Hsiang-Ching Kung,[1] *Ph.D.; Randy Hanzlick,*[2] *MD.; and James F. Spitler,*[3] *M.S.*

Abstracting Data from Medical Examiner/Coroner Reports: Concordance among Abstractors and Implications for Data Reporting*

REFERENCE: Kung H-C, Hanzlick R, Spitler JF. Abstracting data from medical examiner/coroner reports: concordance among abstractors and implications for data reporting. J Forensic Sci 2001;46(5):1126–1131.

ABSTRACT: The purpose of this study was two-pronged: 1) to determine the level of concordance (agreement) between multiple records abstractors who extracted defined data elements from printed medical examiner/coroner (ME/C) death investigation records; and 2) to identify data items for which improved reporting could facilitate the effective use of ME/C reports and data.

Four hundred ninety four printed death investigation records were obtained from 224 medical examiner/coroner offices throughout the United States. Trained abstractors were asked to extract information for 110 data elements from investigative reports. Additional data elements for each toxicology workup were abstracted from toxicology laboratory reports and six-digit AIS codes were also abstracted for each injury as described in autopsy reports. The ability of multiple abstractors to identify each data element and identically abstract the data was assessed using Kappa statistical methods.

Level of agreement for many data elements was very good (>0.9), but for some data elements agreement was marginal to poor, especially for items related to toxicology, the nature of specific injuries, and dates, times of the occurrence of death and injury.

Many data items can be easily abstracted from ME/C records. However, some data items seem difficult to abstract reliably in all cases. Standardizing the report formats used by ME/Cs and/or standardizing the electronic storage of ME/C data would make the abstraction of such data easier and improve the usefulness of ME/C data.

KEYWORDS: forensic science, medical examiner/coroner reports, medical examiner/coroner database, quality assurance

Research has demonstrated the usefulness of information contained in medical examiner/coroner (ME/C) reports (1–3). It is therefore desirable to ensure high quality in ME/C databases for use in scientific studies concerning the circumstances of death. Given the complexity and variability of such reports, there is considerable debate on how to best abstract relevant information from ME/C records with minimal discrepancy between what is on the medical examiner/coroner reports and what is actually transcribed into the database. Electronic storage of relevant data in ME/C records would be one way to reduce the need for manual abstracting. However, many ME/C offices do not have their data completely stored in electronic format. The purpose of this study was to examine the level of concordance (agreement) between multiple records abstractors who were assigned to extract defined data elements from printed medical examiner/coroner death investigation records using manual abstraction methods, and for some data items, with the assistance of computer coding/classification systems that require initial manual abstraction of data from the record. A second purpose of the study was to identify data items that pose problems when records are manually abstracted, so that methods might be suggested to improve the reporting, electronic storage, and utilization of ME/C data.

Data Collection and Abstraction

The data for this study were obtained from the 1993 National Mortality Followback Survey (NMFS) conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention. During the Followback Survey, 1265 ME/C offices were contacted for 6671 decedents in the survey whose deaths were ME/C certified as due to external causes or which were still pending further investigation. Ultimately, 4696 (70% response rate) ME/C reports were received. Data collection procedures were similar to those used in the pilot study that laid the framework for this report (4). For the present study, we randomly selected 494 printed death investigation records from 224 ME/C offices.

To facilitate the abstraction of defined data elements into an electronic database, a computer assisted data entry (CADE) program was developed. This CADE program included preloaded data (i.e., drug names and compound lists), look-up screens, range and consistency checks, and Abbreviated Injury Scale (AIS) coding software programs to code injury information from autopsy reports (5). For the basic death investigation data, 110 data elements were abstracted from investigative reports. Drug detection, the type of specimen, drug concentrations, and test methods were abstracted from toxicology reports. For injuries, data were abstracted from autopsy reports concerning general body region (such as abdomen), type of anatomic structures injured (such as viscera), specific anatomic structure injured (such as liver), and specific injury type (such as laceration).

A detailed instruction and coding manual was developed for the abstractors to ensure standardization of the data entry process. The manual covered topics related to the CADE application, Abbrevi-

[1] National Center for Health Statistics, Centers for Disease Control and Prevention, 6525 Belcrest Road, Room 840, Hyattsville, MD.

[2] Chief medical examiner, Fulton County, Georgia; Associate professor of Pathology, Emory University School of Medicine, Atlanta, GA; Forensic pathologist, Centers for Disease Control and Prevention, Atlanta, GA.

[3] Pricewaterhouse Coopers LLP, Former Team Leader for the 1993 National Mortality Followback Survey.

* This paper was presented at the 51th Annual Meeting of American Academy of Forensic Sciences, Orlando, FL February, 1999.

