

An Evaluation of New Jersey's Hospital Discharge Database for Surveillance of Severe Occupational Injuries

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Computerized population-based hospital discharge data in New Jersey offer new opportunities for surveillance of serious work-related injuries. This database was evaluated for its potential in identifying selected injuries that occurred at work during 1985 and 1986. Hospital discharge data were compared with data collected by telephone interview of discharged patients. A total of 1,575 unique hospital discharge records for the selected injuries included finger amputation (1,041), thumb amputation (209), crush injury of the lower limb (208), toxic effects of heavy metals (69), and eye burns (48). Of 809 study subjects sent letters, 445 (55%) could be contacted and 289 (36%) were interviewed for the study. Sixty-one percent (175) said their injury was work related. A comparison was made between self-reported injury at work, and the presence of workers' compensation payer codes on the discharge database. The agreement beyond chance (Kappa) was 0.78 (95% CI = 0.67,0.89). The sensitivity of this indicator of work relatedness was 83%; specificity was 98%. These data suggest that workers' compensation payment on the hospital discharge database may be a good to excellent proxy indicator of the work relatedness of these injuries. However, this proxy indicator will underestimate the number of work-related injuries by about 20%. Only 11% of hospital discharge records had external cause of injury codes (E-codes), which reduces the utility of the database for understanding the causal mechanisms of work-related injuries. © 1993 Wiley-Liss, Inc.

Key words: work-related injuries, heavy metal intoxication, occupational disease, finger amputations, eye burns, lower limb trauma, workers' compensation, hospital discharge data

INTRODUCTION

Nonfatal work-related injuries are a major cause of work-related illness, and may require immediate medical care, engender lost work days and/or hospitalization, and result in permanent disability. The National Institute for Occupational Safety and Health estimates that at least 10 million injuries occur on the job each year [CDC,1984], about 3 million of which are severe enough to be treated in hospital emergency rooms [CDC, 1983]. The National Safety Council estimates that about 1,700,000 work-related injuries result in temporary or permanent disability beyond

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the day of the injury [National Safety Council, 1990]. If progress toward The Year 2000 Objectives [USDHHS, 1991] of reducing severe work-related injuries by 20% is to be achieved, adequate surveillance mechanisms [CDC, 1988] must be in place to assess changes in the frequency of severe on-the-job injuries.

An injury surveillance system is useful, if it generates data that can lead to the prevention and control of injuries, or if it leads to research about injury prevention and control [CDC, 1988]. For example, the presence of external cause of injury information (E-code) on a database, such as injury caused by a metal working machine (E919.3), would be useful for targeting prevention activities. Statewide hospital discharge data are increasingly being used for injury surveillance [Sniezek et al., 1989; Marganitt et al., 1990] and are potentially useful for surveillance of work-related injuries that result in hospitalization. These databases are not, however, designed for the purpose of surveillance, and the extent to which they can be used for work-related injury surveillance is largely unexamined. These databases are currently maintained by 28 states [Mackenzie et al., 1988].

The purpose of this paper is to evaluate the utility of New Jersey's hospital discharge database for surveillance of 5 selected injuries that occurred at work during 1985 or 1986. The 5 injuries and their International Classification of Disease—9th Coding Manual (ICD-9CM) nature of injury codes (N-codes) are finger amputation (886.0–886.1), thumb amputation (885.0–885.1), crush injury of the lower limb (928.0–928.9), intoxication due to heavy metals (985.0–985.9), and eye burns (940.0–940.9). The 5 specific injuries were chosen based on the expectation that a high proportion of 4 would be work-related (finger and thumb amputation, crushing injury of the lower limb, and eye burns), and because one was already reportable by regulation [New Jersey Register, 1985] to the New Jersey Department of Health (NJDOH) (intoxication due to heavy metals).

Two main questions were addressed by this study. First, was there sufficient information on the hospital discharge database to identify work-related injuries? This is an essential first step to counting these injuries as part of an occupational injury surveillance system. Second, was there external cause of injury information on the discharge database, e.g., metal working machine, coded as E-codes? In addition, was there sufficient external cause of injury information on the original medical records (admission sheet and discharge summary) to assign E-codes to the medical record? This information is necessary for suggesting where to target prevention activities.

