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Reliability of cause of death due to violence from information systems in Belo Horizonte, Southern Brazil

ABSTRACT

OBJECTIVE: To determine reliability of data encoding for death due to violence; to assess the agreement between cause of death in the Mortality Information System and cause selected from the Forensic Medicine Institute database; and to assess the impact of adding information of non-specified injuries and undetermined death events subsequently obtained from Forensic Medicine Institute in the mortality statistics due to violence.

METHODS: A random sample of 411 death certificates due to violence was obtained in Belo Horizonte, Southeastern Brazil, between 1998 and 2000. Based on data from death certificates and Forensic Medicine Institute database, causes of death were coded and the agreement between this information and that from Mortality Information System was assessed. Also, in all certificates including "non-specified injury" and "undetermined death events," the impact of adding information from Forensic Medicine Institute was assessed in the classification of cause of death.

RESULTS: Coding agreement was significant (Kappa=0.782; 95% CI: 0.744; 0.819) and of the underlying cause was moderate to significant (Kappa=0.602; 95% CI: 0.563; 0.641). There were 12.9% and 5.7% misclassification of suicides and murders, respectively, for those causes classified as "non-specified injury" and "undetermined death events," which were overall reduced to 47.3% and 59.8% respectively.

CONCLUSIONS: There is a need for further improving the process of underlying cause coding and selection. Also medical examiners need to provide more complete death certificates and medical and police information provided with bodies for Forensic Medicine Institute autopsy should be more complete, especially in those cases of road traffic injuries and falls.

KEYWORDS: Mortality. External causes. Violence. Information systems.

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INTRODUCTION

Mortality statistics are often used for assessing health status of people, planning of public policies and determining the impact of interventions. The comparison between different mortality patterns allows the formulation of etiological hypotheses to be tested.[13]

Nevertheless, the quality of information provided to health care services have been a major concern.[4,7] Assessments of data quality of diseases and specific age groups have often indicated incomplete reporting of items on death certificates (DCs) as well as poor readability.[3,9,10] Deficient coding and selection of the underlying cause of death[9] in DCs and their issuance with missing test and autopsy results have also been pointed out.[3,10]

As for mortality from violence, the main limiting factor is lack of information on the circumstances injuries causing death occurred.[1,2,5,8,11] In Brazil, the correct identification of the cause of death rely on a particular flow of information, beginning at hospitals and police stations where the nature of violence is first reported in the forms sent along with the bodies for autopsy in Forensic Medicine Institutes (IML). There, together with medical expert examination results, this information is then transcribed to DCs. This information flow reaches its end at local health departments, where data is used in the process of coding and selection of underlying causes of death.

Lack of knowledge and concern about legal consequences are among the most common reasons claimed by medical examiners for not reporting the circumstances of death in DCs. This practice leads to an excessively high number of deaths classified as "unspecified accidents" or "injuries of unknown intentionality".[7,8,15] Systematic investigation and use of information available in IML database are alternative options some local authorities have taken to improve quality of violent death registrations.[1,2,15]

In the state of Minas Gerais, Southeastern Brazil, Fundação João Pinheiro was responsible for managing vital statistics until 1999. However, in 1995, after a third copy of DC was set as a requirement, the Municipal Health Department of Belo Horizonte (SMSA) started its own database following standard criteria for data coding and processing. In 2000, SMSA officially took over the generation of mortality statistics and implemented a process of systematic information search in IML database.

Ladeira & Guimarães[5] (1998) found in the city of Belo Horizonte low agreement rate (Kappa value =0.124) between the underlying cause of road traffic accidents obtained from hospital investigations and the cause of death selected by Fundação João Pinheiro. In addition, the proportion of deaths in the city between 1998 and 2000 due to external causes classified as events of undetermined intent remained around 15.0%,* indicating a need for improving data quality.

The present study aimed to assess the reliability of SMSA process of coding and selection of the underlying cause of violent deaths, before and after conducting a search in IML database, and to measure the impact of including information available in IML for unspecified accidents and events of undetermined intent.

METHODS

Belo Horizonte, the capital of the state of Minas Gerais, Southeastern Brazil, has a population of 2,238,526 inhabitants.** The study examined the *Sistema de Informações sobre Mortalidade* (SIM - Mortality Information System) database of SMSA for the years 1998 to 2000. There were reported 39,816 deaths during the study period, 4,255 (10.7%) of them due to external causes.

