Electronic Medical Billing Records and Public Health Surveillance: Comparison of Two Systems Used During the 1996 Atlanta Olympic Games

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For selected diagnoses of public health interest during the 1996 Olympic Games, the authors compared data concurrently obtained on the same patient population by two separate surveillance systems: (1) an existing hospital electronic medical billing records system and (2) a system based on manual record abstraction. Counts of total patient visits closely agreed, though the two systems differed considerably in some diagnostic categories, especially injuries. The authors concluded that while causation, risk factors, and illness severity are not reflected directly in standard International Classification of Diseases (ICD) codes, and "E" codes to indicate causation may not be used, special-purpose surveillance systems based on existing computerized medical records may be as effective as manual data abstracting.

Key words: *causation, coding, computer data processing, data abstracting, electronic medical records, ICD-9-CM, nosology, risk factors, surveillance*

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Introduction

In the United States, public health surveillance began on a national level in the mid-1800s. Since that time, reports of selected conditions from health care providers have been the primary means of gathering data and disseminating information.[1] The volume and timeliness of such reports, even in the era of computerization, have been limited by the need for manual abstraction of medical information and data entry, both labor-intensive processes. Data on medi-

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cal encounters for diseases of high incidence or prevalence are available for public health decision making only through the expensive process of record abstraction as part of a study or special-purpose surveillance system.

Public health surveillance systems in nineteenth-century America were rudimentary, fragmented, incomplete, lacked timeliness, and were neither very sensitive nor specific. Unfortunately, the state of today's systems, where they exist at all, remains much the same. However, the computerization of medical records during the past decade offers an opportunity to improve the quality and timeliness as well as to expand the scope of public health surveillance to potentially include the entire range of conditions encountered in clinical practice, not just rare infectious diseases. To examine the possibility of obtaining public health surveillance data from an existing computerized system, we compared data from a routine electronic medical records system with data obtained by manual record abstraction for selected diagnoses. We evaluated the two sources for their potential usefulness in public health emergencies.

Methods

Olympic Sentinel Surveillance

During the 1996 Summer Olympic Games in Atlanta, Georgia, the Division of Public Health, Georgia Department of Human Resources, set up a surveillance system to detect public health problems during the Olympic Games. The system was based on manual record abstraction and entry of data regarding patient visits to emergency departments (EDs) and walk-in clinics affiliated with nine hospitals in the metropolitan Atlanta area. One of these hospitals, Grady Memorial Hospital, has an electronic medical records system for billing purposes that covers all acute care facilities. For purposes of this study, only records from Grady were evaluated. Public health personnel or volunteers visited the nine hospitals daily, abstracted paper records of the previous day's activity in the acute care setting, and tallied the total number of patient visits. Abstractors entered data into electronic files by using laptop computers and Epi Info[2] software. The files were combined, analyzed, and processed for quality control at the Georgia Division of Public Health.

The Olympic Sentinel Surveillance (OSS) functioned for the 2 weeks before, 2 weeks during, and 2 weeks after the Olympic Games. OSS staff, who were generally entry-level professionals at the Masters of Public Health (MPH) level and above, were employees from all parts of the Georgia Division of Public Health who volunteered to work on the OSS. They received several hours of orientation and written instructions for abstracting ED records using a coding sheet for 17 subcategories of conditions of public health interest (Figure 1).

Among the volunteer coders from OSS, levels of familiarity with medical terminology and medical records varied. They had access to the written medical record but no contact with the actual patient. They were encouraged to search for diagnoses falling within 17 OSS categories defined by the Georgia Division of Public Health for public health relevance.

Grady electronic medical billing record

One of the participating hospitals, Grady Memorial Hospital, had an existing electronic medical billing record (EMBR) system used for billing in its EDs and walk-in clinics. Acute care visits were coded according to the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) system.

For billing purposes, data about each visit to an ED or walk-in clinic at Grady routinely are recorded on one-page forms and entered into the hospital computer system. Data include patient identifiers, age, sex, race, date of visit, "chief complaint," and attending physician. The lower half of the form contains about 100 check boxes corresponding to selected ICD-9-CM codes and is used by the physician to record one primary diagnosis and unlimited secondary diagnoses. Available codes appear on the form based on historical experience of the most common diagnoses encountered in the ED or particular clinic. A box for "OTHER Dx:" at the end of the list of diagnoses allowed the attending physician to enter a text phrase that is mapped later to a specific ICD-9-CM code that might not appear on the list (Figure 1).

