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Improvement of the unspecified external causes classification based on the investigation of death in Brazil in 2017

Melhoria da classificação das causas externas inespecíficas de mortalidade baseada na investigação do óbito no Brasil em 2017

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ABSTRACT: *Background*: Unspecified causes of death are among the traditional indicators of quality of information. *Objective*: To verify the performance of the 60 cities in the Data for Health Initiative project and to analyze the reclassification of unspecified external causes of death (UEC). *Methods*: Using the 2017 records from the Mortality Information System, the proportion and percent change in UEC were compared after investigation between project cities and other cities, and the percent of reclassification to specific external causes was calculated. *Results*: The project cities comprised 52% (n = 11,759) of the total UEC in Brazil, of which 64.5% were reclassified after investigation, whereas the other cities reclassified 31% of UEC. Results were similar for men, youth, blacks, metropolitan cities, the Southeast region, and deaths attested by forensic institutes. In the project cities, pedestrian traffic accidents were external causes with greater reclassification. In men, the UEC was reclassified to homicides (23.8%) and accident of terrestrial transportation (ATT) (11.1%), with motorcyclists (4.4%) and pedestrians (4.3%) being the most prominent. In women, these causes were changed to other accident causes (20.8%), ATT (10.6%) and homicides (7.9%). UEC changed to ATT (18.3%) in the age groups of 0-14 years old and to homicides (32.5%) in the age groups of 15-44 years. *Conclusion*: The project cities obtained better results after investigation of UEC, enabling analysis of the reclassification to specific causes by sex and age groups.

Keywords: Cause of death. Mortality registries. External causes. Data accuracy. Information systems. Death certificates.

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RESUMO: *Introdução*: Causas inespecíficas de mortalidade estão entre os indicadores tradicionais de qualidade da informação. *Objetivo*: Verificar o desempenho das 60 cidades do projeto Dados para a Saúde e analisar a reclassificação das causas externas inespecíficas de mortalidade (CEI). *Métodos*: A partir de registros de 2017 do Sistema de Informações sobre Mortalidade, comparou-se proporções e variações percentuais após investigação das CEI, entre cidades do projeto e demais cidades, e calculou-se percentual de reclassificação para causas específicas. *Resultados*: As cidades do projeto concentraram 52% (n = 11.759) das CEI do Brasil, das quais 64,5% foram reclassificadas após investigação, enquanto as demais cidades reclassificaram 31%. Resultados foram semelhantes para homens, jovens, negros, cidades metropolitanas, região Sudeste, e em eventos atestados por institutos forenses. Nas cidades do projeto, acidentes de pedestres foram causas com maior reclassificação. Em homens, as CEI migraram para homicídios (23,8%) e acidentes de transporte terrestre (ATT) (11,1%), com destaque para motociclistas (4,4%) e pedestres (4,3%). Em mulheres, essas causas foram alteradas para outras causas acidentais (20,8%), ATT (10,6%) e homicídios (7,9%). CEI migraram para ATT (18,3%) no grupo de idade de 0 a 14 anos, e homicídios (32,5%) no grupo de 15 a 44 anos. *Conclusão*: As cidades do projeto obtiveram melhores resultados após investigação de CEI, possibilitando analisar a reclassificação para causas específicas, por sexo e faixas etárias.

Palavras-chave: Causas de morte. Registros de mortalidade. Causas externas. Confiabilidade dos dados. Sistemas de informação. Atestado de óbito.

INTRODUCTION

Cause-of-death statistics are important sources of information to monitor population health and to establish public policy. However, death certificates (DC) do not always provide accurate evidence about the circumstance. Unknown, nonspecific causes, or *garbage* causes (GC) are among the traditional quality indicators of mortality reporting[1-3]. Many of these DC conceal the true underlying cause of death[4], and clarification is needed through field investigations.

Redistribution of GC to defined causes is essential for the calculation of estimates made by the *Global Burden of Disease* (GBD) study[5,6.] Periodically reviewed, GC include ill--defined (IDC) and unspecific causes belonging to different chapters of the International Classification of Diseases (ICD), which are, therefore, of little use from a public health perspective[7,8.]

In 2016, Brazil recorded more than 1.3 million deaths, 33.6% with some type of GC, and 155,861 external causes, with 15.4% unspecified external causes (UEC). In about 80% of these cases, the DC was issued by institutes of forensic medicine (IFM) in the Northeast and Southeast regions[9]. The identification of external causes between IDC[10-12] and the frequency of UEC, considered quality indicators of the records produced by IFM, indicate insufficient access to public services and quality of health care[13-15].