Deaths of people living in the city where the underlying causes of death have been classified according to the International Classification of Diseases – 10th Revision (ICD-10) chapter XX were included in the study. Violent death was defined as that caused by all types of accidents, suicides, homicides, events of undetermined intent and legal interventions, corresponding to ICD-10 V01-Y36 codes.

The sample size was defined through a proportion estimation approach and there were estimated large heterogeneity of data (p=0.5), 95% confidence intervals (α=0.05) and error margin of 10% (e=0.1). The minimum sample size estimated was 386 DCs.[16]

Deaths were divided into groups according to the following codes: homicides (X85-Y09 and Y35-Y36), unspecified accidents and events of undetermined intent (X59 and Y10-Y34), and other causes of violent death (V01-X58 and X60-X85). A systematic sampling of 10% was carried out in each group every year, making a total of 411 reports.

DCs were then recoded by a trained coder, blinded to

*Ministério da Saúde. Sistema de Informação sobre Mortalidade. Disponível em http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obtbr.def [acesso em 7 fev 2002]

**Instituto Brasileiro de Geografia e Estatística. Censo demográfico 2000 - Brasil e Estados. Rio de Janeiro; 2003. [11. Recenseamento Geral do Brasil]

Table 1 - Phase 1: Concordance between groups of underlying cause of death defined in the study (DC) and in SIM. Belo Horizonte, Southeastern Brazil, 1998-2000.

	SIM	Death certificate													Total	
		1	2	3	4	5	6	7	8	9	10	11	12	13	N	%
1	Pedestrian road accidents (V01- V09)	42		**5**				1					2		50	13.1
2	Specified transport accidents (V10-V88 and V90-V98)		8	**1**									1		10	2.6
3	Unspecified transport accidents (V89 and V99)	**7**	**4**	47	2										60	15.7
4	Falls (W00 and W19)				18			2							20	5.2
5	Drowning (W65-W74)	1		1		13									15	3.9
6	Specified accidents (W20-W64 and W75-X58)						6			4			1	1	12	3.1
7	Unspecified accidentts (X59)			1	1			9					1		12	3.1
8	Suicide (X60-X84)								24						24	6.3
9	Firearm homicide (X93-X95)									90		1	2		93	24.3
10	Homicide by sharp object (X99)									1	10	6			17	4.4
11	Homicide (X85-X92; X96-X98; Y00-Y09; Y35-Y36)									3	2	16	2	1	24	6.3
12	Undetermined intent (Y10- Y34)			1		3	2	7	2			2	27	2	46	12.0
13	Other causes (A00-R99/Y40-Z99)													0		
	Total (n)	50	12	56	21	16	8	19	26	98	12	25	36	4	383	
	Total (%)	13.1	3.1	14.6	5.5	4.2	2.1	4.9	6.8	25.6	3.1	6.5	9.4	1.1		100.0

Source: Sistema de Informação Sobre Mortalidade (SIM, Mortality Information System); Municipal Health Department of Belo Horizonte.
Kappa value=0.782 (95% CI: 0.744; 0.819)

the official coding, following the international guidelines of coding and selection of cause of death.

In order to assess the quality of coding, the same DCs were coded by a second independent coder and it was found an agreement rate of 90.1% and Kappa value =0.888; 95% CI: 0.850; 0.926 between the two coders.

The agreement rate between the set of information studied and SIM data was tested in 13 groups of cause of death using the rate of agreement observed and Kappa statistics. Landis & Kock[6] criteria were applied in result interpretation.

The study was conducted in three different phases. In Phase 1, the reliability of the process of coding and selection of the underlying cause of death was assessed by comparing the cause registered in SIM with the one selected by one of the study authors (SGM) (Table 1). The same information available to SMSA officers was used to assure that any inconsistencies would be due to the coding and selection criteria used in the study. A total of 383 DCs were examined in this phase, 93.2% (383/411) of the study sample (Table 2).

Twenty-three DCs (5.6%) were missing, and five of them (1.2%) were illegible copies. Missing DCs were attributed to misfiling or inadequate transfer from Fundação João Pinheiro to SMSA of electronic data without the related documentation.

In Phase 2, the reliability of the underlying cause registered in SIM was compared against the cause of death defined after including IML data (Table 3). Total non-agreement was estimated by the sum of the causes identified in the phase of coding assessment and those identified after including new information.