MATERIALS AND METHODS

Hospital Discharge Database

Beginning in 1976, the 105 acute-care (nonfederal) hospitals in New Jersey were required to computerize information on patient characteristics, diagnoses, procedures, and method of payment for each discharge. Starting in 1981, this database was used to create a uniform bill-patient summary, so that diagnoses could be aggregated into diagnostic-related groups and used by the NJDOH for rate-setting purposes. Computerized records with patient name and address are sent first to a data processing company for editing. Then the records are sent to the NJDOH, without personal identifying information, in order to maintain confidentiality.

A subfile of the database held by the NJDOH was requested for the years 1985 and 1986 for all records with a primary diagnosis of any of the 5 selected injuries. The

TABLE I. Overview of Persons Selected From the Hospital Discharge Database and Subjects Interviewed by Injury Type, New Jersey, 1985–1986

Subject selection process from database	Finger/thumb amputations		Crush injury lower limb		Heavy metal intoxication		Eye burns		Total	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Admissions	1,250	(100)	208	(100)	69	(100)	48	(100)	1,575	(100)
Identified by hospital	1,086	(87)	130	(63)	52	(75)	25	(52)	1,293	(82)
Subjects selected	637	(51)	126	(61)	21	(30)	25	(52)	809	(51)
Subjects interviewed ^a										
Contacted	355	(56)	71	(56)	9	(43)	10	(40)	445	(55)
Not contactable	282	(44)	55	(44)	12	(57)	15	(60)	364	(45)
Interviewed	241	(38)	48	(38)	5	(24)	8	(32)	302	(37)

^aPercentages are based on the total numbers of subjects selected for each injury type.

subfile included the medical record number, patient number, hospital code, the primary ICD9-CM diagnosis, up to 8 ICD9-CM secondary diagnoses, up to eight procedure codes, hospital admission date, sex, birth date, primary payer, zip code of patient's residence, municipality and county of patient's residence, and attending physician code. Discharge coding rules specify that the primary diagnosis code must be a nature-of-injury code (N-code) rather than an E-code. The secondary diagnosis fields may contain an external cause of injury code (E-code) on a voluntary basis. The primary payer may be private health insurance, workers' compensation, self-pay, or uninsured. The primary payer is the expected source of payment asked at the time of hospital admission. The database does not include persons treated only in hospital emergency rooms or outpatient clinics.

Composition of Study Population

A merged file for both years, 1985 and 1986, was created containing 1,601 records. Repeat admissions of the same individual were eliminated from this merged file. This was performed by deleting all discharges ($n = 26$) except the first for any discharge(s) that matched on all of the following fields: primary diagnosis, month and year of birth, sex, race, and zip code of patient's residence. There was a total of 1,575 individual admissions for the 5 selected types of injuries during 1985–1986 (Table I). The number of incident admissions for thumb amputations (209) was a small percentage (17%) of the total finger and thumb amputations (1,250).

A total of 1,575 records were sent to 97 hospital medical records directors for the addition of personal patient identifying information. Eighty-two percent (1,293 records) were returned from 83 hospitals with completely identified records, including name, address, and phone number. Twelve hospital medical records directors did not respond to repeated requests for information; two directors refused for confidentiality concerns.

A list of all personally identified patients was sent to the attending physicians, as identified by the attending physician code on the discharge database. Physicians were asked to notify us if their patients should not be contacted about their injuries. Four physicians objected to including their patients as potential study subjects, so no attempt was made to contact them (4 patients).

There were 1,086 amputations with personal identifiers. Of these, 926 were for

fingers. A simple random sample of 496 finger amputation cases was chosen (about 50%) by selecting random days of the month (1–31), and then selecting records with those days of hospital discharge. The sample was chosen to reduce the number of finger amputations for study relative to the other injury types (Table I).

In addition to the random exclusion of 430 finger amputation records, which reduced the total number of potential study subjects from 1,293 to 863, the number was further reduced by 54, to 809, for the following reasons: suspected coding errors among persons admitted with a primary diagnosis of heavy metal poisoning and secondary psychiatric diagnoses, such as depression and suicide attempts ($n = 29$); persons who participated in the pilot study of the telephone questionnaire were ineligible for the main study ($n = 21$); and physicians who declined on behalf of their patients ($n = 4$).