In assessing levels and patterns of mortality from external causes, it is vital to mitigate information bias due to its under-enumeration in the Mortality Information System (MIS). The estimation of external causes, based on data retrieval, allows to generate more

reliable indicators, while managers undertake structuring actions to reduce unspecified causes of death[4].

Brazil has been expanding MIS data quality improvement and, since 2005, the reduction of IDC has been its main focus[10,12,15]. Implemented in 2017, the Data for Health project aims to improve the diagnosis of cause of death in Brazil in cooperation with death surveillance teams from 60 municipalities through the investigation of GC. The UEC investigation uses as central source of information collection the IFM, recognized for having detailed technical data, often not transcribed to the DC[16,17].

This paper therefore aims to verify the performance of the 60 cities of the Health Data project and to analyze the reclassification of unspecified external causes of mortality after investigations.

METHODS

From the 2017 MIS records, an evaluative study of the investigations of deaths by UEC was conducted in the sixty cities of the Data for Health project, comparing the results of these cities before and after the intervention, and also using the other Brazilian cities as a comparative group.

The selection of the sixty cities in the project activities was made by adhesion agreement. From different population sizes, from all regions of the country, the cities had teams to investigate deaths reported in 2017. Composed of service professionals with experience in investigation of records, the team retrieved data in notifying units, such as IFM and hospitals, according to reference protocol for field work, using standard investigation form. From a list of deaths with GC considered a priority, deaths occurring in residents of the municipality were identified. Cities with up to 500 GC deaths per year should investigate all cases.

In some Brazilian cities not participating in the project, there was a continuation of the investigation routine of epidemiological deaths from UEC, with active search in reports of the IFM and sometimes civil police and press, but carried out without standardized protocol. The capitals have a systematic search activity for traffic accident victims in MIS, which may not translate into qualification of mortality data. In all cities in the country, the ICD-10 chapter 18 death investigations with IDC – infant deaths and maternal causes – were maintained in accordance with the death surveillance guidance policies set out in institutional documents and ordinances of the Ministry of Health[18,19].

The priority research UEC and object of analysis of this work were grouped according to GBD 2015[20] for the ICD-10[21] into: unspecified ATT (V87.0; V87.1; V87.4-V88.1; V88.4-V89.9); accident with unspecified transportation (V99); other unspecified accident causes (X59); unspecified homicide (Y09); and undetermined intention (Y10-Y34). It is noteworthy that a group of UEC was not the object of this study, as it is considered non--priority in the protocol: W76; X40-X44; X47.0; X49; Y85-Y86; Y87.1-Y87.9; Y89. In the

reclassification, the defined causes were the ATT (pedestrians: V01-V04 and V06-V09, cyclist: V10-V19, motorcyclist: V20-V29, vehicle occupant: V30-V79, V87.2 and V87.3, and other specified ATT: V05 and V80-V86), other traffic accidents (V88.2, V88.3 and V90-V98), other specified accident causes (W00-W75, W77- X39, X45, X46, X47.1-X47.8, X48, X50-X58), suicides (X60-X84, Y87.0), specified homicides (X85-Y08), legal intervention (Y35), and other external causes (Y40-Y84, Y88, Y90-Y98). In addition, reclassification to natural and ill-defined causes (A00-R99) was verified. Figure 1 shows a schematic representation flowchart of the external cause reclassification process.

The criterion to consider alteration of the cause of death was the change of the original underlying cause after the investigation, in MIS, according to the reclassification method proposed by França et al.[10].

In the characterization of the UEvC, the following variables were also analyzed: gender (male; female), age group (0 to 14; 15 to 44; 45 to 74; 75 or more), race/color (white; black), population size of the municipality (<50 thousand; 50 to 100 thousand; ≥ 100 thousand), metropolitan region (yes; no) and large regions (North; Northeast; Southeast; South; Midwest), place of occurrence (hospital/other health facilities; domicile/street and others), and certificate (IFM; others).