Received 19 Sept. 2000; accepted 20 Oct. 2000.

ated Injury Scale (AIS) coding method, screen look-up dictionaries, and specific cross-references that could arise in data query and resolution situations. The manual was used to train abstractors as a working reference document throughout the abstraction process. Ten experienced medical abstractors underwent a two-day standardized training course that included the basic principles of anatomy, pathophysiology, medical diagnosis, and coding methodology. A medical supervisor was also on site to do 5% random audits of each abstractor's work.

Analyses and Results

The assessment of the consistency of multiple abstractors' ability to identify each data element and identically abstract the data was assessed using the Kappa statistical method (6). The Kappa Coefficient was used to measure the degree of consistency between independent abstractors. A Kappa of 0.8 to 1.00 signifies very high reliability. For investigative reports, we first analyzed the agreement of values for each data element. Then, we excluded missing values and recalculated Kappa statistics to prevent overestimation of the Kappa Coefficient. The results of analyzing the complete record were about the same as those for the analysis with missing values included with the single exception of Hispanic Origins—the Kappa Coefficient dropped from 0.76 to 0.58. We abstracted information related to demographic characteristics of the decedent: time and location of events surrounding death or fatal injury, activity and impairment at the time of death, medical history, circumstance of death, and manner of death. As Table 1 indicates, of 110 items abstracted, only ten items fell below an 0.80 Kappa Coefficient. Among these ten items, five of them fell between 0.49 to 0.59, indicating poor agreement. The items in this group all related to the time and location of events surrounding death, such as date and time last seen alive; date, time, and location of occurrence of fatal injury; date and time of discovery of the body; actual date and time

TABLE 1—*Agreement of information abstracted from ME/C investigative reports in the 1993 NMFS.*

Variable Name	Total Number	Overall Agreement	Medical Examiner/Coroner (ME/C) System		
			State ME/C	State ME County ME/C	County ME/C
Last seen alive	494	0.49091	0.52542	0.42424	0.69811
Discovery of body	494	0.50101	0.52542	0.45455	0.64151
Occurrence of fatal injury	494	0.55758	0.58192	0.51894	0.66038
Pronouncement of death	494	0.57172	0.55367	0.55682	0.69811
Occurrence of death	494	0.59192	0.57627	0.58333	0.67925
Signs of drug use	64	0.64646	0.70056	0.59470	0.71698
Activity at time of injury	110	0.67071	0.72881	0.64773	0.58491
Activity at time of death	147	0.71515	0.76836	0.67045	0.75472
Hispanic origin	38	0.74545	0.76271	0.75758	0.64151
#of death from event	400	0.78586	0.76271	0.81439	0.71698
Marital status	90	0.80000	0.79661	0.79924	0.81132
*Other disease	104	0.81818	0.77966	0.84091	0.83019
Disease history unknown	360	0.82424	0.77966	0.85606	0.81132
Describe death circumstance	83	0.84242	0.83051	0.85606	0.81132
Organ/tissue donation	12	0.86263	0.94350	0.80303	0.88679
Incident occurred on roadway	113	0.87273	0.87571	0.88636	0.79245
Manner of death	494	0.88889	0.88701	0.89015	0.90566
Mechanism of fatal injury	106	0.90505	0.92090	0.89773	0.90566
Drug use	23	0.90909	0.91525	0.91667	0.84906
Race	467	0.90909	0.97175	0.87121	0.88679
Type of firearm	57	0.91313	0.92655	0.89773	0.94340
# of vehicles involved	114	0.91313	0.92655	0.92045	0.84906
Safety equipment on decedent's vehicle unknown	99	0.91515	0.94350	0.89773	0.90566
Type of vehicle involved in Accident, Sedan	62	0.91717	0.90395	0.92803	0.92453
History of mental problem	17	0.91717	0.92090	0.90530	0.96226
Protective device used by decedent unknown	112	0.92121	0.93220	0.91288	0.92453
Decedent's role in fatal event	6	0.92525	0.93220	0.92803	0.88679
*Heart disease	31	0.92929	0.94915	0.92045	0.90566
Alcohol use	17	0.92929	0.95480	0.90909	0.94340
Type of vehicle involved in accident, unknown	30	0.93131	0.92090	0.93939	0.92453
Type of autopsy performed	419	0.93333	0.93785	0.93561	0.90566
Relation to person discharge firearm	422	0.94141	0.94350	0.94318	0.92453
Relation to alleged perpetrators	430	0.94343	0.94350	0.93939	0.98113
Form of poisoning	39	0.94545	0.95480	0.93561	0.96226