Subject Interviews

A letter of introduction, consent form, and a form giving us permission to request a copy of the patient's medical records were mailed to each potential study subject with a return self-addressed stamped envelope. A telephone call was made 2–3 days after the mailing to attempt to interview the study subject. The work-relatedness of the injury was based on the subject's response (yes/no) to the question: "Were you at work or at your job or at your place of business when the injury occurred?" For instances in which the injury was work related, additional questions regarding the employer and occupation at the time of the injury; the circumstances of the injury, including the external source of injury; worker training; and actions taken to prevent similar injuries were asked. For work-related cases in which a social security number was provided, a workers' compensation claim was searched for in the workers' compensation office of the New Jersey Department of Labor. Interviews of subjects who were injured at work lasted approximately 15 minutes. Interviews of subjects who were not injured at work lasted about 5 minutes. After the interview, the subject was asked to send the consent form and the form giving permission to request a copy of their discharge summary and admission sheet back to the NJDOH. All study interviews were conducted between October 1989 and October 1990, a period 3–5 years following hospitalization.

A total of 809 letters were mailed to potential subjects. Of 364 persons unable to be contacted, 265 (73%) moved, 73 (20%) had an unpublished telephone number, and 26 (7%) could not be contacted for other reasons. Of 445 people contacted, 302 (68%) were successfully interviewed and 143 (32%) refused. Only persons 16 years of age or older were eligible for the study ($n = 289$). The 55% contact rate (445/809) was achieved after at least 2 mailings for persons who moved to another address and searching the Department of Motor Vehicle records for current addresses of persons who did move. The 68% (302/445) interview rate was achieved after up to 5 telephone callbacks. The response rate for completed eligible interviews was 36% (289/809).

No one under 16 had an occupationally related injury. Thirteen subjects who were interviewed and who were under age 16 at the time of their injury, were excluded. Thus, there was a total of 289 completed interviews of persons 16 years of age or older.

Medical Record Review

The medical records (discharge summary and admission sheet) were requested from the respective hospital where the hospitalization occurred. The medical records were abstracted for primary diagnosis (N-code), admitting diagnosis, occupation and industry, and external cause of injury information. E-codes were then assigned to each case, based on the medical record data available, and later, independently, based on the telephone interview.

Statistical Analysis

Agreement between work relatedness of injury by self-report and presence of workers compensation codes in the primary payer field in the hospital discharge database was assessed by an agreement statistic (Kappa) and 95% confidence intervals [Fleiss, 1981].

The Chi-square test was used to assess the statistical significance of the difference in proportions of people interviewed from people not interviewed by selected variables on the database.

RESULTS

A comparison of selected demographic variables of persons interviewed with persons unable to be interviewed was made (Table II). For this comparison, the total number of hospital discharge records for persons 16 years of age or older were used ($n = 1,414$). Younger persons, especially those 25–34, were less likely to be interviewed than older persons, especially those 55–64. Similarly, blacks and Hispanics were less likely to be interviewed than whites. Persons interviewed were more likely to have a thumb amputation than a finger amputation. No difference by gender was seen, however, in likelihood of a completed interview. In addition, persons who were interviewed were just as likely to have a workers' compensation primary payer code on their discharge database (50.9%) as those who were not interviewed (51.0%).

Work-Relatedness of Injuries

The total proportion of 289 interviewed cases, who said their injury was work related, was 60.6% or 175/289. The proportion of subjects who said their injury was work related by injury type was finger/thumb amputation (58.8%, 134/228), lower limb crush injury (70.2%, 33/47), heavy metal intoxication (60%, 3/5), and eye burns (50%, 2/4).

The only indicator of the potential work relatedness of these injuries on the hospital discharge database was the presence of workers' compensation payer codes in the primary payer field. The agreement between self-reported injury at work for an amputation and the presence of workers compensation codes in the primary payer field on the database is presented in Table III. The reliability measure (Kappa) is 0.76 and is interpreted as excellent agreement beyond chance [Fleiss, 1981]. Furthermore, assuming the true classification is by interview, the specificity was higher than the sensitivity. The proportion of false negatives (19%) (i.e., no workers' compensation code, but self-reported injury at work) is higher than false positives (2%) (i.e., there is a workers' compensation code, but the self-report of injury was not work related).