Intervention performance was analyzed by comparing results from participating cities (Project cities) and non-project participants (Other cities). Statistical inference was estimated for each proportion by 95% confidence intervals (95%CI). The hypothesis of no difference (H0) of proportions was refuted when the confidence intervals did not overlap, that is, the alternative hypothesis (H1) was assumed that the proportions were significantly different in the comparisons. The interval estimation is given by the following formula:

$$\overline{x} \pm Z\left(\frac{\sigma}{\sqrt{n}}\right)$$

This study was approved by the Research Ethics Committee of the Universidade Federal de Minas Gerais (CAEE 75555317.0.0000.5149). The study used non-nominal secondary data, according to Resolution No. 510 of April 7, 2016, which provides for research standards[22].

RESULTS

From the 60 cities in the project, 48 are in metropolitan regions and, of these, 20 are capital cities; and 52 have a population of over 100,000. In these municipalities reside 35% of the Brazilian population, distributed in the five regions, mainly Southeast and Northeast. These cities registered 31% (n = 34,558) of deaths from external causes in 2017, and of these 34% (n = 11,759) were originally UEC. In cities not participating in the project, there were 10,972 deaths from these causes (Table 1 and Figure 1). Ignored data of the analyzed variables ranged from 0.1% to 3%.
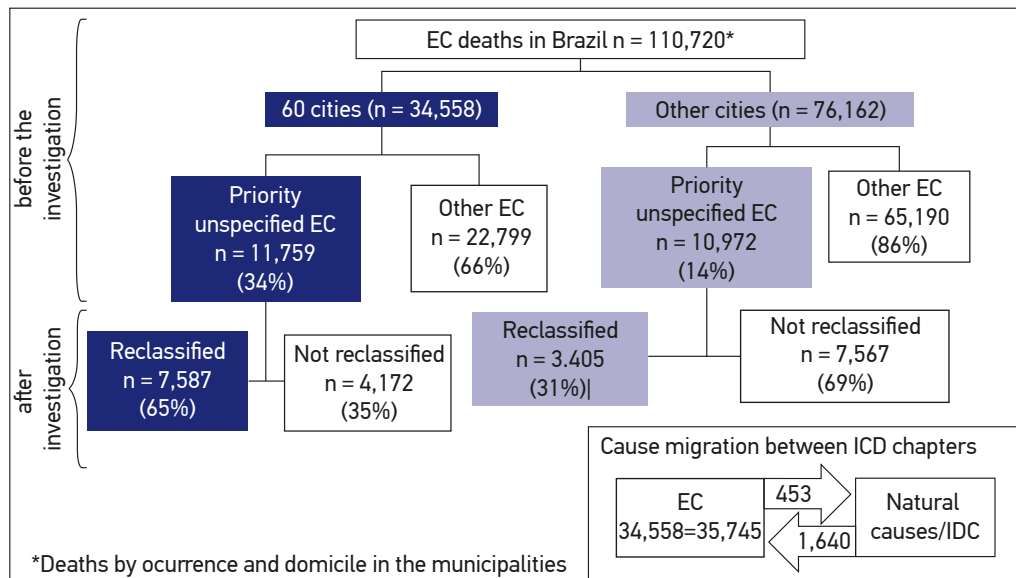
Figure 1. Flow diagram of schematic representation of deaths from injuries reclassified in Brazil, 2017.

IDC: ill-defined causes; EC: external causes.

Research in the 60 cities corrected deaths from external causes from 34,558 to 35,745 (3%) due to migration of events between natural and unnatural causes, where 453 external causes were reclassified into natural causes, and 1,640 natural causes were reclassified as external causes (Figure 1).

From the total UEC, 64.5% (95%CI 63.7; 65.4) changed the cause after investigation in the project cities and 31% (95%CI 30.2; 31.9) in the other cities (data not shown). These differences were repeated for the variables gender, age group, race/color, place of occurrence and attestant. The largest proportions of changes in the project cities were observed in males (67.7%), age group 15 to 44 years old (73.2%), black race (67.6%) and attestant IFM (69, 1%) (Table 1).

The cities of the project also had higher proportions of changes in undetermined intent deaths (71.3%, 95%CI 70.4; 72.2) and ATT or unspecified traffic accidents (42.2%, 95%CI 38.4; 46.0), in municipalities with more than 100 thousand inhabitants (64.5%, 95%CI 63.7; 65.4), metropolitan areas (65.5%, 95%CI 64.6, 66.4) and the Midwest (85.2%, 95%CI 81.1; 89.3) and Southeast (69.7%, 95%CI 68.8; 70.7). It is noteworthy that the data by region and type of UEC were not presented in table (Table 1).