There were investigated the circumstances of death in 383 cases studied in the previous phase. The following IML information sources were consulted: Medical Expert Examination Reports (MER), Forensic Medical Examination Order Forms, medical reports requesting autopsy and toxicological test results. Information related to the circumstances of violence and MER findings were transcribed to a form including name, date of death and MER number. The referred causes were coded for each death. When there were inconsistencies regarding the type of violent death, for example, suicide or fall, DCs were coded as "Unspecified facts and events, undetermined intent". After coding was completed, the underlying cause of death was selected.

There was no records of body entry in IML for 17 DCs (4.4%) either certified by the attending physician, the acting physician or the Post-Mortem Examination Service. Reports of 25 DCs (6.5%) registered in SIM as having been certified by IML were missing from IML files. The final sample size in this phase comprised 341 cases, 82.9% of the study sample (341/411) (Table 1). Reliability analysis in Phase 2 was similar to Phase 1.

In Phase 3, in order to measure the impact of including IML data on mortality statistics due to violence, all deaths of those living Belo Horizonte where the underlying causes were classified as "Accidental exposure to unspecified factors" or "Events of undetermined intent" (n=609) were studied. Information search in IML database was carried out as described in Phase 2.

There were excluded from the analysis 134 DCs

(22.0%) with no record of body entry in IML. According to SIM, 61 deaths were certified by the attending physician, 38 by other acting provider, 15 by other certifying officer and 20 of them did not have any information on the certifying officer. IML autopsy was confirmed in 30 cases (4.9%) but related MERs were missing. The same approach of the previous phases was applied for coding and selection of the new underlying cause of death.

Of 445 reports examined (73.0%; 445/609), there were 70 unspecified accidents and 375 events of undetermined intent distributed in 13 groups of causes (Table 4). The number and percent variation of DCs before and after the search in IML database were compared based on SMSA mortality database for the three years studied.

Data processing and analysis were performed using an electronic spread sheet and Kappa statistics were estimated using Stata 7.0 software program. The study was approved by the Research Ethics Committee of Universidade Federal de Minas Gerais (Report No. 37/2002).

RESULTS

Table 2 shows the frequency distribution of total violent deaths and in Phases 1 and 2 samples. The distribution by age, sex and groups of cause of death in Phase 1 sample was similar to that of violent deaths from SIM. A lower proportion of female deaths can be seen in the sample of Phase 2 compared to SIM.

The distribution of causes of death in SIM and in the present study (Phase 1) is shown in Table 1. There is a slightly different proportional distribution of deaths. Despite a number of inconsistencies (n=72, situated out of the diagonal line in the Table), there can be seen a balance between the groups and the profile of causes remained the same. For example, 50 cases of pedestrian road accidents were identified in each information source and 42 were consistent. However, among 60 deaths classified in SIM as unspecified transport accidents, 11 DCs had information available that would allow determining a specific cause of death (bold in Table 1). Hence, seven deaths were reclassified as pedestrian road accidents and four as specified transport accidents.

Most inconsistencies were associated to events of undetermined intent. Overall agreement rate was 80.9% (Kappa value =0.782; 95% CI: 0.744; 0.819), showing high agreement.

The distribution of groups of causes of death in SIM and in the sample of Phase 2 obtained after including IML information is shown in Table 3. Whereas the

Table 2 - Frequency distribution of violent deaths in SIM and in the sample studied in the assessment of the reliability of coding (Phase 1)* and the underlying cause of death (Phase 2),** by age group, sex, and cause of death. Belo Horizonte, Southeastern Brazil, 1998-2000.

Variable	SIM		Phase 1		Phase 2	
	N	%	N	%	N	%
Age (years)						
<10	159	3.8	15	3.9	15	4.4
10-19	578	13.8	43	11.2	42	12.3
20-29	1,240	29.7	115	30.0	110	32.1
30-39	828	19.8	79	20.6	71	21.1
40-49	502	12.0	53	13.8	46	13.5
50-59	296	7.1	27	7.0	22	6.4
60 and more	576	13.8	51	13.3	35	10.2
Unknown	1	0.0				
Sex						
Male	3,323	79.5	311	81.2	285	83.6
Female	857	20.5	72	18.8	56	16.4
Underlying cause						
Pedestrian road accidents	492	11.8	50	13.0	46	13.5
Specified transport accidents	105	2.5	10	2.6	9	2.6
Transport accidents with no other specification	622	14.9	60	15.6	50	14.6
Falls	215	5.2	20	5.2	15	4.4
Other specified accidents	357	8.5	27	7.3	24	7.3
Unspecified accidents	131	3.1	12	3.1	6	1.8
Suicides	287	6.9	24	6.3	23	6.7
Homicides	1,493	35.7	134	34.9	132	38.6
Undetermined intent	478	11.4	46	12.0	36	10.5
Total	4,180		383		341	