TABLE II. Comparison of Selected Variables From Hospital Discharge Database for Interviewed (n = 289) and Noninterviewed (n = 1125) Persons, New Jersey, 1985-1986

	Interviewed ^b		Noninterviewed	
	n	(%)	n	(%)
Age category				
16-24	64	(22)	249	(22)
25-34	52	(18)	317	(28)
35-44	52	(18)	208	(19)
45-54	40	(14)	150	(13)
55-64	52	(18)	122	(11)
65+	29	(10)	79	(7)
Race/ethnicity				
White (non-Hispanic)	232	(80)	714	(64)
Black (non-Hispanic)	30	(10)	191	(17)
Hispanic	19	(7)	183	(16)
Other	3	(1)	25	(2)
Unknown	5	(2)	12	(1)
Injury type ^a				
Finger amputation	162	(56)	774	(69)
Thumb amputation	67	(23)	129	(12)
Crush injury lower limb	47	(16)	131	(12)
Eye burn	8	(3)	28	(3)
Chemical poisoning	5	(2)	63	(6)

^aIncludes one person who had a finger amputation according to the hospital discharge data but who refused to identify the type of injury during the telephone interview.

^bThe percent distributions of all 3 above variables for interviewed and non-interviewed persons were significantly different by chi-square test ($p < 0.001$).

TABLE III. Agreement Between Injury at Work by Interview and Presence of Workers' Compensation Payer Codes on the Discharge Database: Finger and Thumb Amputations, New Jersey, 1985-1986 (n = 228)

	Workers' compensation codes on the discharge database		
	Yes	No	Total
Injury at work by interview			
Yes	109	25	134
No	2	92	94
Total	111	117	228

Reliability measures: Percent agreement = 89%.

Agreement beyond chance (Kappa) = 0.76.

95% confidence interval for Kappa = (0.67-0.89).

Validity measures: Sensitivity = 81%; false negative proportion = 19%.

Specificity = 98%; false positive proportion = 2%.

Of the 25 false negatives, 13 were self-employed, and, thus, would not be covered by workers' compensation. Twelve were employed by others, eight of whom had a workers' compensation claim on file in the New Jersey Department of Labor. The

TABLE IV. Number of Records With External Cause of Injury Codes (E-code) on the Hospital Discharge Database, and the Number of Available Medical Records Assigned an E-code by Injury Type, New Jersey 1985–1986

	Hospital discharge records ^a			Medical records		
	No. with E-code	(%)	Total records	No. E-codable ^b	(%)	Total records
Finger/thumb amputation	97	(9)	1,132	73	(78)	94
Lower limb crush injury	15	(7)	178	12	(75)	16
Heavy metal intoxication	36	(53)	68	—	—	—
Eye burns	3	(8)	36	4	(80)	5
Total	151	(11)	1,414	89	(77)	115

^aDischarge records of persons 16 years of age or older.

^bHad sufficient information to assign an E-code.

agreement for crush injury of the lower limb was 91%, Kappa = 0.84 (95% CI = 0.61–1.07); the false negative number and percent were 4 and 12%, respectively.

Of the 289 persons interviewed, 115 (40%) gave permission to request their medical records. We retrieved 100% of these records. We asked for only the admission sheet and the discharge summary, but we frequently got more than these records. All of the 115 records we received confirmed the nature of injury by self-report by examining the primary discharge diagnosis (N-code) and the written admitting diagnosis on the admission sheet of the medical record.

We also examined work-relatedness information on medical records. Of 115 medical records reviewed, including the admission sheet and discharge summary, only 59 (51%) had any mention of whether the injury occurred at work or not. Of 68 persons with work-related injuries and whose medical records were reviewed, 43 (63%) records indicated the injury occurred at work, 25 (37%) had no information about the work-relatedness of injury.

External Cause of Injury Codes (E-Code)

The second objective of this evaluation was to determine the frequency of occurrence of E-codes on the hospital discharge database. In addition, medical records were requested in order to assign E-codes independently of the database and to verify the injuries.

The frequency of E-code occurrence on the hospital discharge database by injury type, and the frequency of E-codes that we assigned based on the available medical records are presented in Table IV. For the discharge data, only 151 of 1,414 (11%) records of persons 16 years of age or older had at least one E-code in one of eight secondary diagnosis fields. Only one of the 151 records with E-codes had more than one E-code. E-codes were less likely to be present on the hospital discharge database, if the injury was at work (7%) than if it was not (15%).

Of 115 medical records, 89 (77%) were assigned an E-code based on information in the admission sheet and discharge summary. External cause information was less common on medical records of persons injured at work (74%) than not (83%). We were unable to assign an E-code, based on the admission sheet and discharge summary, to 23% of the medical records of persons injured at work.