After reclassification of external causes of mortality, the cities of the project presented a higher percentage variation for all types of defined external causes when compared to other cities, with statistically significant differences, except for other traffic accidents and other external causes. In the project cities, the variation was higher in legal intervention (616.8%), in accidents with pedestrian (72.5%), cyclists (71.8%), and motorcyclists (50.5%); while the percentage variation of specified suicides and homicides was 45.5% and 16%, respectively.

Table 1. Change after investigation of classification of the unspecified injuries according to the city in the Project and demographic variables, Brazil, 2017.

Variables	Project cities			Other cities		
	before (n)	Change (%; CI)		before (n)	Change (%; CI)	
Gender						
Male	9,143	67.7	(66.7; 68.7)	8,821	31.0	(30.0; 31.9)
Female	2,610	53.4	(51.5; 55.4)	2,137	31.4	(29.5; 33.4)
Age group						
0 to 14 years old	240	68.3	(62.4; 74.2)	364	25.0	(20.6; 29.4)
15 to 44 years old	5,942	73.2	(72.1; 74.3)	5,804	33.9	(32.7; 35.2)
45 to 74 years old	3,399	61.9	(60.3; 63.6)	3,432	27.7	(26.2; 29.2)
75 years or older	2,052	44.4	(42.2; 46.5)	1,295	28.8	(26.3; 31.3)
Race						
White	4,415	60.6	(59.1; 62.0)	4,059	28.8	(27.4; 30.2)
Black	7,163	67.6	(66.5; 68.7)	6,592	32.9	(31.8; 34.1)
Inhabitants						
< 50 thousand	2		-	3,328	14.9	(13.7; 16.1)
50 to 100 thousand	10	70.0	(41.6; 98.4)	1,566	21.5	(19.4; 23.5)
> 100 thousand	11,747	64.5	(63.7; 65.4)	6,078	42.3	(41.1; 43.6)
Capital						
Yes	11,516	65.5	(64.6; 66.4)	5,597	43.6	(42.3; 44.9)
No	243	18.5	(13.6; 23.4)	5,375	18.0	(16.9; 19.0)
Occurrence						
Hospital*	6,920	64.0	(62.9; 65.1)	3.960	33.7	(32.2; 35.2)
Domicile**	4,833	65.2	(63.9; 66.6)	6,955	29.7	(28.6; 30.7)
IFM	10,479	69.1	(68.2; 69.9)	8,877	33.7	(32.7; 34.7)
Others	1,116	27.4	(24.8; 30.0)	1,654	18.9	(17.0; 20.7)

UEC: unspecified external causes; ATT: accident of terrestrial transportation; US: unspecified; * and other health facilities; ** and public street.

There was a reduction of 71.2% (95%CI −73.3; −69.0) of undetermined external causes in the project cities, and 39.5% in other cities (95%CI −41.3; − 37,7). The latter group also exhibited a decrease in unspecified ATT/transportation and other unspecified accident causes (Table 2).

In the project cities, other accident causes and unspecified homicides were the UEC that remained with a higher proportion without clarification, for both gender (Table 3). In men, the UEC were mainly reclassified to specified homicides (23.8%, n = 2,177) and ATT (11.1%, n = 1,016), with emphasis on motorcycle (4.4%, n = 399) and pedestrian (4.3%, n = 389) accidents. Specified homicides were clarified in 27% (n = 2,114) of undetermined intentions and 20.3% (n = 57) of unspecified homicides. Other unspecified accident causes

Table 2. Percent variation of the reclassification from injuries after investigation, according to cause and city in the Project, Brazil, 2017.