Source: Sistema de Informação Sobre Mortalidade (SIM, Mortality Information System); Municipal Health Department of Belo Horizonte and Forensic Medicine Institute of Belo Horizonte.
SIM: Total deaths due to violent causes
Phase 1: Sample used for assessing coding reliability
Phase 2: Sample used for assessing the reliability of the underlying cause of death
*SIM *vs* death certificate (DC) age (X^2 6gl=2.85; p=0.83); sex (X^2 1gl=0.63; p=0.43); underlying cause (X^2 8gl=1.92; p=0.98)
**SIM *vs* IML age (X^2 6gl=5.32; p=0.50); sex (X^2 1gl=3.26; p=0.07); underlying cause (X^2 8gl=4.97; p=0.73)

Table 3 - Phase 2: Concordance between groups of underlying cause of death defined after search in IML and in SIM. Belo Horizonte, Southeastern Brazil, 1998-2000.

	SIM	IML													Total	
		1	2	3	4	5	6	7	8	9	10	11	12	13	n	%
1	Pedestrian road accidents (V01-V09)	32	8	5									1		46	13.5
2	Specified transport accidents (V10-V88 and V90-V98)	1	6	1			1								9	2.6
3	Unspecified transport accidents (V89 and V99)	**13**	**19**	16	2										50	14.7
4	Falls (W00-W19)				11		1						3		15	4.4
5	Drowning (W65-W74)	1		1		12									14	4.1
6	Specified accidents (W20-W64 and W75-X58)						6			**4**					10	2.9
7	Unspecified accidents (X59)	1		1	1		1	0			1		1		6	1.8
8	Suicides (X60-X84)								22					1	23	6.7
9	Firearm homicides (X93-X95)									89	1	2			92	27.0
10	Homicide by sharp object (X99)									**5**	10			1	16	4.7
11	Homicide (X85-X92; X96-X98; Y00-Y09; Y35-Y36)	1					1		1	**13**	1	7			24	7.0
12	Undetermined intent (Y10- Y34)	1	2	3	5		2	1	2	3	2	1	12	2	36	10.6
13	Other causes (A00-R99/Y40-Z99)													0		
	Total (n)	50	35	27	19	12	12	1	25	114	15	10	17	4	341	
	Total (%)	14.7	10.3	7.9	5.6	3.5	3.5	0.3	7.3	33.4	4.4	2.9	5.0	1.2		100.0

Source: Sistema de Informação Sobre Mortalidade (SIM, Mortality Information System); Municipal Health Department of Belo Horizonte and Forensic Medicine Institute of Belo Horizonte.
Kappa value =0.602 (95% CI: 0.563; 0.641)

inclusion of IML information made it possible to better determining the underlying cause of death, it also produced more inconsistencies. The sum of inconsistencies identified in Phases 1 and 2 changed the relation between the groups and increased the number of specified transport accident and firearm homicide cases, resulting in 118 inconsistencies situated out of the diagonal line in Table 3.

By improving the quality of information, most inconsistencies were concentrated in the groups of events of undetermined intent, transport accidents and homicides. The main difference (bold in Table 3) in the group of transport accidents was that vehicles involved could be identified (N=19) as well as a majority of motor vehicle and pedestrian road accidents (N=13).

The identification of the means used in assaults can partially explain the increased number of firearm homicides and allowed to reclassify five assaults using sharp objects and four firearm-related accidents as well.

In summary, Table 3 shows a dispersion of cases classified as unspecified accidents and events of undetermined intent in several groups studied, indicating that more specification of violence could be achieved. Overall agreement rate was 65.4% (Kappa value =0.602; 95% CI: 0.563; 0,641), showing a moderate-to-high agreement.

In Phase 3, information available in IML allowed to identifying the cause of 58 (bold) out of 70 deaths

Table 4 - Phase 3: Underlying cause of death in SIM and as defined after search in IML. Belo Horizonte, Southeastern Brazil, 1998-2000.