The list of check boxes varies by clinic within the Grady system. The list for the Women's Urgent Care Center differs from that of the Pediatric Emergency Care Center, for example. The attending physician assigns the diagnosis at the time of patient discharge based on all the information available at that time,

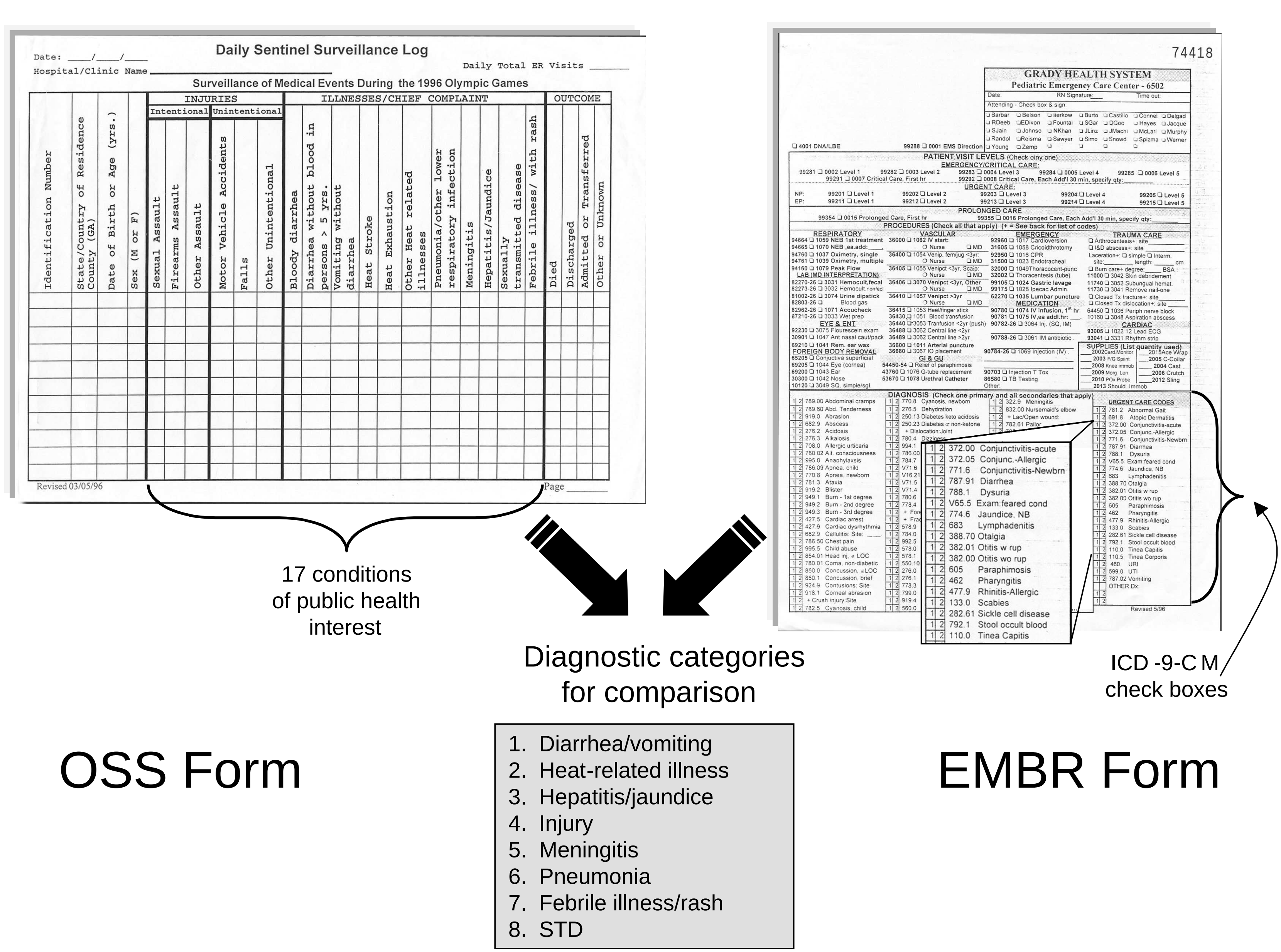

Figure 1. Mapping Olympic Sentinel Surveillance (OSS) and electronic medical billing record (EMBR) diagnoses to comparison categories

including whatever diagnostic test results are available. In many instances, the result is a nonspecific sign or symptom.

