (7.5)	38 (43.7)	0.000
≥1 cause of death on a single line	10 (18.9)	12 (13.8)	0.424
Blank/duplication	5 (9.4)	4 (4.6)	0.299
Incorrect manner of death	1 (1.9)	9 (10.3)	0.089
Unacceptable cause of death	0 (0.0)	5 (5.7)	0.157
Minor errors			
Mode of dying with appropriate UCOD	1 (1.9)	49 (56.3)	0.000
No cause of injury as UCOD	27 (50.9)	69 (79.3)	0.000
No result of injury as COD	3 (5.7)	0 (0.0)	0.052
Unclear COD with clear cause of injury as UCOD	3 (5.7)	0 (0.0)	0.052
Incorrect time interval	32 (60.4)	78 (89.7)	0.000
Incorrect other significant conditions	45 (84.9)	81 (93.1)	0.117
Incorrect operating findings even after surgery	0/0	40/45 (88.9)	
Incorrect date of surgery even after surgery	0/0	23/45 (51.1)	
Incorrect type of accident	1 (1.9)	2 (2.3)	1.000
Incorrect intention of external cause	5 (9.4)	10 (11.5)	0.702
Incorrect time of accident	1 (1.9)	14 (16.1)	0.008
Incorrect place of accident	3 (5.7)	24 (27.6)	0.001

Values are presented as mean±standard deviation or number (%)
ED: emergency department, SD: standard deviation, COD: cause of death, UCOD: underlying cause of death.

common in neurosurgeon (68%). No operating finding even after surgery was 72%. It was 100% for both trauma surgeon and neurosurgeon (Table 4).

Total errors by the number of lines filled up for COD were the smallest (3.1) for two lines and the largest (6.0) for four lines. Major error with only mode of dying as UCOD was 14% for one line. Incompatible casual relationship was 35% for three lines and 92% for four lines. Minor error with mode of dying followed by a legitimate COD was 13% for two lines and 88% for four lines (Table 5).

DISCUSSION

Of a total of 140 DCs included in the study, only one DC had no major or minor error. This is similar to previous

Table 4. Errors of death certificates according to specialty of medical doctor

	Trauma surgeon[a] (n=49)	Emergency physician[b] (n=43)	Neuro-surgeon[c] (n=38)	Other resident[d] (n=10)	*p*-value	*Post hoc.* (scheffe)
Number of lines filled up for COD	2.4±0.9	1.9±0.6	3.4±0.7	1.4±0.5	0.000	d,b<a<c
Number of total errors of death certificate	4.3±1.8	2.7±1.3	6.2±1.3	4.9±1.7	0.000	b<a,d<c
Number of major errors	0.8±0.7	0.5±0.7	0.8±0.5	1.2±1.1	0.020	a,b,c<d
Number of minor errors	3.5±1.6	2.2±0.9	5.4±1.2	3.7±1.5	0.000	b<a,d<c
Major errors						
Mode of dying as UCOD	2 (4.1)	0 (0.0)	0 (0.0)	2 (20.0)	0.009[e]	
Secondary condition as UCOD	1 (2.0)	0 (0.0)	1 (2.6)	2 (20.0)	0.024[e]	
Ill-defined conditions as UCOD	2 (4.1)	5 (11.6)	1 (2.6)	0 (0.0)	0.336[e]	
Improper sequence	1 (2.0)	0 (0.0)	0 (0.0)	0 (0.0)	1.000[e]	
Incompatible causal relationship	13 (26.5)	4 (9.3)	24 (63.2)	1 (10.0)	0.000	
≥1 cause of death on a single line	14 (28.6)	7 (16.3)	1 (2.6)	0 (0.0)	0.005	
Blank/duplication	4 (8.2)	5 (11.6)	0 (0.0)	0 (0.0)	0.132[e]	
Incorrect manner of death	2 (4.1)	1 (2.3)	2 (5.3)	5 (50.0)	0.000[e]	
Unacceptable cause of death	2 (4.1)	0 (0.0)	1 (2.6)	2 (20.0)	0.040[e]	
Minor errors						
Mode of dying with appropriate UCOD	13 (26.5)	0 (0.0)	34 (68.0)	3 (30.0)	0.000	
No cause of injury as UCOD	33 (67.3)	20 (46.5)	37 (97.4)	6 (60.0)	0.000	
No result of injury as COD	0 (0.0)	3 (7.0)	0 (0.0)	0 (0.0)	0.122[e]	
Unclear COD with clear cause of injury as UCOD	0 (0.0)	3 (7.0)	0 (0.0)	0 (0.0)	0.122[e]	
Incorrect time interval	35 (71.4)	27 (62.8)	38 (100)	10 (100)	0.000	
Incorrect other significant conditions	42 (85.7)	37 (86.0)	38 (100)	9 (90.0)	0.048[e]	
Incorrect operating findings even after surgery	13/18 (72.2)	0/0	25/25 (100)	2/2 (100)	0.022[e]	
Incorrect date of surgery even after surgery	8/18 (44.4)	0/0	13/25 (52.0)	2/2 (100)	0.542[e]	
Incorrect type of accident	0 (0.0)	1 (2.3)	2 (5.3)	0 (0.0)	0.356[e]	
Incorrect intention of external cause	9 (18.4)	4 (9.3)	2 (5.3)	0 (0.0)	0.203[e]	
Incorrect time of accident	7 (14.3)	0 (0.0)	6 (15.8)	2 (20.0)	0.013[e]	
Incorrect place of accident	12 (24.5)	1 (2.3)	11 (28.9)	3 (30.0)	0.008	