Underlying cause of death - IML	SIM			
	Unspecified accidents		Undetermined intent	
	N	%	N	%
Pedestrian road accidents	**7**	10.0	**24**	6.4
Road traffic accidents	**4**	5.7	**10**	2.7
Other specified transport accidents	**2**	2.9	**11**	2.9
Unspecified transport accidents	**11**	15.7	**28**	7.5
Falls	**13**	18.6	**48**	12.8
Drowning	**1**	1.4	**9**	2.4
Other specified accidents	**8**	11.4	**15**	4.0
Unspecified accidents	2	2.9	6	1.6
Total accidents	48	68.6	151	40.3
Suicides	**2**	2.9	35	9.3
Homicides	**7**	10.0	**78**	20.8
Events of undetermined intent	8	11.4	**81**	21.6
Total of intentional deaths	17	24.3	194	51.7
Natural	**3**	4.3	**8**	2.1
Undetermined cause	2	2.9	22	5.9
Total	70	100.0	375	100.0

Source: Sistema de Informação Sobre Mortalidade (SIM, Mortality Information System); Municipal Health Department of Belo Horizonte and Forensic Medicine Institute of Belo Horizonte.

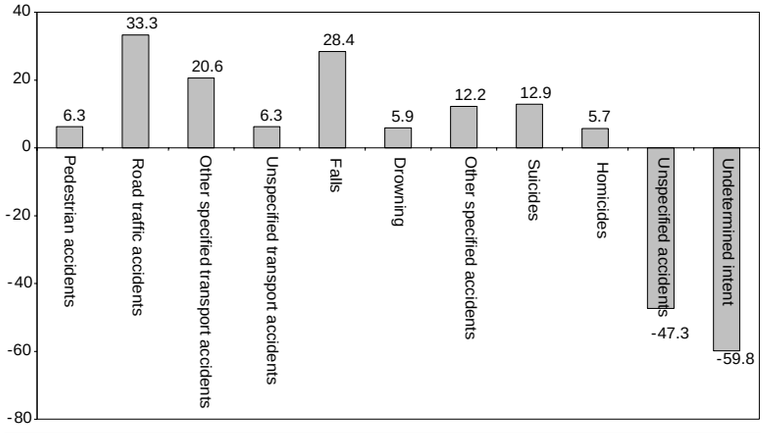

Figure - Percent variation of clustering of violent death obtained from the search of unspecified accidents and events of undetermined intention in IML. Belo Horizonte, Southeastern Brazil, 1998-2000.

previously classified as unspecified accidents (83%) (Table 4). Most deaths (46/58, 79%) were confirmed as caused by accidents, predominantly transport accidents and falls. However, nine deaths were due to suicide or homicide, intentional accidents that had been previously misclassified as accidents. Eight cases did not have information available to support its classification as accidental deaths. They were bodies with signs of violence or cases of uncertain intentionality where the most adequate classification would be undetermined intent. Also, there were identified three cases of natural death and two cases classified as undetermined cause could not be confirmed as due to external causes.

Of 375 cases classified as events of undetermined intent, it was possible to identify the cause of death in 266 cases (70.9%) (bold in Table 4). Of these, 145 cases (38.6%) were considered accidental, mostly falls and transport accidents. IML provided adequate information to identify 113 cases as homicides or suicides (30.1%). There was no information available in 81 deaths (21.6%) to determine the type of external cause or assault intentionality, and thus these deaths remained classified as of unknown intentionality. The cause of death was not identified in 22 cases (5.9%) either due to poor body conditions or inadequate resources available in IML for making a diagnosis. These cases could not even be classified as deaths by natural or external causes.

The Figure shows a comparison between the groups of violent causes in SIM and those resulting from data correction after including IML information. There is a remarkable increase in motor vehicle accidents and falls by 33.3% and 28.4% respectively. In the group of intentional deaths, suicides and homicides increased by 12.9% and 5.7% respectively. A significant reduction of unspecified accidents, from 131 to 69 (-47.3%), and events of undetermined intent, from 478 to 192 (-59.8%) was also seen.

DISCUSSION

Morbidity and mortality statistics are valuable tools for measuring the impact of violence on people's health and contribute to the development of public policies against violence. By identifying and correcting sources of error, the quality of such information can be improved.

In the city of Belo Horizonte, during the study period between 1998 and 2000, the overall agreement rate between groups of cause of death, by comparing SIM data with that obtained after including IML information, was relatively low (65.4%). Assuming higher reliability and validity of IML information, it can reasonably be assumed that, in 34.6% of DCs, the underlying cause of death selected was incorrect.

The agreement rate found in Phase 1 of coding (Kappa value =0.782), although high, contributed to a lower final reliability. Barros et al[1] (2001), in Recife (Northeastern Brazil), reported higher agreement rates (Kappa value =0.881). The process of coding and selection of the underlying cause of violent deaths is relatively simple when DCs have adequate information to determine the circumstances of death. Therefore, inconsistencies observed in the coding phase of the cause of death can be attributed to inadequate information available.