After patients are discharged, clerical personnel in each clinic enter the contents of the forms into the hospital computer system, which is managed by the Health Information Systems (HIS) Office of the hospital.

One of the authors, a Grady staff physician, obtained computer files for all patient visits to the Grady Emergency Care Center, Urgent Care Center, Women's Urgent Care Center, and Pediatric Emergency Care Center for the period May 12, 1996, through August 31, 1996 (which included the Olympic period of July 20, 1996, through August 4, 1996). Pertinent items for each visit included patient medical record number, age, sex, race, the "chief complaint" (in text form), and ICD-9-CM code(s). Other variables concerning dates and admissions status also were available. The files were imported into Epi Info for analysis.

Comparisons

We concentrated our analysis on the records of patients seen at Grady that were selected by the OSS system and had analogous records in the Grady EMBR system. We compared the OSS and EMBR systems at Grady for the study period July 7, 1996 through August 14, 1996. The following eight broad diagnostic categories covered by OSS were chosen for comparison:

- diarrhea/vomiting
- heat-related illness
- hepatitis/jaundice
- injury
- meningitis
- pneumonia
- febrile illness/rash
- sexually transmitted disease (STD)

The EMBR ICD-9-CM code for the primary diagnosis and the OSS diagnosis were mapped separately to one of these categories (Figure 1). Because hospital record numbers were present in both systems, it was possible to link the two data files and make detailed comparisons of electronic records for conditions in which counts were divergent and to read the "chief complaint" field in the EMBR records. No attempt was made to return to the original paper records. For reasons of confidentiality, upon completion of analysis of the data, patient identifiers, including hospital record numbers, were deleted.

The data from both systems were analyzed for trends. Patient visits were graphed by diagnosis and, when indicated, by age group. Epi Info files from the two systems were used to compare total visits and visits for the eight diagnostic categories cited above during the study period. Differences in daily counts by category were noted.

Results

Trends during the Olympics

EMBR records for May 12, 1996, through August 31, 1996, documented that total visits for most age groups remained relatively constant, though total visits for the age group 0 to 9 years declined noticeably during this interval (Figure 2). Further examination indicated that the decline was primarily in visits for respiratory disease.

Comparison of results from the two systems

Both systems recorded the total visit count, although the OSS produced abstracts only for the approximately one fourth of the visits considered to be of public health interest. During the study period, the total number of patient visits at Grady and its affiliated clinics recorded by the EMBR system was 20,962; the total number of patient visits at Grady recorded by the OSS system was 20,841. The mean number of total visits per day recorded by the EMBR system was 537.5; by the OSS system, 534.4. Daily totals differed by as much as –72 to +97 visits, however.

A possible explanation for the differences in daily totals at Grady lay in the sorting of stacks of records according to date of visit. The stacks were used by the OSS volunteers to enter data. Although volunteers were instructed to enter only records from the previous day, the stacks often contained numerous records from the following morning as well. The EMBR data were tied directly to the "date of visit" as recorded in the ED record. It is not surprising, therefore, that we observed a "phase shift" phenomenon in which graphs of patient visits generally matched, but one series occasionally lagged or led by a day or two.

After removal of EMBR records for which ICD-9-CM codes were not present (about 8% of the total),