Based on the interview data, we were able to assign an E-code to 100% of the cases interviewed ($n = 68$) for which we had medical record data and whose injury occurred at work. E-codes assigned to medical records were the same as E-codes assigned to the interview 90% (45/50) of the time E-codes were available from both the medical record and the interview. The most frequent external causes of the 68 injuries in descending order were other and unspecified machinery (E919.8 and E919.9, $n = 19$), caught accidentally in or between objects (E918, $n = 8$), lifting machines and appliances (E919.2, $n = 7$), woodworking and forming machines (E919.4, $n = 6$), metal working machines (E919.3, $n = 5$), struck accidentally by falling object (E916, $n = 5$), accidents caused by machinery (E919, $n = 4$), and 14 with other less common E-codes.

Of 68 medical records from persons with work-related injuries, 59 (87%) had name of employer; 8 of the remaining 9 were not self-employed, but their employer's name was not in the medical record. Only 32 (47%) records included the occupation of the patient. The percent agreement between employer and occupation information on the medical records and the interview, when information from both sources was present, was 97% and 88%, respectively.

DISCUSSION

The major findings of this study are two-fold. First, the New Jersey hospital discharge database can be used for surveillance of hospitalized severe occupational injuries. Second, the database has major limitations with respect to understanding why these injuries occur.

The positive aspects of using the database for occupational injury surveillance are (1) workers' compensation codes may be used as good to excellent proxy indicators of the work relatedness of finger amputations and crush injuries of the lower limb, thus, injury incidence and trend analysis are feasible; (2) basic demographic variables on the database permit the calculation of incidence rates by age, race, and sex (provided population data are available); (3) occupational injuries are reported reliably by workers as confirmed by medical records; and (4) at least in New Jersey, hospitals will provide personal identifying information, so that further epidemiologic study of the injured workers can be conducted.

The limitations of using the database for surveillance and epidemiologic study include: (1) the absence of personal identifying information for contacting injured individuals about the circumstances of their injuries; (2) the paucity of E-code information on the database; (3) the database only captures the most severe cases, i.e., it may represent only about 20% of all occupational finger amputations treated in New Jersey hospital emergency rooms [Consumer Product Safety Commission, 1990]; and (4) the less frequently occurring injuries, including lower limb crush injuries, eye burns, and heavy metal intoxication, are not suited for epidemiologic study unless larger databases are used, yet they may still be targeted for surveillance and prevention activities. A specific limitation of this study was the time lag between discharge and interview. This reduced the response rate and probably the recall of the injury circumstances.

In this study, E-codes were added to 50 of 68 (74%) medical records that described work-related injuries in enough detail to permit E-coding. This percentage

is much higher than the percentage of records on the hospital discharge database with an E-code: 11%. Clearly, more E-coding of medical records is feasible. E-codes on the discharge database were less often present for work-related rather than non-work-related cases. It may be that external causes of injuries are asked of non-work-related cases more thoroughly.

There are barriers to the use of E-codes on medical records. In New Jersey, E-codes do not influence hospital reimbursement rates, so the extra coding work is not of financial benefit to the hospital. Use of E-codes would also require some initial training, which adds to the cost. In addition, there may not be enough diagnostic fields in the database to add an E-code, depending on the severity of the injuries and the number of comorbid conditions of the injured person. The presence of E-codes on Maryland's hospital discharge database has been found to vary inversely with the age of the injured person and the severity of the injury [Marganitt et al., 1990].

E-codes are useful for understanding the mechanism of injuries, for suggesting how to prevent them, and thus, they should be added to hospital discharge databases [Guyer et al., 1990]. In a study of injuries to about 59,000 children injured in Massachusetts [Guyer et al., 1990], almost all medical records were assigned an E-code, whether the case resulted in hospitalization or emergency room treatment. The combination of nature of injury (N-code) data and cause of injury (E-code) data indicated a high proportion of head injuries to children in motor vehicle crashes. This suggested improving child restraint devices and possibly changing states laws regarding their use. Similarly, in a companion paper [Sorock et al., 1992], finger amputations at work in New Jersey were associated with work on saws and slicing machines, suggesting the need for improved guarding devices or safety practices.

Another problem with E-codes is their lack of detail in some instances. For example, in this study, nonspecific E-codes were assigned in 36 of 68 (53%) persons who were injured at work. E-codes should be expanded to include more detailed categories, including many types of machinery. We look forward to the next revision of the ICD-10 that will expand E-coding options.