Twenty-five percent of inconsistencies found in Phase 1 were due to local coders' inclusion as events of undetermined intent deaths subsequently classified as accidental. In the present study, deaths by falls were identified in several different situations: same-level falls, falls from stairs, scaffolds, buildings and overpasses, among others. However, though in most cases there was no information available to determine the circumstances of the event, they were classified as accidental deaths since the intentionality of the event had not been questioned in MERs.[2,12] Classification criteria in this grouping needs to be further discussed as well as the use of standard criteria allowing data comparison with other localities.

Information available in DCs, especially in the "type of accident" field, was not used for defining the cause of death, which has particularly affected the pedes-

trian road accident group. This information loss resulted in 18.0% increase in unspecified transport accidents. It is likely that the lack of, or lack of knowledge of, existing criteria for reporting this information in DCs gave raise to questions and made coders be more conservative i.e., classify these deaths in non-specific categories.

The decentralization of SIM processing to the local level has expanded the utilization of this information system to surveillance and, due to the proximity of information sources, has facilitated communication with medical providers, making it possible to correct DCs and improve data quality.

In Belo Horizonte, the data processing team also manages actions in the surveillance system of mandatory notifiable diseases and infant and maternal mortality, among others, making information immediately available. On the other hand, since SIM processing is conducted in nine different health districts, there is a large number of coders working in the city, which increases the likelihood of applying different criteria, and hinders the dissemination of new coding guidelines and, consequently, the identification and correction of deviations.

The implementation of mechanisms for quality control of coding at the different levels of SUS, as recommended by Santo,[14] will support decentralized processing and improve data reliability.

Information losses of deaths not referred to IML – 4.4% in Phase 2 and 22.2% in Phase 3 – as well as missing autopsy reports – 6.5% and 5.6% respectively – should be taken into consideration in the result analysis.

Although Phase 2 sample had the same distribution of age groups and cause of death, the proportion of females (16.4%) was lower than SIM (20.5%), which led to weaker representativeness of women. A similar situation was seen in Phase 3, where lower proportions of women and people aged more than 65 years were seen among IML cases compared to total violent deaths. The fact that autopsies were not requested especially in female and elderly deaths may have introduced a significant bias in the description of mortality from violence.

The agreement rate between the groups of underlying cause of death in SIM and those in the sample including IML data (Kappa value =0.602) reflects successive losses of information. If all information available were properly used, unspecified transport accidents would be reduced to 46.0% and would allow better estimating pedestrian road accidents and road traffic accidents as causes of death. Yet, one in every four accidents would still be due to unknown cause. The description of these accidents and identification of the type of victim rely on information that can be obtained in hospitals and police stations, as shown in a study on road traffic accidents conducted in five hospitals in Belo Horizonte: the type of accident and victim were described in 96% of deaths.[5]

During case search in IML database, it was verified that only one hospital attending emergency cases in Belo Horizonte systematically reports death circumstances. A good number of care services mostly provide information on medical progress.

The same can be said about police information, since it is often restricted to a brief description of the event. Though adequate to determine the cause of death in most homicides and suicides, it is inadequate to describe falls, burns and other events, presumably accidental. Remittance of a copy of police reports to IML, as seen in other cities,[2] can help improve the quality of death information.

Despite a reminder included in DCs instructing that information on circumstances of death has epidemiological purposes, it has had no effect on the routine of medical examiners who continue to provide only data on the nature of injuries; reporting this information is still a function of IML administrative officers in Belo Horizonte. The identification of an excess 12.9% of suicide cases and about an excess 6.0% of homicides during the study period, additionally to the description of several accidents only among those classified as of unknown intentionality and unspecified accidents, shows that when this is left to the responsibility of others the resulting quality of information is low.

As physicians are the most qualified providers and have greater access to information provided by police officers and health services, it is their duty to fully report all information in DCs. There is also a need to decide whether it is lawful or not to use this information in judicial actions, so as to prevent penalizing medical examiners due to information misuse and to allow authorities managing mortality statistics to define strategies to ensure good data quality. While there is no definite decision, it is recommended to continue searching information in IML, provided that standard criteria are followed, since this practice highly improves quality of information on the underlying cause of violent deaths and ensures higher reliability and validity of studies and analyses on mortality, which are undoubtedly valuable to public health.

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