	Cities of the project (n = 34,558)				Other cities (n = 76,162)			
	before	after (n,%; CI)			before	after (n,%; CI)		
ATT/traffic accident US	661	688	4.1	(2.6; 5.6)	2,998	2,584	−13.8	(−15.2; −12.4)
US accident	803	928	15.6	(13.1; 18.1)	866	589	−32.0	(−36.3; −27.7)
US homicide	323	549	70.0	(65.0;75.0)	711	730	2.7	(1.5; 3.9)
undetermined	9,972	2,875	−71.2	(−73.3; −69.0)	6,397	3,871	−39.5	(−41.3; −37.7)
pedestrian	801	1,382	72.5	(69.4; 75.6)	2,531	2,768	9.4	(8.2; 10.5)
cyclist	124	213	71.8	(63.9; 79.7)	629	699	11.1	(8.7; 13.6)
motorcyclist	992	1,493	50.5	(47.4; 53.6)	5,400	5,867	8.6	(7.9; 9.4)
motor vehicle occupant	356	527	48.0	(42.8; 53.2)	3,341	3,560	6.6	(5.7; 7.4)
other ATT	30	49	63.3	(46.1; 80.6)	251	266	6.0	(3.0; 8.9)
other traffic accidents	14	16	14.3	(−4.0; 32.6)	95	97	2.1	(−0.8; 5.0)
specific accidents	4,560	5,934	30.1	(28.8; 31.5)	11,715	12,154	3.7	(3.4; 4.1)
suicides	1,443	2,099	45.5	(42.9; 48.0)	8,272	8,560	3.5	(3.1; 3.9)
specific homicides	13,381	15,518	16.0	(15.3; 16.6)	31,858	32,856	3.1	(2.9, 3.3)
legal intervention	131	939	616.8	(520; 713)	290	451	55.5	(44.8; 66.2)
other EC	647	557	−13.9	(−17.0; −10.8)	472	423	−10.4	(−13.2; −7.2)
other *garbage*	320	338	5.6	(3.1; 8.1)	336	342	1.8	(0.4; 3.2)
natural/IDC	-	453	-		-	345	-	

UEC: nonspecific external causes; ATT: accident of terrestrial transportation; US: unspecified; IDC: ill-defined cause; EC: external causes.

migrated to other specified accident causes (6.4%, n = 31) and motorcycle accident (4.4%, n = 21). Unspecified ATT/unspecified transport accidents changed to motorcycle accident (21.9%, n = 123) and motor vehicle occupant (8.7%, n = 49).

In females, the UEC migrated mainly to other specified accident causes (20.8%, n = 544), ATT (10.6%, n = 276), mainly pedestrians, and specified homicides (7.9%, n = 205). Undetermined intentions were reclassified especially to other specified accident causes (24.3%; n = 522) and specified homicides (8.8%; n = 144). Unspecified homicides clarified changed to specified homicides (35.7%) in their entirety. Other unspecified accident causes migrated to other specified ones (6.5%; n = 21). Unspecified ATT/unspecified transportation accidents were reclassified to motorcycle (20.2%, n = 20) and pedestrian (13.1%, n = 13) accidents (Table 3).

Table 3. Reclassification (%) after investigation of deaths from unspecified injuries by gender, in the cities of the Project, Brazil, 2017.

Before the investigation	ATT/traffic US accident		US accident		US homicide		Undetermined		total	
After the investigation	male	female	male	female	male	female	male	female	male	female
	561	99	481	322	281	42	7,820	2,147	9,143	2,610
ATT/ transportation US accidents	58.3	54.5	0.4	-	-	-	3.4	1.6	6.5	3.4
US accident	-	-	81.9	90.4	-	-	2.3	2.6	6.3	13.3
US homicide	-	-	0.2	-	75.8	64.3	3.6	0.8	5.4	1.7
Undetermined	-	-	0.4	0.3	-	-	25.8	39.3	22.1	32.3
pedestrian	6.2	13.1	2.9	0.6	-	-	4.3	7.2	4.3	6.5
cyclist	2.9	1.0	0.6	-	-	-	0.6	0.2	0.7	0.2
motorcyclist	21.9	20.2	4.4	0.6	-	-	3.3	1.2	4.4	1.8
motor vehicle occupant	8.7	9.1	1.0	0.3	0.4	-	1.2	1.9	1.6	1.9
other ATT	-	-	0.2	0.3	-	-	0.2	0.1	0.2	0.2
Specified accidents	1.4	1.0	6.4	6.5	1.4	-	11.5	24.3	10.3	20.8
suicides	-	-	0.2	-	-	-	6.3	6.7	5.4	5.5
specified homicides	0.5	1.0	0.6	0.3	20.3	35.7	27.0	8.8	23.8	7.9
legal intervention	-	-	0.2	-	2.1	-	7.5	-	6.5	-
natural/IDC	-	-	0.4	0.3	-	-	2.6	5.0	2.2	4.2

UEC: unspecific external causes; ATT: accident of terrestrial transportation; US: unspecified; IDC: ill-defined cause; gender ignored: 0.1%; 0.3% of US accidents and undetermined migrated to non-priority garbage.