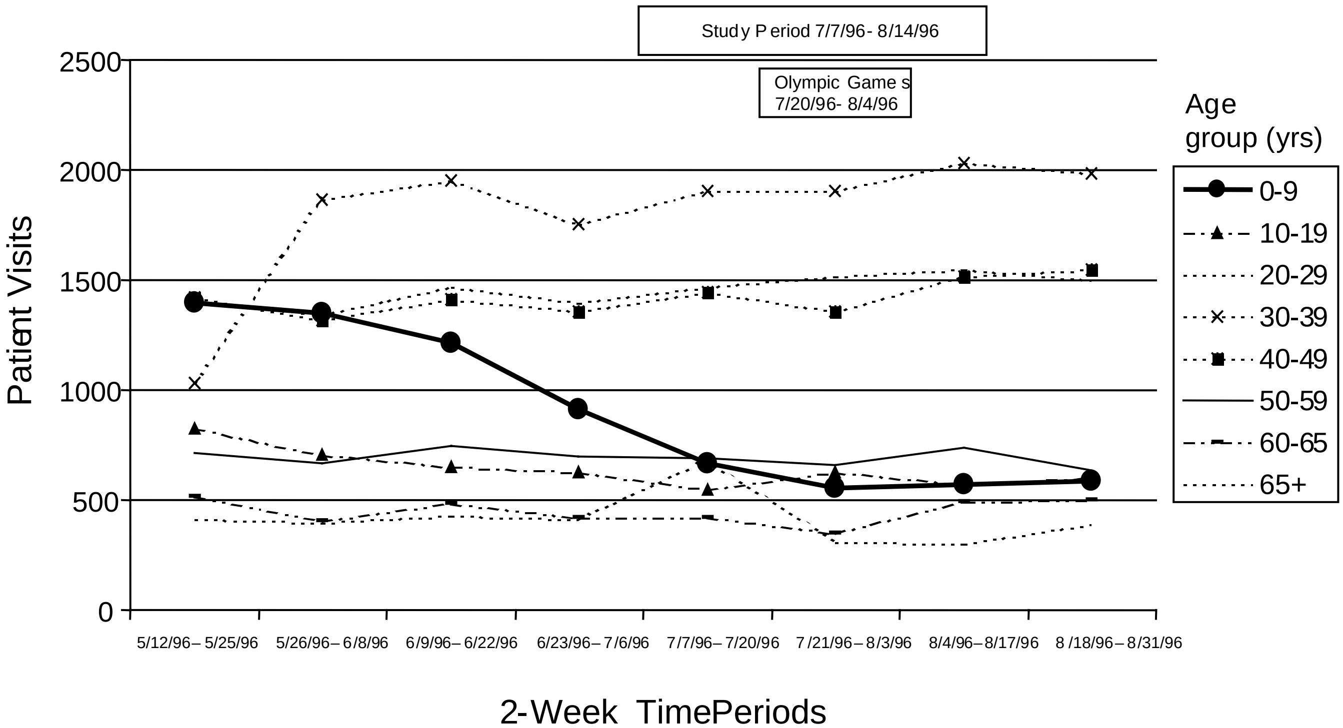

Figure 2. Patient visits by age group over 2-week time periods May 12, 1996, to Aug 13, 1996, electronic medical billing record (EMBR) data

19,708 records remained in the EMBR system. Diagnoses were present in all of the OSS records obtained after cleanup and processing. During the study period, 5,156 visits at Grady had diagnoses of OSS interest. Therefore, visits recorded by the OSS system comprised about one fourth of total visits recorded by the EMBR system. The remainder of visits at Grady had diagnoses not targeted by OSS.

In the EMBR system, 4,407 records were selected for the eight broad categories of comparison based on mapping ICD-9-CM codes in the EMBR system to the categories used in the OSS. Therefore, 749 more records existed in the OSS system than in the EMBR system for these categories, with the greatest numerical difference occurring in the injury category (1,081 more records in the OSS system than in the EMBR system). The results are summarized in Table 1.

Comparison of injuries detected

Detailed comparisons of injuries in the two systems were made because the discrepancies were greatest in this area. The OSS system contained 3,574 records with injury codes. These consisted of 577 falls (16%), 113 firearms assaults (3%), 863 other assaults (24%), 119 sexual assaults (3%), 1,479 unintentional injuries (41%), and 423 motor vehicle accidents (12%). Using medical record numbers, these OSS injury records were linked to 3,067 records in the EMBR file. Because 98 percent of the paired records had ages matching within 1 year, we considered that the match using medical record numbers was generally successful. The match allowed more detailed comparison of variables in the two systems for the same visit. Note that OSS records were derived by abstraction of paper records that included

> ***The match allowed more detailed comparison of variables in the two systems for the same visit.***

Table 1

Comparison of OSS and EMBR coding systems and surveillance results: Study period 7/7/96–8/14/96