Values are presented as mean±standard deviation or number (%).
SD: standard deviation, UCOD: underlying cause of death, COD: cause of death.
[e]Fisher's exact test.

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studies showing that major errors are found in more than 50% of issued DCs or minor errors are found in most DCs, with DCs having no errors account for only 1% [3,5,6,16]. Cases with no cause of injury as the UCOD accounted for 69% (96/140) in this study. This result reflects that in many cases, principles for writing DCs related to trauma are not well understood or adhered to. In order to reduce these errors, efforts are needed to improve the quality of a DC through a feedback system which evaluates the adequacy of a DC in the institution where the DC is issued [10,17]. Continuous education is also required for individuals authorized to write the DC [4,7,8,11,18].

A previous study has found that the lower the age of the issuer and the lower the level of the issuing hospital, the greater the number of errors of DC [9]. Total number of errors was the smallest in board certified emergency physicians while the number of major errors was the largest in others under medical residency in this study. This may

Table 5. Errors of death certificates according to number of lines filled up for COD

	One[a] (n=29)	Two[b] (n=46)	Three[c] (n=40)	Four[d] (n=25)	*p*-value	*Post hoc.* (sheffe)
Number of total errors of death certificate	4.0±1.9	3.1±1.7	5.2±1.6	6.0±1.3	0.000	a,b<c,d
Number of major errors	0.8±0.9	0.6±0.7	0.8±0.7	1.0±0.4	0.068	
Number of minor errors	3.3±1.7	2.5±1.4	4.5±1.7	5.0±1.2	0.000	a,b<c,d
Major errors						
Mode of dying as UCOD	4 (13.8)	0 (0.0)	0 (0.0)	0 (0.0)	0.002[e]	
Secondary condition as UCOD	2 (6.9)	1 (2.2)	1 (2.5)	0 (0.0)	0.534[e]	
Ill-defined conditions as UCOD	3 (10.3)	1 (2.2)	3 (7.5)	1 (4.0)	0.408[e]	
Improper sequence	0 (0.0)	1 (2.1)	0 (0.0)	0 (0.0)	1.000[e]	
Incompatible causal relationship	0 (0.0)	5 (10.6)	14 (35.0)	23 (92.0)	0.000	
≥1 cause of death on a single line	3 (10.7)	9 (19.1)	9 (22.5)	1 (4.0)	0.179[e]	
Blank/duplication	0 (0.0)	8 (17.1)	1 (2.5)	0 (0.0)	0.006[e]	
Incorrect manner of death	6 (21.4)	2 (4.3)	1 (2.5)	1 (4.0)	0.024[e]	
Unacceptable cause of death	3 (10.7)	0 (0.0)	2 (5.0)	0 (0.0)	0.041[e]	
Minor errors						
Mode of dying with appropriate UCOD	0 (0.0)	6 (12.8)	22 (55.0)	22 (88.0)	0.000	
No cause of injury as UCOD	20 (71.4)	23 (48.9)	30 (75.0)	23 (92.0)	0.001	
No result of injury as COD	3 (10.7)	0 (0.0)	0 (0.0)	0 (0.0)	0.012[e]	
Unclear COD with clear cause of injury as UCOD	0 (0.0)	2 (4.3)	1 (2.5)	0 (0.0)	0.777[e]	
Incorrect time interval	20 (71.4)	32 (68.1)	36 (90.0)	22 (88.0)	0.039	
Incorrect other significant conditions	25 (89.3)	40 (85.1)	37 (92.5)	24 (96.0)	0.505[e]	
Incorrect operating findings even after surgery	5/5 (100)	3/6 (50.0)	15/15 (100)	17/19 (89.5)	0.021[e]	
Incorrect date of surgery even after surgery	5/5 (100)	2/6 (33.3)	5/15 (33.3)	11/19 (57.9)	0.051[e]	
Incorrect type of accident	0 (0.0)	0 (0.0)	3 (7.5)	0 (0.0)	0.074[e]	
Incorrect intention of external cause	3 (10.7)	3 (6.4)	8 (20.0)	1 (4.0)	0.172[e]	
Incorrect time of accident	3 (10.7)	2 (4.3)	10 (25.0)	0 (0.0)	0.004[e]	
Incorrect place of accident	7 (25.0)	4 (8.5)	11 (27.5)	5 (20.0)	0.120	