Regarding age group, in the 0-14 age group, informed UEC migrated mainly to ATT (18.3%), especially pedestrians (n = 29), other specified accident causes (n = 36) and specified homicides (n = 31). In the 15-44 age group, migration occurred mainly for specified homicides (32.5%, n = 1,929) and legal intervention (9.7%, n = 575), while in the 45-74 age group, occurred for other specified accident causes (18.8%, n = 638) and specified homicides (11.2%, n = 381). And in the 75 years and older group, the main changes happened for other specified accident causes (29.6%, n = 607) and pedestrians (4.6%, n = 94). The UEC groups that remained with the highest proportion without clarification were undetermined intentions (38.2%, n = 784) and other unspecified accident causes (18.7%, n = 384) in the 75 years and older group, and unspecified homicides (7%, n = 414) and unspecified ATT/traffic accidents (7.2%, n = 425) aged 15 to 44 years (Table 4).

Table 4. Reclassification (%) of deaths from unspecified injuries after investigation, by age group, in the cities of the Project, Brazil, 2017.

After the investigation	Priority UEC (before investigation)				
	0 to 14	15 to 44	45 to 74	75 or older	Total
	n = 240	n = 5,942	n = 3,399	n = 2,052	n = 11,633
Priority EC					
ATT/US Transport Accidents	4.6	7.2	6.0	1.5	5.8
US accident causes	7.1	4.0	8.4	18.7	7.9
US homicide	5.8	7.0	2.7	0.4	4.5
undetermined causes	21.7	17.1	28.2	38.2	24.2
Accident					
pedestrian	12.1	3.0	7.4	4.6	4.8
cyclist	1.3	0.5	1.0	0.1	0.6
motorcyclist	1.7	6.2	2.2	-	3.8
motor vehicle occupant	3.3	2.0	1.7	0.5	1.7
other ATT	-	0.3	0.1	-	0.2
specified accidents	15.0	3.3	18.8	29.6	12.7
Violence					
suicides	3.8	5.5	7.7	2.0	5.5
specified homicides	12.9	32.5	11.2	1.0	20.3
legal intervention	1.7	9.7	0.2	-	5.0
non-priority garbage	-	0.3	0.3	0.1	0.3
natural/IDC	9.2	1.5	4.0	3.1	2.7

UEC: unspecific external causes; ATT: accident of terrestrial transportation; US: unspecified; IDC: ill-defined causes; age ignored: 1.1%.

DISCUSSION

The performance in improving the diagnosis of UEC of death was, on average, 2.1 times higher in the project cities than in the other cities. This performance is repeated mainly in men, youth and black people, from metropolitan cities, Southeast and Midwest regions of the country, and for deaths attested by the IFM.

In the 60 cities, reclassification of causes after investigation corrected deaths from external causes by 3%, while study GBD[23] corrected by 9% for Brazil. In addition to reclassifying all GC, it is noteworthy that GBD also corrects underreporting of deaths. Opposed to the results obtained in the project cities, the GBD also estimated a higher proportion of traffic accidents and lower homicides for 2016.

In men, the UEC were reclassified mainly for homicide and ATT, especially those involving motorcyclists and pedestrians. In women, they migrated to other specified accident causes, ATT, especially pedestrians, and homicides. The clarification of undetermined intentions in the state of Rio de Janeiro resulted in the largest increase, especially of traffic accidents and homicides in 2014[24]. These differences may indicate heterogeneity in the results of investigations conducted in different areas of Brazil, due to different demographic and socioeconomic characteristics.

Regarding age, the UEC migrated mainly to ATT in the 0-14 age group, to homicides at 15-44 years old, and to other specified accident causes in the other age groups. Pedestrian accidents are among the ATTs with higher percentage increase after investigation at all ages, similar to that estimated by the GBD[23] study This demographic profile found in the clarification of the UEC is similar to the findings in the state of Rio de Janeiro and in Belo Horizonte and in places where data from external causes are routinely investigated through the retrieval of information from IFM and newspapers[7,14,24].

Different scenarios in the municipalities and multiple study designs have an impact on the reclassification of the cause. In addition to the repertoire of non-specific causes, other conditions determine its success, such as the species and composition of data retrieve sources. Since 1990, most research conducted in different parts of the country has been restricted to events of undetermined intent and unspecified accidents, with the IFM as the central source[4.] In these institutes, police reports, autopsy reports and referral files were available from health facilities[16,17,25,26].