Cases (OSS)	OSS Subcategory	Comparison Categories (8)	ICD-9-CM Description	ICD-9-CM Code	Cases (EMBR)	Discrepancy (Absolute Value)
214	Diarrhea –bloody –nonbloody	**1. Diarrhea/ vomiting**	Food poisoning, unspecified	005.9	1	
3	Vomiting		Clostridium difficile (pseudomembranous colitis)	008.45	1	
			Infectious colitis, enteritis, and gastroenteritis	009.0	1	
			Other and unspecified noninfectious gastroenteritis and colitis	558.9	223	
			Diarrhea NOS	787.91	22	
			Unspecified vomiting of pregnancy	643.93	17	
			Nausea with vomiting	787.01	84	
			Vomiting alone	787.03	6	
217		<—— Category Totals ——>			**355**	**138**
42	Heat exhaustion	**2. Heat-related illness**	Dehydration	276.5	92	
32	Heat stroke		Dizziness and giddiness	780.4	125	
458	Other heat-related illnesses		Heat stroke and sunstroke	992.0	1	
			Heat syncope	992.1	1	
			Heat exhaustion due to salt depletion	992.4	1	
			Heat exhaustion, unspecified	992.5	8	
			Syncope and collapse	780.2	64	
532		<—— Category Totals ——>			**292**	**240**
21	Hepatitis	**3. Hepatitis/ jaundice**	Hepatitis, unspecified	573.3	31	
			Jaundice, unspecified, not of newborn	782.4	2	
21		<—— Category Totals ——>			**33**	**12**
577	Falls	**4. Injury**	Injury and poisoning	800.0–999.9	2384	
113	Firearms assault		Examination of individual involved in motor vehicle traffic accident	V71.4	8	
863	Other assault		Observation following other inflicted injury	V71.6	3	
119	Sexual assault		Observation following alleged rape or seduction	V71.5	98	
1479	Unintentional injury					
423	MVA					
3574		<—— Category Totals ——>			**2493**	**1081**

continues

Table 1

Continued

Cases (OSS)	OSS Subcategory	Comparison Categories (8)	ICD-9-CM Description	ICD-9-CM Code	Cases (EMBR)	Discrepancy (Absolute Value)
8	Meningitis	**5. Meningitis**	Herpetic meningoencephalitis	054.3	1	
			Meningitis, unspecified	322.9	2	
8		<—— Category Totals ——>			**3**	**5**
159	Pneumonia	**6. Pneumonia**	Acute bronchitis	466.0	123	
			Pneumonia due to other virus not elsewhere classified	480.8	1	
			Pneumococcal pneumonia	481	4	
			Other specified bacteria	482.89	1	
			Bacterial pneumonia unspecified	482.9	2	
			Pneumonia, organism unspecified	486	86	
159		<—— Category Totals ——>			**217**	**58**
82	Fever/rash	**7. Febrile illness/rash**	Fever	780.6	209	
			Viral exanthem, unspecified	057.9	1	
			Rash and other nonspecific skin eruption	782.1	208	
82		<—— Category Totals ——>			**418**	**336**
563	STD	**8. STD**	Genital herpes	054.1	14	
			Herpetic infection of penis	054.13	1	
			Herpes simplex without mention of complication	054.9	12	
			Syphilis and other venereal disease	090–099.9	57	
			Candidal vulvovaginitis	112.1	39	
			Trichomonal vulvovaginitis	131.01	56	
			Phthirus pubis [pubic louse]	132.2	4	
			Acute parametritis and pelvic cellulitis	614.3	1	
			Unspecified inflammatory disease of female pelvic organs and tissues	614.9	43	
			Unspecified inflammatory disease of uterus (chronic)	615.1	3	
			Cervicitis and endocervicitis	616.0	172	
			Vaginitis and vulvovaginitis, unspecified	616.10	190	
			Contact with or exposure to venereal diseases	V01.6	4	
563		<—— Category Totals ——>			**596**	**33**
5156	<—— Total OSS cases		Total cases selected from Grady EMBR system —>		**4407**	**749**

text and other items not available in the EMBR electronic file.

ICD-9-CM codes for injury and poisoning are those from 800–999, V71.4 through V71.6. Of the 3,067 EMBR records identified, 1,400 had codes not in the range 800–999. Of the latter group, the most frequent ICD-9-CM diagnoses are shown in Table 2.

Using a different approach, namely visual inspection of the "chief complaint" text listed in EMBR records, we inferred that at least 500 entries not coded as such were likely injuries. In other records, injury was suspected but could not be substantiated (e.g., "pain in wrist").

"E" coding—"supplementary classification of external causes of injury and poisoning," E800–999—was present in only a few records. Injuries were coded by anatomic site and type.

The discrepancy between the OSS and EMBR systems in the category of injuries appeared to be caused mainly by ICD-9-CM coding that did not include information on cause or severity.