TABLE 1—*Continued.*

Variable Name	Total Number	Overall Agreement	Medical Examiner/Coroner (ME/C) System: State ME/C	State ME County ME/C	County ME/C
Method of poisoning	39	0.94949	0.95480	0.94697	0.94340
Fell from or into an object	34	0.95152	0.97175	0.93561	0.96226
Injury result from firearm	26	0.95354	0.97175	0.94697	0.92453
Other substance used	14	0.95758	0.97740	0.93939	0.98113
Age at death	494	0.95758	0.96045	0.95455	0.96226
# of alleged perpetrator	31	0.95960	0.96045	0.95455	0.98113
Detailed Hispanic ethnicity	12	0.96162	0.98870	0.94318	0.96226
Mental disability	15	0.96162	0.96045	0.96212	0.96226
Poison code	38	0.96162	0.95480	0.96591	0.96226
Method of homicide	79	0.96364	0.97740	0.95076	0.98113
Cause of fall	37	0.96364	0.97740	0.95455	0.96226
Method of suicide	73	0.96768	0.94915	0.97348	1.00000
Firearm circumstance unknown	22	0.96970	1.00000	0.96591	0.88679
None safety equipment used	20	0.96970	1.00000	0.95455	0.94340
Other protective device used	8	0.97172	0.99435	0.96212	0.94340
Suicidal factor unknown	28	0.97172	0.94915	0.98485	0.98113
Depression	31	0.97172	0.98305	0.96212	0.98113
Physical disability	9	0.97374	0.98305	0.96212	1.00000
*COPD	8	0.97374	0.97740	0.96591	1.00000
Type of vehicle involved in accident, light truck	29	0.97374	0.96045	0.97727	1.00000
Other type of vehicles involved in accident	8	0.97576	0.98305	0.96970	0.98113
Other suicidal factor	9	0.97576	0.97740	0.96970	1.00000
Marital/relation problem	16	0.97778	0.98305	0.97727	0.96226
Passenger seat belt(s)	5	0.97980	0.97175	0.98106	1.00000
Other safety equipment	6	0.97980	0.99435	0.97348	0.96226
Permission to donate organ	7	0.97980	0.98870	0.97348	0.98113
Organ/tissue/bone donnated	13	0.98182	0.99435	0.97348	0.98113
Dispute, argument, domestic	6	0.98182	0.98305	0.98106	0.98113
Dispute, argument, non-domestic	5	0.98182	0.98305	0.98106	0.98113
Driver seat belt used	9	0.98182	0.97175	0.98864	0.98113
Type of water source for non-transport accident	11	0.98586	0.98305	0.98485	1.00000
Other firearm circumstance	--	0.98586	0.99435	0.97727	1.00000
Previous suicide threats	13	0.98586	0.98870	0.98106	1.00000
Gender	492	0.98788	1.00000	0.97727	1.00000
*Hypertension	11	0.98788	0.98870	0.99242	0.96226
Seat belt equiped	9	0.98990	0.97740	0.99621	1.00000
*Cancer	12	0.98990	1.00000	0.98485	0.98113
*Alzheimer's	--	0.98990	0.98870	0.99621	0.96226
*Organic brain syndrome	--	0.98990	0.98870	0.99621	0.96226
Financial problems	5	0.98990	0.98305	0.99242	1.00000
*Stroke	--	0.98990	0.99435	0.98485	1.00000
*Osteoporosis	--	0.99192	0.99435	0.98864	1.00000
*Arthritis	--	0.99192	0.99435	0.98864	1.00000
Drive-by shooting	--	0.99192	1.00000	0.98485	1.00000