Certain data sources, by their own characteristics, result in unique diagnoses, such as police inquiries that favor the identification of homicides[17,24-26], and news from newspapers that favor the capture of ATT accidents[14]. Medicalrecords are an important source for clarifying causes, especially inspecialized units[7] and associated with home investigation[27]. It is observed greater efficiency ofusing multiple sources in redefining the causes of death[4]. Note thatthis study found natural and ill-defined causes reclassified to external causes. By coinciding with previous findings[15,24], it contradicts studies that disregard external causes in the redistribution of IDC, as other authors have pointed out[10,12,28,29.]

Some hypotheses have been enumerated about the explanatory conditions for IFMs not incorporating information necessary to define the death circumstance in the DC. The technical-legal character of the institutional management of deaths with unnatural causes certified by an institute linked to the Secretariat of Security and Justice, the IFM, which is distinct from the epidemiological purpose of the health sector, may play a central role. Dissonant logics conditiondifferent rhythms and criteria in the process of defining the diagnosis by external causes, so essential to the elaboration of public policies. Prosecutors are alleged to be punitive for possible failures in the exercise of their profession for the use of DC in lawsuits; in turn, the clarification of the cause of death would depend on examinations and the performance of the police inquiry[4,15,16,24]. These questions reinforce the importance of actively seeking autopsy results and establishing flows and procedures for reporting information on the DC issued by the IFM, until the MIS reaches satisfactory levels of data quality on causes of death.

In addition, it is necessary to improve both the completion of the appropriate sequence of death causes in the DC, as well as the codification and selection of the underlying cause, besides medical and police information in the documents for the referral of bodies for autopsy, which is essential to the effective work of the coroner[14,26,30]. Result from incorrect ordering of the causal chain, GC-coded DCs may provide evidence of the valid cause of death from underlying causes noted in the DC lines, corresponding to those that contributed to death[31].

The experience of other countries points out ways to deal with all these issues, such as the establishment of a deadline of up to 6 days after death to fill the sequence of causes in the DC, favoring the incorporation of examinations and police investigation results. The implementation of a prior death certificate for civil registration purposes, without initial mention to the cause of death[24], could be a possibility to assist in the correct registration of external causes. As well as an *online* death certification system combined with medical training programs[32]. Finally, information systems need to work together to ensure cooperation and integration of service provision by public institutions. Access to legal documents through certification of vital events is the fundamental purpose of the systems, as they provide evidence of event characteristics based on which governments determine rights[33].

Although the underreporting of external causes is not the object of this paper, it is important to highlight that it is a subinformation dimension, although smaller when considering the correction of mortality data. Investigation of active search of death described IFM as a source of information for at least 2% of deaths recovered and not reported in MIS in 2012, remaining the biggest challenge to reach rural and remote municipalities[34-36], probably areas with poor socioeconomic and access to services indicators, especially health and public security agencies[37].

Possible limitations of this study refer to regional differences in MIS quality and coverage and to the geographic distribution of the population from the project municipalities, which are different from other cities. The quality of the investigations and the validity of the reclassified causes was also not assessed. The use of protocol and the results presented here indicate, however, greater reliability of this type of planned investigation, which allowed a significant reduction of the UEC.

The UEC needs explanations on issues not fully understood, such as why the medical expert does not use all the information found in the IFM to define the probable cause of death. The characterization of the interests of 2 distinct sectors (public security and health) and the mediations of the interinstitutional structure of these rationalities in the actions and interactions of professionals would form a set of evidence for informed decision making in the production of quality death records by IFM[38]. The promotion of the evidence-based interinstitutional health-justice dialogue can be an incentive for the formulation of a intersector national policy of qualified registration of death by accidents and violence, with consequent reduction of the need for investigations by health managers. In addition, planned GC research makes it possible to identify misconduct and conduct at the local level, as well as systematizing knowledge about the best collaborative practices of surveillance and forensic expertise services.

CONCLUSION

The findings of this study indicated that the cities participating in the Data for Health project obtained a greater - statistically significant - reduction in the UEC after investigation when compared to the others, which did not implement a systematic intervention to recover the cause of death records of 2017. The UEC reclassification has corrected the under--enumeration of defined causes of accidents and violence – in particular homicides, other accident causes and traffic accidents – thus impacting on improved health information; therefore, continuity and expansion of this type of intervention is recommended.

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