In spite of these barriers, six states have mandated the use of E-codes for injuries recorded on their hospital discharge databases: New York, Rhode Island, Vermont, Wisconsin, Washington, and California [Sniezek et al., 1989; Marganitt et al., 1990]. Suggested strategies for mandating use of E-codes include: (1) meeting with hospital administrators and medical records personnel to discuss the issue of mandating the use of E-codes for injuries; (2) encouraging health professionals to ask about external causes of injuries at time of treatment or admission, and documenting causes in the medical record; (3) adding an additional field(s) in the discharge database exclusively for E-code(s); (4) providing training for medical record personnel in the use of E-codes; and (5) monitoring accuracy and trends in E-code usage by hospital and patient characteristics.

Occupational injury surveillance should be part of a comprehensive occupational illness and injury surveillance system. Hospital discharge databases can provide a valuable mechanism for identifying health conditions and for suggesting where public health interventions should be targeted [Rosenman, 1988; Kipen et al., 1991]. To be more effective, however, medical and public health professionals must work together to ensure that necessary information on external causes, and industry and occupation information is collected and recorded for future use.

CONCLUSIONS

In this study, we found that in New Jersey, the hospital discharge database can be used for counting cases with workers' compensation codes as a proxy indicator of work-relatedness of selected injuries, the caveat being that the number will be an underestimate and will primarily miss self-employed injured workers.

We recommend that, to improve use of hospital discharge databases for occupational injury surveillance, other states should conduct similar analyses to verify these findings; databases would be more efficient for surveillance, including follow-up activities such as interviewing patients, if personal identifying information were readily available, provided that strict adherence to confidentiality is maintained; E-coding should be mandated for medical records and inclusion on the hospital discharge database; the name of the employer and occupation should be added to the database, as agreement between both these variables on the medical records and interview was 97% and 88%, respectively, when they were available on both data sources; and at worksites identified by this surveillance mechanism, inspections could be conducted to determine the feasibility of adding a public health response component to prevent similar nonfatal injuries.

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REFERENCES

- Consumer Product Safety Commission (1990): National Injury Information Clearinghouse, Finger Amputation-1985 and 1986, National Electronic Injury Surveillance system (NEISS) (written communication).
- CDC (1983): Occupational finger injuries—United States, 1982. *MMWR* 32:589–591.
- CDC (1984): Leading work-related diseases and injuries—United States. *MMWR* 33:3–5.
- CDC (1988): Introduction: Moving from the 1990 injury control objectives to state and local surveillance systems. *MMWR* 37(No. SS-1):1–4.
- Fleiss J (1981): "Statistical Methods for Rates and Proportions," 2nd ed. New York: John Wiley & Sons, pp 212–236.
- Guyer B, Berenholz G, Gallagher S (1990): Injury surveillance using hospital discharge abstracts coded by external cause of injury (E-code). *J Trauma* 30:470–473.
- Kipen H, Gelperin K, Tepper A, Stanbury M (1991): Acute occupational respiratory diseases in hospital discharge data. *Am J Ind Med* 19:637–642.
- MacKenzie E, Steinwachs D, Edelstein S (1988): Utility of uniform hospital discharge data in trauma research and system evaluation. *Ann Proc Assoc Adv Auto Med* 32:89–109.
- Marganitt B, MacKenzie E, Smith G, Damiano A (1990): Coding external causes of injury (E-codes) in Maryland hospital discharge 1979–1988: A state wide study to explore the uncoded population. *Am J Pub Health* 80:1463–1466.
- National Safety Council (1990): "Accident Facts, 1990." Chicago, IL.
- New Jersey Register, October 21, 1985 (1985): New Jersey Administrative Code 8:57–1.13.
- Rosenman K (1988): Use of hospital discharge data in the surveillance of occupational disease. *Am J Ind Med* 13:281–289.

- Sniezek J, Finklea J, Graciter P (1989): Injury coding and hospital discharge data. *JAMA* 262:2270–2272.
- Sorock G, Smith E, Hall N (1993): Hospitalized occupational finger amputations, New Jersey, 1985 and 1986. *Am J Ind Med* 23:439–447.
- USDHHS (1991): “Healthy People 2000. National Health Promotion and Disease Prevention Objectives.” PHS 91-50212, Washington, DC: US Government Printing Office.