continues

TABLE 1—*Continued.*

Variable Name	Total Number	Medical Examiner/Coroner (ME/C) System: Overall Agreement	State ME/C	State ME County ME/C	County ME/C
Robbery	--	0.99192	0.98870	0.99242	1.00000
Type of vehicle involved in accident, bicycle	5	0.99192	0.99435	0.98864	1.00000
Legal problems	--	0.99192	0.98870	0.99242	1.00000
Work related problems	--	0.99192	0.98870	0.99621	0.98113
Previous suicide attempts	11	0.99192	0.99435	0.99242	0.98113
*Diabetes	7	0.99394	0.99435	0.99242	1.00000
*HIV/AIDS	5	0.99394	0.99435	0.99242	1.00000
Type of vehicle involved in accident bus	--	0.99394	0.99435	0.99242	1.00000
truck, heavy	--	0.99394	0.98870	0.99621	1.00000
Illness of decedent	14	0.99394	0.99435	0.99242	1.00000
Mental/ psych illness	--	0.99394	0.99435	0.99621	0.98113
Helmet equiped	--	0.99394	0.99435	0.99242	1.00000
Cleaning firearm	--	0.99596	1.00000	0.99242	1.00000
Fire resulted from	8	0.99596	1.00000	0.99242	1.00000
Loss/death of loved one	--	0.99596	1.00000	0.99621	0.98113
Type of vehicle involved in accident airplane	--	0.99596	1.00000	0.99621	1.00000
boat	--	0.99596	0.99435	0.99621	1.00000
farm equipment	--	0.99596	1.00000	0.99242	1.00000
Abduction	--	0.99798	1.00000	0.99621	1.00000
Assault, sexual	--	0.99798	1.00000	0.99621	1.00000
Assault, other	--	0.99798	1.00000	0.99621	1.00000
Drug activity	--	0.99798	1.00000	0.99621	1.00000
Gang activity	--	0.99798	1.00000	0.99621	1.00000
Hunting incident	--	0.99798	1.00000	0.99621	1.00000
Police intervention	--	0.99798	1.00000	0.99621	1.00000
Playing with firearm	--	0.99798	1.00000	0.99621	1.00000
Random shooting	--	0.99798	1.00000	0.99621	1.00000
Type of vehicle involved in accident, motorcycle	13	0.99798	1.00000	0.99621	1.00000
Train	--	0.99798	1.00000	0.99621	1.00000
Driver air bag	--	0.99798	1.00000	0.99621	1.00000
Passenger air bag	--	0.99798	1.00000	0.99621	1.00000
Type of fire/flame injury	7	0.99798	1.00000	0.99621	1.00000

*The diseases mentioned are from medical condition/history of the investigative report not from underlying cause-of-death of the death certificate.

-- Indicates less than 5 cases were reported.

of occurrence of death; and date, time, and location of pronouncement of death.

For toxicology reports, we also evaluated the agreement of abstractors related to: 1) Specific drugs for which toxicology tests were performed (missing data included), and 2) Drugs detected, type of specimen tested, drug concentration, and test method (missing value excluded). As Table 2 indicates, there is 69% agreement for the drugs tested. When type of specimen, drug concentration, and test method were also included in the evaluation of abstractor agreement, however, agreement decreased to 47%.

For autopsy reports, injury-related information was abstracted using the abbreviated injury scale (AIS) coding—a 6 digit code. All of the information abstracted in this group was taken from cases with complete records only (no missing values included). AIS coding was anlyzed for: 1) body region injured (1st digit), 2) body region and type of anatomic structure injured (1st and 2nd digit), 3) body region, type of anatomic structure, and specific anatomic structure injured (1st—4th digit), 4) body region, type of anatomic structure, specific anatomic structure injured, and specific injury type (all 6 digits). As shown in Table 3, as more injury detail was included in the assessment of abstractor agreement, less abstracting agreement was observed.

Discussion

There are several types of error that can occur during the abstraction of ME/C reports into a useful database. They may result from incomplete reporting of information by ME/Cs or sub-

TABLE 2—*Agreement of toxicology information abstracted from toxicology reports in the 1993 NMFS.*

Reliability of Abstraction of	Medical Examiner/Coroner (ME/C) System			
	Overall	State ME/C	State ME County ME/C	County ME/C
Drug tested	0.691	0.693	0.674	0.638
Drug, specimen, concentration, and test method	0.472	0.451	0.494	0.451

TABLE 3—*Agreement of injury information abstracted from autopsy reports in the 1993 NMFS.*

Reliability of Abstraction of	Medical Examiner/Coroner (ME/C) System			
	Overall	State ME/C	State ME County ME/C	County ME/C
Body region	0.553	0.551	0.556	0.544
Body region, type of anatomic structure	0.494	0.502	0.497	0.458
Body region, type and specific anatomic structure	0.427	0.425	0.435	0.406
Body region, type and specific anatomic structure and injuries	0.303	0.293	0.308	0.320

sequent errors associated with typography, interpretation, coding, or keying. Despite our efforts to minimize abstraction errors related to typography, interpretation, coding, and data entry, we did not achieve good inter-rater reliability for the items related to the time and location of events surrounding death, specifics of toxicology evaluations, and very specific injury. Possible reasons could be:

- nonstandard report formats used by ME/Cs, which may make the difference unclear between the circumstances of actual occurrence of death and pronouncement of death, especially if the data were included in narrative format rather than line items;
- the complexity of toxicology reports themselves and, depending on the laboratory, the format of reports (which may vary from a few lines to extensive listings or narrative descriptions), starting from reports of initial drug screens to reports of positive drug confirmations;
- multiple dimensions of drug type, specimens tested, test methods, and concentrations;
- the use of ambiguous language, at times (such as "cocaine and/or cocaine metabolites), which made interpretation difficult;
- inconsistent significant figures and unit usage when reporting concentration values;
- use of different names for the same drug or metabilite;
- discrepancies between injury detail in ME/C reports and the criteria used for AIS coding schemes;
- presence of injury information in narrative form within autopsy reports which requires thorough understanding of terminology and injury concepts by abstractors.