Coding differences

A number of coding problems were discovered in the OSS data set. Patients with urinary tract infections, who were screened for STDs, sometimes were given the STD diagnosis though results of the screen were not yet known (and may have been negative). Patients with upper respiratory infections sometimes were coded as "pneumonia" because the instruction sheet included "lower respiratory infections" in the pneumonia subcategory. Several cases of "rule-out meningitis" were coded as "meningitis." Occasionally, an event in the medical history was recorded as a current condition. These examples reflect a few of the difficulties of rapid training of non-medical volunteers for coding purposes, particularly if the range of conditions covered is large and the clinical setting is a general one. Approximately 20 records were identified in which the OSS code was for "firearms assault" but the EMBR diagnosis, confirmed by phrases in the electronic record, was "diarrhea." Further checking revealed that the laptop computer program used to code data in the OSS system made it easy to produce this particular miscoding error through an inadvertent keystroke at a page boundary.

Table 2

Most frequent ICD-9-CM diagnoses

Number of records	ICD-9-CM code	Diagnosis
197	719.4	Pain in joint
128	729.5	Pain in limb
117	724.5	Backache, unspecified
78	723.1	Cervicalgia (pain in neck)
50	786.5	Chest pain
49	V62.6	Refusal of treatment for reasons of religion or conscience
46	V71.8	Observation for other specified suspected conditions
39	729.1	Myalgia and myositis, unspecified
38	789	Other symptoms involving abdomen and pelvis

Bombing episode

On July 27, 1996, a bomb blast occurred in Centennial Olympic Park, approximately one mile from Grady Memorial Hospital. Thirty-five victims were taken to the Grady ED. The OSS system recorded a unique visible peak in "other assault" injuries for that day, but EMBR failed to show a similar peak in total injuries. The usual number of injuries recorded by EMBR ranged from 47 to 94 per day. Therefore, 35 injuries did not account necessarily for a majority of injuries for one day in the Grady ED. Because the EMBR system did not record causal information for injuries, bomb blast victims could not be differentiated.

Discussion

Evaluation of the surveillance systems

According to Thacker et al,[3] an assessment of the quality of a surveillance system should include the following attributes: usefulness, cost, sensitivity, specificity, representativeness, timeliness, simplicity, flexibility, and acceptability.

Usefulness

A system is useful if it generates a public health response leading to the control and prevention of an adverse health event or provides a better understanding of the underlying process responsible for the event.[3] Neither system appeared to be especially useful in detecting or preventing an adverse health event. However, both systems demonstrated the absence of major changes in acute care visits during the Olympic period. Because the EMBR system had data during a longer period, it was more useful for showing trends. OSS recorded a unique visible peak in "other assault" injuries on the day of the bomb blast, but one cannot conclude definitely that the blast actually caused the peak. Both systems lacked indicators of severity, medical care cost, and outcome. For some illnesses with an incubation period longer than a few days, neither system would have been useful in identifying the affected individuals nor in preventing further spread of disease because the victims would have scattered.

Cost

Surveillance can be costly, and evaluating the total cost of a system is difficult. Capturing data for the OSS system required daily visits to the Grady acute care facilities and about a half day of effort for each day recorded to obtain data on only about one fourth of the total Grady visits. "Cleaning" and preparing the data at the Georgia Division of Public Health occupied at least another week. Both systems required about the same effort for analysis. Because coding and data entry for the OSS were done by public health personnel, the *public health* resources required to operate OSS were estimated to be at least fourfold greater than those needed to analyze EMBR data from Grady, which had been entered by the hospital staff. Including all diagnoses, rather than the 25 percent transcribed, could have increased the difference to 16-fold.

Sensitivity and specificity

Sensitivity, also known as "completeness of reporting," is the proportion of persons with the health event that are identified by the surveillance system. It is the ability of the system to detect the adverse health event of interest.[4] Computing true sensitivity (and specificity as well) is not possible in the absence of a "gold standard." We can say, however, that the EMBR system *recorded* more cases of diarrhea/vomiting, pneumonia, and febrile illness/rash while the OSS system recorded more heat-related illness and injuries. The two systems were approximately equally "sensitive" in detecting hepatitis/jaundice, meningitis, and STD.

The OSS system detected 1081 more injuries than the EMBR. The higher sensitivity of OSS for "injury" was attributable to:

1. A difference in definition: The OSS system classified injury based on external cause whereas EMBR used injury type and anatomic site. No "E" codes to indicate cause of injury were recorded for primary diagnoses in the EMBR system.
2. The ability of public health coders to skim through each patient's chart and detect ancillary history that might classify "pain in the wrist," for example, as an injury. Although the electronic EMBR records contained "chief complaint," they omitted other items that may have been available to OSS abstractors (e.g., nursing notes, Emergency Medical Service (EMS) records, laboratory reports, records of prior visits).