Values are presented as mean±standard deviation or number (%).

SD: standard deviation, COD: cause of death, UCOD: underlying cause of death.

[e]Fisher's exact test.

be related to the experience for writing DC. Emergency physician would have experienced relatively many cases of death in the ED and in issuing DC. However, the understanding for DC and the experience for issuing DC of residents would be poor. Moreover, more errors for incorrect manner of death were found in case of the patient being transferred to other specialty especially internal medicine because of complication after admitted to trauma team first.

In this study, the higher the number of lines for COD, the higher the number of errors, especially minor errors. Common minor errors were missing time interval or other significant conditions in previous studies [3,6,10,11]. Even if four lines for COD were recorded in this study, 88% were missing time interval and 96% were missing other significant conditions. Although the specific characteristics of medical doctors who filled up a lot of lines for COD of DC were not investigated in this study, this might reflect a misconception of them that if more or all lines for COD of DC were recorded, the more accurate the DC would be. A poor knowledge and misconception for writing the DC might result in more lines filled up for COD, thus leading to more errors.

In a previous study, among 307 cases of DCs with 162 cases of natural death, 50 cases of external cause, 95 cases of undetermined or unknown cause, and 17 cases (5.5%) of the total DCs were found to have errors for incorrect manner of death with 10 cases being issued as undetermined or unknown cause instead of external cause and seven cases being issued as natural death instead of external cause [12]. Errors for the manner of death in this study that included only DCs related to trauma accounted for 7.1% (10/140). These results reflect that it is unlikely that natural death would be wrongly issued as the death from external cause. However, there is a high possibility that the death from external cause would be wrongly issued as natural death. In particular, the longer the time from an accident to death, the greater the confusion about the direct COD and its relevance to trauma, and the more likely it will lead to errors in determining the manner of death.

In case of trauma related death, it is likely that the subject of responsibility for the cause of trauma is more controversial than in natural death. If there is a conflict between parties concerned about the outcome of death, the DC would be an important document to resolve the dispute. It is not easy to issue a DC correctly with limited clinical information without any findings from an autopsy. However, the issuer of the DC is responsible for issuing it as accurately as possible according to medical knowledge and guidelines for writing the DC, although they might only have limited clinical information.

The result of this study cannot be generalized because only DCs issued by a training hospital were included. In addition, although we examined errors according to medical doctors, the experience or educational status for writing the DC of doctors were not investigated.

CONCLUSION

Numbers of total errors and major errors on DCs related to trauma only were 4 and 0.8, respectively. As more CODs were written, more errors were found. Thus, Education and steady quality control are needed to improve the quality of DC.

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