Conclusions

Overall, the results indicate that manual abstraction of many data items in ME/C records can be accomplished reliably, but that some data items pose problems for abstractors. The results are consistent with other studies that descriptions in ME/C investigative and autopsy reports are detailed—and that AIS coding may be successfully applied to autopsy reports—but that the application of AIS coding to autopsy report information is better for some types of injuries than others (7–9). These considerations might explain why abstractor agreement about injury information decreased as the specificity of injury information increased. Possible reasons for low abstractor agreement among other types of information were discussed above.

The results also suggest that using ME/C investigative and autopsy reports for research could benefit from more standardized electronic storage of data and more standardized reporting of some "troublesome" variables in a more consistent hard copy format. Electronic formats would reduce the need for manual abstraction thereby reducing the effect of human error. Standard hard copy report formats would facilitate the manual abstraction of data from reports. Recommendations for standard electronic data bases (ME/C Office Automation Manual available from Gib Parrish, Medical Examiner/Coroner Information Sharing Program, CDC, Atlanta) and hard copy report formats (11) have been offered, although some revision and updating of these recommendations is probably needed. Electronic standardization could provide for the clearest possible presentation of ME/C reports, minimize errors, avoid duplication, promote efficiency, provide for the transfer of data between systems, and provide better management control of study operations. But clearly, electronic standardization alone cannot improve data quality: it needs to be combined with quality assurance, education, and ongoing evaluation.

References

1. Pollock DA, O'Neil JM, Parrish RG, Combs DL, Annest JL. Temporal and geographic trends in autopsy frequency of blunt and penetrating trauma deaths in the United States. JAMA 1993;269: 1525–31.
2. Riddick LR, Wanger GP, et al. Gunshot injuries in Mobile County, Alabama: 1985–1987. Am J Forensic Med Pathol 1993:14:215–25.
3. Li L, Smialek JE. Observations on drug abuse deaths in the State of Maryland. J Forensic Sci 1996;41:106–9.
4. Kung H-C, Parrish RG, Spitler JF. The abstractability and consistency of medical examiner/coroner reports: results from the 1993 National Mortality Followback Survey pilot. J Forensic Sci 1996;41:86–93.
5. The abbreviated injury scale, 1990 Revision. Association for the Advancement of Automotive Medicine, 2340 Des Plaines River Road, Suite 106, Des Plaines, Il. 60018.
6. Lilienfield DE, Stolley PD. Foundation of epidemiology. Third edition, Oxford University Press, 1994.
7. Long WB, Sacco WJ, Copes WS, Lawnick MM, Proctor SM, Sacco JB. An evaluation of expert human and automated abbreviated injury scale and ICD-9-CM injury coding. J Trauma 1994;36:499–503.
8. Adams VI, Carrubba C. The abbreviated injury scale: application to autopsy data. Am J Forensic Med Pathol 1998;19(3):246–51.
9. Riddick L, Long WB, Copes WS, Dove DM, Sacco WJ. Automated coding of injuries from autopsy reports. Am J Forensic Med Pathol 1998; 19(3):267–74.
10. Centers for Disease Control, Death Investigation Data Set, unpublished report, 1988. Atlanta: Department of Health and Human Services, Public Health Services, CDC, 1988.
11. Hanzlick RL, Parrish RG. Death investigation report form (DIRFs): generic forms for investigators (IDIRFs) and Certifiers (CDIRFs). J Forensic Sci 1994;39(3):629–36.
12. Iyasu S, Hanzlick R, Rowley D, Willinger M. Proceedings of "Work-

shop on Guidelines for Scene Investigation of Sudden Unexplained Infant Deaths"—12–13 July 1993.
13. Rosenberg ML, Davidson LE, Smith JC, et al. Operational criteria for the determination of suicide. J Forensic Sci 1989;33(6):1445–56.
14. Hwang R-J, Kung H-C. In need of standardization of toxicology reports for forensic laboratories. Proceedings of 1998 American Academy of Forensic Sciences;1998(4):244.

Additional information and reprint requests:
Hsiang-Ching Kung, Ph.D.
NCHS
CDC
6525 Belcrest Road
Room 840
Hyattsville, MD 20782