Specificity is an indicator of the absence of false-positive events. The difference in injuries recorded by the two systems suggests the difficulty of balancing sensitivity and specificity in an automated surveillance system. Were joint disorders and non-specific cervical, back, and limb disorders (Diseases of the Musculoskeletal System and Connective Tissue—ICD-9-CM 710–739) recoded as injuries (Injury and Poisoning—ICD-9-CM 800–999), more injuries would have been identified in the EMBR system and sensitivity for injuries would have increased. However, perhaps hundreds of false positives would have been introduced, with consequent deterioration of specificity. Specificity would have decreased even further with the inclusion of symptom-based codes such as head, neck, and chest pain. Categories such as patient observation, psychosocial circumstances, and "no treatment" would have been even less specific, although they also would have contained some true injuries.

Representativeness

Representativeness refers to the completeness and validity of the collected surveillance data.[4] The EMBR and OSS systems observed essentially every patient visit in their target population. Consequently, both systems were highly representative of

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the acute care visits.[3] How representative they were of the surrounding community must be left to conjecture because acute care at Grady is open to all and population shifts during the Olympics were profound.

Timeliness

Timeliness refers to the interval between the occurrence of a health event and its report to the person or agency that needs to know.[3] In our "prototype" study, both systems recorded data within a day and preliminary analyses and comparison of the data were completed within the same week. Were a "production" system in place, free of logistical and scheduling problems, future analyses would not require more than a few hours of work and detection of an event of potential public health importance could occur the day after the event took place. Setting up systems that extract data from computerized medical records within a hospital, however, requires weeks or months of advance negotiation and planning. Without data standards that pertain to all hospitals and clinical care facilities, a system designed for one facility cannot function at another. In order to develop a truly portable system—one that could be "plugged in" to an existing computerized medical record system at any location in order to monitor the patient population and detect a pattern of adverse health events—standards are essential.

Simplicity

Simplicity can be very important if the interviewers or abstractors are volunteers who have only limited experience or training in the field of public health.[3] The wide range of medical diagnoses and indefinite amount of ancillary information in each patient's chart made the OSS system complex for the coders and for analysis. Attempts to define "heat-related illness" and to separate it from other episodes of dizziness, fainting, and dehydration did not achieve the desired simplicity.

Flexibility

Flexibility is a measure of a system's adaptability to new requirements based on the changing nature of health events in the population of interest.[3] The EMBR was not confined to any particular group of diagnoses and therefore could have been redirected easily during analysis. A team of coders, while still in the field and available for redirection to special studies, is also flexible, although at higher cost.

Acceptability

Acceptability is the willingness of persons involved with the system—both users and subjects—to participate in the functions of the system from initial data collection to final intervention.[3] The possibility of public health emergencies during the Olympics gave the OSS high acceptability. The close agreement between the EMBR and OSS systems in total number of records suggests excellent participation by both physicians and clerical personnel involved with the EMBR system.

Comparison of the systems

The results indicate that the data in the routine (EMBR) system were no less reliable than those obtained through labor-intensive record abstraction but that analyses must be tailored to the coding system(s) employed to obtain the most useful information. In general, the OSS subcategories were broad whereas many ICD-9-CM diagnoses are quite specific. OSS subcategories correspond to at least one, and usually to several, ICD-9-CM diagnosis(es).

The EMBR coding system was designed for administrative, clinical, and billing purposes; the OSS was devised for public health purposes during the Olympics. Because "E" coding is not used for coding the primary diagnosis at Grady, the concept of causation is not represented well. Therefore, causal information of public health interest ("falls," "motor vehicle accident") is not available for many injuries.

This was illustrated by the bombing incident, in which "other assault" injuries in OSS showed an increase but total injuries in EMBR did not. The entire world was made aware of the bombing within minutes through television. The information did not need to come to light via public health surveillance.

However, less visible health events, such as toxin dissemination or infectious agent spread, require public health surveillance.

The difference between these two coding systems illustrates the difference between clinical and public health approaches as well as motivations for classifying medical events. Clinical codes are developed to reflect signs, symptoms, diagnoses, and treatments as well as to facilitate third-party payer remuneration. Public health work and epidemiology require coding systems that also contain information on risk factors or etiologies of disease or injury.

Points for consideration

As an international event, the Olympic Games justified substantial resources for public health and medical surveillance. Every large city, however, plays host to conventions, sporting events, and other large population gatherings and movements. As more hospitals adopt electronic systems for routine medical billing, how can they be accessed for public health surveillance when necessary? Based on the Grady EMBR/OSS comparison, we suggest the following areas for consideration in planning:

1. Time is required to set up access to an electronic medical billing system. Although analysis of the records was well underway a week after we received our data, it took several weeks of discussion and some computer programming at Grady to obtain the EMBR records in usable form. Although an emergency situation might shorten the lead time, establishing written agreements and conducting pilot runs in advance would facilitate data collection and processing.
2. Manual review of records by surveillance personnel who are not trained nosologists is resource intensive and potentially inaccurate. Narrowing the scope of the diagnoses covered, as was done in OSS, plus careful training, supervision, and pilot runs may increase accuracy.
3. The coding system for a public health surveillance system should be set up to make maximum use of whatever coding system is embedded in available electronic records. This is possible when clinical facilities share a common, standard coding system but difficult otherwise. At Grady, for example, standard ICD-9-CM codes are associated with the check boxes on clinical forms but each clinic offers a different set of check boxes. Therefore, one should interpret comparisons between clinics and certainly between hospitals with caution.
4. Surveillance systems based on statistics can be improved if they are supplemented by information from other sources. The bombing incident illustrates that statistical systems can be relatively insensitive until focused by external information. For example, fire department reports, volume flow at sewage treatment plants, pharmacy purchases, EMS call frequencies, and so forth are all sources of information potentially useful for detecting public health emergencies. A complete public health system should provide channels for those information sources and for anecdotal reports.
5. Detailed review of selected records as needed for a particular situation could supplement the electronic analysis. A mobile "SWAT team" of record abstractors and computer experts preferably with previous experience and training, could be developed to obtain specialized data from records identified through processing electronic billing records. On the national level, it would be useful to have such a team available to assist in mounting temporary surveillance systems during high-risk events, natural disasters, terrorist episodes, epidemics, product-related syndromes, and other local, regional, or national public health events. Such a team should be provided with portable hardware and software and suitable Internet connections to set up and process new databases rapidly. Team members should have expertise and experience in rapidly negotiating legal, administrative, and technical access to existing electronic records for purposes of public health surveillance.

■ ■ ■

In our investigation, manual abstraction of data for surveillance purposes offered little discernible advantage over automated processing of existing computerized medical record data and would have been prohibitively expensive if done routinely. The EMBR system contained much of the same data as did the manually captured surveillance data of interest in our analysis. Other data, in marginal notes, for example, were subject to varying interpretation by abstractors. Though frequently inexact, physician coding of data through check boxes was at least as useful and accurate as coding by public health staff.

Obtaining data with hospital record numbers but without other personal identifiers was feasible when a member of the hospital staff was a participant in the study. Unique identifiers are essential for data comparison, checking, or reproduction of results but their use raises questions of confidentiality. Identifiers in our study were used for matching records and then discarded.

It is not yet clear what effect recently enacted privacy legislation [as part of the Health Insurance Portability and Accountability Act of 1996 or (HIPAA)] will have on public health surveillance systems that rely on patient data residing in hospital electronic medical records systems. In order to obtain and use such data, even for public health purposes, will it be necessary to acquire consent from each individual patient involved in the population under study, even if personal identifiers are not used? Were HIPAA regulations in place in 1996, could we have obtained EMBR data for our study without the prior written consent of each and every acute care patient at Grady? Will projected savings brought about by establishing standards for electronic medical records, as envisioned in HIPAA, offset the increased expense and complexity of implementing privacy and confidentiality safeguards? Though beyond the scope of our discussion, these are certainly intriguing questions.

In our study, the electronic records provided adequate data on medical observations but were largely devoid of information on causes and risk factors, a limitation that could have been improved by the use of "E" codes. Despite limitations, computerized data sets in some hospitals have achieved the level of completeness and accuracy that can be useful for surveillance and the trend to capture more patient encounters in electronic format should make data repositories in hospitals, physicians' offices, and other point-of-care sites progressively more extensive in coming years. If properly harnessed, these existing and future electronic medical records systems can enable more complete, timely, cost effective, and flexible reporting of events of public health importance without the need for the additional and time-consuming step of manual extraction and reassembly of data. Surveillance systems thus based will be more sensitive, specific, and representative: in short, they will satisfy more adequately the conditions that define surveillance quality.

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